



NUREG-2120

# **Safety Evaluation Report for the General Electric-Hitachi Global Laser Enrichment LLC Laser- Based Uranium Enrichment Plant in Wilmington, North Carolina**

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# **Safety Evaluation Report for the General Electric-Hitachi Global Laser Enrichment LLC Laser- Based Uranium Enrichment Plant in Wilmington, North Carolina**

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General Electric-Hitachi Global Laser Enrichment LLC



## **ABSTRACT**

The report documents the U.S. Nuclear Regulatory Commission (NRC) staff review and safety and safeguards evaluation of the General Electric-Hitachi Global Laser Enrichment LLC (the applicant) application for a license to construct a laser-based uranium enrichment facility and possess and use special nuclear material (SNM), source material, and byproduct material in a laser-based uranium enrichment facility. The applicant proposes that the laser-based uranium enrichment facility be located in Wilmington, North Carolina, at the site of General Electric-Hitachi Global Nuclear Fuel – Americas nuclear fuel fabrication site. The facility will possess natural, depleted, and enriched uranium, and will enrich uranium up to a maximum of 8 weight percent uranium-235.

The objective of this review is to evaluate the potential adverse impacts of operation of the facility on worker and public health and safety under both normal operating and accident conditions. The review also considers physical protection of SNM and classified matter, material control and accounting of SNM, and the management organization, administrative programs, and financial qualifications provided to ensure safe design and operation of the facility.

In this safety evaluation report, the NRC staff concludes that the applicant's descriptions, specifications, and analyses provide an adequate basis for safety and safeguards of facility operations and that operation of the facility does not pose an undue risk to worker and public health and safety.

Potential environmental impacts associated with the proposed facility and its reasonable alternatives will be addressed in a separate NRC document, the final environmental impact statement, which is expected to be issued in February 2012.



# TABLE OF CONTENTS

|   | Page |
|---|------|
| <b>ABSTRACT</b> .....                                       | iii  |
| <b>TABLE OF CONTENTS</b> .....                              | v    |
| <b>TABLES</b> .....   | xvi  |
| <b>EXECUTIVE SUMMARY</b> .....                              | xvii |
| <b>LIST OF ACRONYMS AND ABBREVIATIONS</b> .....             | xxi  |
| <b>1.0 GENERAL INFORMATION</b> .....                        | 1-1  |
| <b>1.1 FACILITY AND PROCESS DESCRIPTION</b> .....           | 1-1  |
| 1.1.1 REGULATORY REQUIREMENTS .....                         | 1-1  |
| 1.1.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA .....     | 1-1  |
| 1.1.3 STAFF REVIEW AND ANALYSIS .....                       | 1-2  |
| 1.1.4 EVALUATION FINDINGS.....                              | 1-4  |
| <b>1.2 INSTITUTIONAL INFORMATION</b> .....                  | 1-4  |
| 1.2.1 REGULATORY REQUIREMENTS .....                         | 1-4  |
| 1.2.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA .....     | 1-5  |
| 1.2.3 STAFF REVIEW AND ANALYSIS .....                       | 1-5  |
| 1.2.3.1 Corporate Identity .....                            | 1-5  |
| 1.2.3.2 Foreign Ownership, Control, or Influence .....      | 1-6  |
| 1.2.3.3 Financial Qualifications.....                       | 1-6  |
| 1.2.3.4 Liability Insurance.....                            | 1-8  |
| 1.2.3.5 Type, Quantity, and Form of Licensed Material ..... | 1-9  |
| 1.2.3.6 Authorized Uses .....                               | 1-10 |
| 1.2.3.7 Special Exemptions or Special Authorizations .....  | 1-11 |
| 1.2.3.8 Security of Classified Matter .....                 | 1-24 |
| 1.2.4 EVALUATION FINDINGS.....                              | 1-25 |
| <b>1.3 SITE DESCRIPTION</b> .....                           | 1-30 |
| 1.3.1 REGULATORY REQUIREMENTS .....                         | 1-31 |
| 1.3.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA .....     | 1-31 |
| 1.3.3 STAFF REVIEW AND ANALYSIS .....                       | 1-31 |
| 1.3.3.1 Site Geography .....                                | 1-31 |
| 1.3.3.2 Demographics .....                                  | 1-33 |
| 1.3.3.3 Meteorology.....                                    | 1-34 |
| 1.3.3.4 Geology.....  | 1-39 |
| 1.3.3.5 Hydrology .....                                     | 1-44 |
| 1.3.4 EVALUATION FINDINGS.....                              | 1-45 |

|          |   |      |
|----------|---|------|
| 1.4      | REFERENCES .....  | 1-45 |
| 2.0      | ORGANIZATION AND ADMINISTRATION.....                                      | 2-1  |
| 2.1      | REGULATORY REQUIREMENTS .....   | 2-1  |
| 2.2      | REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA .....                         | 2-1  |
| 2.3      | STAFF REVIEW AND ANALYSIS.....  | 2-1  |
| 2.3.1    | ORGANIZATION.....   | 2-1  |
| 2.3.2    | ORGANIZATIONAL RESPONSIBILITIES AND QUALIFICATIONS.....                   | 2-3  |
| 2.3.3    | MANAGEMENT CONTROL .....  | 2-7  |
| 2.3.4    | TRANSITION FROM DESIGN AND CONSTRUCTION TO<br>OPERATIONS.....             | 2-10 |
| 2.4      | EVALUATION FINDINGS.....  | 2-11 |
| 2.5      | REFERENCES .....  | 2-11 |
| 3.0      | INTEGRATED SAFETY ANALYSIS AND INTEGRATED SAFETY ANALYSIS<br>SUMMARY..... | 3-1  |
| 3.1      | REGULATORY REQUIREMENTS .....   | 3-1  |
| 3.2      | REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA .....                         | 3-3  |
| 3.3      | STAFF REVIEW AND ANALYSIS.....  | 3-3  |
| 3.3.1    | SAFETY PROGRAM AND ISA COMMITMENTS .....                                  | 3-3  |
| 3.3.1.1  | Process Safety Information.....   | 3-4  |
| 3.3.1.2  | ISA Commitments.....  | 3-5  |
| 3.3.2    | DESCRIPTION OF THE SITE AND FACILITY .....                                | 3-6  |
| 3.3.2.1  | Description of the Site .....   | 3-6  |
| 3.3.2.2  | Description of the Facility.....  | 3-7  |
| 3.3.3    | PROCESS DESCRIPTIONS .....  | 3-8  |
| 3.3.4    | EXTERNAL HAZARDS .....  | 3-8  |
| 3.3.4.1  | High Wind and Tornado Hazards.....  | 3-9  |
| 3.3.4.2  | Hurricanes and Tsunami.....   | 3-10 |
| 3.3.4.3  | Extreme Rainfall .....  | 3-11 |
| 3.3.4.4  | Flooding .....  | 3-12 |
| 3.3.4.5  | Snow .....  | 3-13 |
| 3.3.4.6  | Nearby Highways .....   | 3-14 |
| 3.3.4.7  | Railroads .....   | 3-15 |
| 3.3.4.8  | Nearby Industrial Facilities.....   | 3-15 |
| 3.3.4.9  | Air Transportation.....   | 3-15 |
| 3.3.4.10 | Geology and Seismic Events.....   | 3-17 |
| 3.3.4.11 | Slope Stability.....  | 3-21 |
| 3.3.4.12 | Liquefaction .....  | 3-21 |
| 3.3.4.13 | Settlement and Soil-Bearing Capacity .....                                | 3-22 |



|          |  |      |
|----------|--|------|
| 3.3.5    | DESCRIPTION OF ISA TEAM QUALIFICATIONS AND ISA METHODS .....       | 3-23 |
| 3.3.5.1  | ISA Team Qualification .....                                       | 3-23 |
| 3.3.5.2  | ISA Methods .....  | 3-24 |
| 3.3.6    | ISA REGULATORY REQUIREMENTS .....                                  | 3-25 |
| 3.3.6.1  | Completeness .....   | 3-25 |
| 3.3.6.2  | Consequences .....   | 3-26 |
| 3.3.6.3  | Enabling Conditions.....   | 3-26 |
| 3.3.6.4  | Conditional Events.....  | 3-27 |
| 3.3.6.5  | Safety Controls.....   | 3-27 |
| 3.3.6.6  | Overall Risk .....   | 3-27 |
| 3.3.7    | ISA APPROACH .....   | 3-28 |
| 3.3.7.1  | Define Nodes To Be Evaluated.....                                  | 3-28 |
| 3.3.7.2  | Identify Hazards .....   | 3-28 |
| 3.3.7.3  | Identify Scenarios .....   | 3-28 |
| 3.3.7.4  | Determine Consequence Category.....                                | 3-29 |
| 3.3.7.5  | Determine Unmitigated Likelihood .....                             | 3-29 |
| 3.3.7.6  | Determine Unmitigated Risk .....                                   | 3-30 |
| 3.3.7.7  | Perform Quantitative Risk Analysis.....                            | 3-30 |
| 3.3.7.8  | Develop IROFS and Likelihoods.....                                 | 3-31 |
| 3.3.7.9  | Management Measures .....  | 3-31 |
| 3.3.7.10 | Update Lists and Risk Indices .....                                | 3-31 |
| 3.3.7.11 | Defense-In-Depth .....   | 3-31 |
| 3.3.7.12 | ISA Approach Summary Evaluation.....                               | 3-32 |
| 3.3.8    | NUCLEAR CRITICALITY REVIEW.....                                    | 3-32 |
| 3.3.8.1  | Criticality Safety IROFS.....                                      | 3-32 |
| 3.3.8.2  | Nuclear Criticality ISA Evaluation .....                           | 3-33 |
| 3.3.9    | CHEMICAL PROCESS REVIEW .....                                      | 3-34 |
| 3.3.9.1  | Chemical Process Descriptions .....                                | 3-35 |
| 3.3.9.2  | Chemical Hazards, Accident Sequences, and IROFS .....              | 3-35 |
| 3.3.9.3  | Chemical Consequence Analysis Approach .....                       | 3-36 |
| 3.3.9.4  | Chemical Consequence Limits .....                                  | 3-36 |
| 3.3.10   | FIRE PROTECTION REVIEW.....  | 3-37 |
| 3.3.11   | RADIATION PROTECTION REVIEW.....                                   | 3-38 |
| 3.3.12   | IROFS STRUCTURES REVIEW .....                                      | 3-38 |
| 3.3.12.1 | Structural Design Loads .....                                      | 3-39 |
| 3.3.12.2 | Load Combinations.....   | 3-39 |
| 3.3.12.3 | Structural Analysis Method .....                                   | 3-40 |
| 3.3.12.4 | Structural Design Criteria, Bases, and Method .....                | 3-40 |
| 3.3.13   | MANAGEMENT MEASURES.....   | 3-41 |
| 3.3.14   | IDENTIFICATION OF IROFS .....                                      | 3-42 |
| 3.3.15   | LIST OF SOLE IROFS .....   | 3-43 |
| 3.3.16   | DEFINITIONS OF “CREDIBLE,” “UNLIKELY,” AND “HIGHLY UNLIKELY” ..... | 3-43 |
| 3.3.16.1 | Credible.....  | 3-43 |
| 3.3.16.2 | Unlikely.....  | 3-44 |
| 3.3.16.3 | Highly Unlikely .....  | 3-44 |
| 3.3.17   | DESCRIPTION OF THE VERTICAL SLICE REVIEW.....                      | 3-44 |

|         |  |      |
|---------|--|------|
| 3.4     | <b>EVALUATION FINDINGS</b> .....                         | 3-45 |
| 3.5     | <b>REFERENCES</b> .....                                  | 3-45 |
| 4.0     | <b>RADIATION PROTECTION</b> .....                        | 4-1  |
| 4.1     | <b>REGULATORY REQUIREMENTS</b> .....                     | 4-1  |
| 4.1.1   | RADIATION PROTECTION PROGRAM .....                       | 4-1  |
| 4.1.2   | AS LOW AS IS REASONABLY ACHIEVABLE PROGRAM.....          | 4-1  |
| 4.1.3   | ORGANIZATION AND PERSONNEL QUALIFICATIONS .....          | 4-1  |
| 4.1.4   | WRITTEN PROCEDURES.....                                  | 4-1  |
| 4.1.5   | RADIATION PROTECTION TRAINING.....                       | 4-1  |
| 4.1.6   | VENTILATION AND RESPIRATORY PROTECTION PROGRAMS .....    | 4-1  |
| 4.1.7   | RADIATION SURVEY AND MONITORING PROGRAMS .....           | 4-2  |
| 4.1.8   | ADDITIONAL PROGRAM REQUIREMENTS .....                    | 4-2  |
| 4.2     | <b>REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA</b> ..... | 4-2  |
| 4.3     | <b>STAFF REVIEW AND ANALYSIS</b> .....                   | 4-2  |
| 4.3.1   | RP PROGRAM IMPLEMENTATION .....                          | 4-3  |
| 4.3.2   | ALARA PROGRAM .....                                      | 4-4  |
| 4.3.3   | ORGANIZATION AND PERSONNEL QUALIFICATIONS .....          | 4-7  |
| 4.3.4   | WRITTEN PROCEDURES .....                                 | 4-8  |
| 4.3.5   | TRAINING .....   | 4-9  |
| 4.3.6   | VENTILATION AND RESPIRATORY PROTECTION PROGRAMS ....     | 4-11 |
| 4.3.7   | RADIATION SURVEY AND MONITORING PROGRAMS .....           | 4-15 |
| 4.3.8   | ADDITIONAL PROGRAM REQUIREMENTS .....                    | 4-21 |
| 4.3.9   | EXEMPTIONS.....  | 4-22 |
| 4.4     | <b>EVALUATION FINDINGS</b> .....                         | 4-23 |
| 4.5     | <b>REFERENCES</b> .....                                  | 4-23 |
| 5.0     | <b>NUCLEAR CRITICALITY SAFETY</b> .....                  | 5-1  |
| 5.1     | <b>REGULATORY REQUIREMENTS</b> .....                     | 5-1  |
| 5.2     | <b>REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA</b> ..... | 5-2  |
| 5.3     | <b>STAFF REVIEW AND ANALYSIS</b> .....                   | 5-2  |
| 5.3.1   | INDUSTRY STANDARDS .....                                 | 5-2  |
| 5.3.2   | ORGANIZATION AND ADMINISTRATION .....                    | 5-4  |
| 5.3.3   | MANAGEMENT OF THE NCS PROGRAM.....                       | 5-6  |
| 5.3.4   | NCS MANAGEMENT MEASURES .....                            | 5-8  |
| 5.3.4.1 | Training .....   | 5-9  |
| 5.3.4.2 | Procedures.....  | 5-10 |
| 5.3.4.3 | Audits and Assessments .....                             | 5-10 |

|            |  |             |
|------------|--|-------------|
| 5.3.5      | NCS METHODS AND TECHNICAL PRACTICES .....                | 5-12        |
| 5.3.5.1    | NCS Methodologies.....                                   | 5-12        |
| 5.3.5.2    | NCS Technical Practices .....                            | 5-21        |
| 5.3.5.3    | NCS Methods and Technical Practice Findings .....        | 5-28        |
| 5.3.6      | CRITICALITY ACCIDENT ALARM SYSTEM.....                   | 5-29        |
| 5.3.6.1    | Criticality Accident Alarm System Description.....       | 5-29        |
| 5.3.6.2    | CAAS in the ISA Summary .....                            | 5-31        |
| 5.3.6.3    | CAAS Exemption Request.....                              | 5-32        |
| 5.3.6.4    | CAAS Findings .....                                      | 5-33        |
| 5.3.7      | REPORTING REQUIREMENTS .....                             | 5-34        |
| 5.3.8      | INTEGRATED SAFETY ANALYSIS .....                         | 5-35        |
| 5.3.8.1    | ISA Commitments.....                                     | 5-35        |
| 5.3.8.2    | ISA Summary Review.....                                  | 5-37        |
| 5.3.8.3    | ISA Summary Review Conclusions .....                     | 5-39        |
| 5.3.9      | FACILITY CHANGES AND CONFIGURATION MANAGEMENT .....      | 5-40        |
| <b>5.4</b> | <b>EVALUATION FINDINGS.....</b>                          | <b>5-42</b> |
| <b>5.5</b> | <b>REFERENCES .....</b>                                  | <b>5-43</b> |
| <b>6.0</b> | <b>CHEMICAL PROCESS SAFETY .....</b>                     | <b>6-1</b>  |
| <b>6.1</b> | <b>REGULATORY REQUIREMENTS .....</b>                     | <b>6-1</b>  |
| <b>6.2</b> | <b>REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA .....</b> | <b>6-1</b>  |
| <b>6.3</b> | <b>STAFF REVIEW AND ANALYSIS.....</b>                    | <b>6-1</b>  |
| 6.3.1      | PROCESS DESCRIPTION .....                                | 6-2         |
| 6.3.1.1    | General Process Description .....                        | 6-2         |
| 6.3.1.2    | Chemical Process Inventories .....                       | 6-3         |
| 6.3.1.3    | Chemical Safety Strategy .....                           | 6-3         |
| 6.3.1.4    | Hazardous Chemicals and Chemical Interactions.....       | 6-4         |
| 6.3.1.5    | Process Description Conclusion. ....                     | 6-5         |
| 6.3.2      | CHEMICAL ACCIDENT SEQUENCES .....                        | 6-5         |
| 6.3.2.1    | Review of Selected Accident Sequences.....               | 6-6         |
| 6.3.2.2    | Chemical Accident Sequences Conclusion .....             | 6-6         |
| 6.3.3      | CHEMICAL ACCIDENT CONSEQUENCES.....                      | 6-6         |
| 6.3.4      | IROFS AND MANAGEMENT MEASURES.....                       | 6-8         |
| 6.3.4.1    | Chemical-Process IROFS.....                              | 6-8         |
| 6.3.4.2    | Management Measures.....                                 | 6-9         |
| 6.3.4.3    | IROFS and Management Measures Conclusion .....           | 6-13        |
| 6.3.5      | EMERGENCY MANAGEMENT .....                               | 6-14        |
| 6.3.6      | BASELINE DESIGN CRITERIA.....                            | 6-14        |
| <b>6.4</b> | <b>EVALUATION FINDINGS.....</b>                          | <b>6-16</b> |
| <b>6.5</b> | <b>REFERENCES .....</b>                                  | <b>6-16</b> |

|            |   |      |
|------------|---|------|
| <b>7.0</b> | <b>FIRE SAFETY</b> .....  | 7-1  |
| <b>7.1</b> | <b>REGULATORY REQUIREMENTS</b> .....  | 7-1  |
| <b>7.2</b> | <b>REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA</b> .....                              | 7-1  |
| <b>7.3</b> | <b>STAFF REVIEW AND ANALYSIS</b> .....  | 7-1  |
| 7.3.1      | FIRE SAFETY MANAGEMENT MEASURES .....   | 7-2  |
| 7.3.1.1    | Fire Safety Management and Direction.....   | 7-2  |
| 7.3.1.2    | Fire Protection Program.....  | 7-2  |
| 7.3.1.3    | Fire Protection Quality Assurance Measures .....                                      | 7-3  |
| 7.3.1.4    | Fire Safety Management Measures Conclusions.....                                      | 7-4  |
| 7.3.2      | FIRE HAZARDS ANALYSIS.....  | 7-4  |
| 7.3.3      | FACILITY DESIGN.....  | 7-5  |
| 7.3.4      | PROCESS FIRE SAFETY .....   | 7-7  |
| 7.3.5      | FIRE PROTECTION AND EMERGENCY RESPONSE .....  | 7-8  |
| 7.3.5.1    | Fire Protection Systems.....  | 7-8  |
| 7.3.5.2    | Emergency Response Capability.....  | 7-9  |
| 7.3.5.3    | Fire Protection and Emergency Response Conclusion .....                               | 7-9  |
| <b>7.4</b> | <b>EVALUATION FINDINGS</b> .....  | 7-10 |
| <b>7.5</b> | <b>REFERENCES</b> .....   | 7-10 |
| <b>8.0</b> | <b>EMERGENCY MANAGEMENT</b> .....   | 8-1  |
| <b>8.1</b> | <b>INTRODUCTION</b> .....   | 8-1  |
| <b>8.2</b> | <b>EVALUATION FINDINGS</b> .....  | 8-1  |
| <b>8.3</b> | <b>REFERENCES</b> .....   | 8-1  |
| <b>9.0</b> | <b>ENVIRONMENTAL PROTECTION</b> .....   | 9-1  |
| <b>9.1</b> | <b>REGULATORY REQUIREMENTS</b> .....  | 9-1  |
| <b>9.2</b> | <b>REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA</b> .....                              | 9-2  |
| <b>9.3</b> | <b>STAFF REVIEW AND ANALYSIS</b> .....  | 9-2  |
| 9.3.1      | TRAINING AND QUALIFICATIONS .....   | 9-2  |
| 9.3.1.1    | Personnel Training .....  | 9-3  |
| 9.3.1.2    | Personnel Qualifications .....  | 9-3  |
| 9.3.2      | RADIATION SAFETY .....  | 9-5  |
| 9.3.2.1    | As Low As Is Reasonably Achievable Goals for Air and<br>Liquid Effluent Control ..... | 9-5  |
| 9.3.2.2    | Air Effluent Controls to Maintain Public Doses ALARA .....                            | 9-7  |
| 9.3.2.3    | Liquid Effluent Controls to Maintain Public Doses ALARA .....                         | 9-8  |
| 9.3.2.4    | ALARA Reviews and Reports to Management .....   | 9-9  |
| 9.3.2.5    | Waste Minimization .....  | 9-10 |

|             |  |              |
|-------------|--|--------------|
| 9.3.3       | EFFLUENT AND ENVIRONMENTAL MONITORING .....                  | 9-11         |
| 9.3.3.1     | Air Effluent Monitoring .....                                | 9-13         |
| 9.3.3.2     | Liquid Effluent Monitoring .....                             | 9-17         |
| 9.3.3.3     | Environmental Monitoring .....                               | 9-19         |
| 9.3.4       | ISA SUMMARY .....  | 9-23         |
| <b>9.4</b>  | <b>EVALUATION FINDINGS</b> .....                             | <b>9-24</b>  |
| <b>9.5</b>  | <b>REFERENCES</b> .....                                      | <b>9-24</b>  |
| <b>10.0</b> | <b>DECOMMISSIONING</b> .....                                 | <b>10-1</b>  |
| <b>10.1</b> | <b>REGULATORY REQUIREMENTS</b> .....                         | <b>10-1</b>  |
| <b>10.2</b> | <b>REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA</b> .....     | <b>10-2</b>  |
| <b>10.3</b> | <b>STAFF REVIEW AND ANALYSIS</b> .....                       | <b>10-2</b>  |
| 10.3.1      | CONCEPTUAL DECONTAMINATION AND DECOMMISSIONING<br>PLAN ..... | 10-3         |
| 10.3.1.1    | Decommissioning Strategy .....                               | 10-3         |
| 10.3.1.2    | Decommissioning Steps .....                                  | 10-4         |
| 10.3.1.3    | Management and Organization .....                            | 10-5         |
| 10.3.1.4    | Health and Safety .....                                      | 10-6         |
| 10.3.1.5    | Waste Management .....                                       | 10-6         |
| 10.3.1.6    | Security and Nuclear Material Control .....                  | 10-7         |
| 10.3.1.7    | Recordkeeping .....  | 10-7         |
| 10.3.1.8    | Decontamination Process .....                                | 10-8         |
| 10.3.2      | DECOMMISSIONING COSTS AND FINANCIAL ASSURANCE .....          | 10-9         |
| 10.3.2.1    | Decommissioning Costs .....                                  | 10-9         |
| 10.3.2.2    | Financial Assurance for Decommissioning .....                | 10-13        |
| <b>10.4</b> | <b>EVALUATION FINDINGS</b> .....                             | <b>10-17</b> |
| <b>10.5</b> | <b>REFERENCES</b> .....                                      | <b>10-18</b> |
| <b>11.0</b> | <b>MANAGEMENT MEASURES</b> .....                             | <b>11-1</b>  |
| <b>11.1</b> | <b>REGULATORY REQUIREMENTS</b> .....                         | <b>11-1</b>  |
| <b>11.2</b> | <b>REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA</b> .....     | <b>11-2</b>  |
| <b>11.3</b> | <b>STAFF REVIEW AND ANALYSIS</b> .....                       | <b>11-3</b>  |
| 11.3.1      | CONFIGURATION MANAGEMENT .....                               | 11-3         |
| 11.3.1.1    | CM Policy .....  | 11-3         |
| 11.3.1.2    | Design Requirements .....                                    | 11-4         |
| 11.3.1.3    | Document Control .....                                       | 11-5         |
| 11.3.1.4    | Change Control .....   | 11-6         |
| 11.3.1.5    | Assessments .....  | 11-7         |

|             |   |              |
|-------------|---|--------------|
| 11.3.2      | MAINTENANCE .....   | 11-8         |
| 11.3.2.1    | Surveillance and Monitoring .....   | 11-8         |
| 11.3.2.2    | Corrective Maintenance.....   | 11-9         |
| 11.3.2.3    | Preventative Maintenance .....  | 11-10        |
| 11.3.2.4    | Functional Testing .....  | 11-11        |
| 11.3.3      | TRAINING AND QUALIFICATIONS .....   | 11-11        |
| 11.3.3.1    | Organization and Management of the Training Function ...                    | 11-12        |
| 11.3.3.2    | Analysis and Identification of Functional Areas Requiring<br>Training ..... | 11-13        |
| 11.3.3.3    | Job Specific Training Requirements .....                                    | 11-16        |
| 11.3.3.4    | Basis of Training and Objectives .....                                      | 11-17        |
| 11.3.3.5    | Organization of Instruction.....  | 11-18        |
| 11.3.3.6    | Evaluation of Trainee Accomplishment.....                                   | 11-18        |
| 11.3.3.7    | On-the-Job Training.....  | 11-18        |
| 11.3.3.8    | Evaluation of Training Effectiveness .....                                  | 11-19        |
| 11.3.3.9    | Personnel Qualification.....  | 11-20        |
| 11.3.3.10   | Provisions for Continuing Assurance .....                                   | 11-20        |
| 11.3.4      | PROCEDURES .....  | 11-21        |
| 11.3.4.1    | Use of Written Procedures.....  | 11-21        |
| 11.3.4.2    | Procedure Development Process .....   | 11-24        |
| 11.3.4.3    | Temporary Changes to Procedures.....  | 11-27        |
| 11.3.4.4    | Temporary Procedures.....   | 11-27        |
| 11.3.4.5    | Periodic Reviews .....  | 11-28        |
| 11.3.4.6    | Use and Control of Procedures.....  | 11-28        |
| 11.3.4.7    | Records.....  | 11-29        |
| 11.3.4.8    | Topics to be Covered in Procedures.....                                     | 11-29        |
| 11.3.5      | AUDITS AND ASSESSMENTS .....  | 11-30        |
| 11.3.5.1    | Activities to be Audited or Assessed.....                                   | 11-31        |
| 11.3.5.2    | Scheduling of Audits and Assessments .....                                  | 11-32        |
| 11.3.5.3    | Procedures for Audits and Assessments .....                                 | 11-33        |
| 11.3.5.4    | Qualifications and Responsibilities for Audits and<br>Assessments .....     | 11-33        |
| 11.3.6      | INCIDENT INVESTIGATIONS.....  | 11-34        |
| 11.3.6.1    | Incident Identification, Categorization, and Notification .....             | 11-34        |
| 11.3.6.2    | Conduct of Incident Investigations .....                                    | 11-35        |
| 11.3.6.3    | Written Followup Report .....   | 11-36        |
| 11.3.6.4    | Corrective Actions .....  | 11-37        |
| 11.3.7      | RECORDS MANAGEMENT .....  | 11-37        |
| 11.3.7.1    | Records Management Program.....   | 11-37        |
| 11.3.7.2    | Record Retention.....   | 11-39        |
| 11.3.7.3    | Organization and Administration.....  | 11-39        |
| 11.3.8      | OTHER QA ELEMENTS .....   | 11-40        |
| 11.3.9      | DEFINITIONS .....   | 11-41        |
| <b>11.4</b> | <b>EVALUATION FINDINGS.....</b>   | <b>11-41</b> |
| 11.4.1      | CONFIGURATION MANAGEMENT .....  | 11-41        |
| 11.4.1.1    | CM Policy .....   | 11-42        |
| 11.4.1.2    | Design Requirements .....   | 11-42        |
| 11.4.1.3    | Document Control.....   | 11-42        |

|               |  |               |
|---------------|--|---------------|
| 11.4.1.4      | Change Control .....   | 11-42         |
| 11.4.1.5      | Assessments .....  | 11-42         |
| 11.4.2        | MAINTENANCE .....  | 11-42         |
| 11.4.3        | TRAINING AND QUALIFICATION.....  | 11-43         |
| 11.4.4        | PROCEDURES .....   | 11-43         |
| 11.4.5        | AUDITS AND ASSESSMENTS .....   | 11-43         |
| 11.4.6        | INCIDENT INVESTIGATIONS.....   | 11-44         |
| 11.4.7        | RECORDS MANAGEMENT .....   | 11-44         |
| 11.4.8        | OTHER QA ELEMENTS .....  | 11-44         |
| <b>11.5</b>   | <b>REFERENCES .....</b>  | <b>11-45</b>  |
| <b>11.0</b>   | <b>APPENDIX A, QUALITY ASSURANCE PROGRAM DESCRIPTION .....</b>         | <b>11.A-1</b> |
| <b>11.A.1</b> | <b>REGULATORY REQUIREMENTS .....</b>                                   | <b>11.A-1</b> |
| <b>11.A.2</b> | <b>REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA .....</b>               | <b>11.A-1</b> |
| <b>11.A.3</b> | <b>STAFF REVIEW AND ANALYSIS.....</b>                                  | <b>11.A-1</b> |
| 11.A.3.1      | INTRODUCTION .....   | 11.A-1        |
| 11.A.3.2      | ORGANIZATION .....   | 11.A-2        |
| 11.A.3.3      | QUALITY ASSURANCE PROGRAM.....   | 11.A-3        |
| 11.A.3.3.1    | Quality Levels .....   | 11.A-4        |
| 11.A.3.3.2    | Application of Management Measures .....                               | 11.A-5        |
| 11.A.3.3.3    | QA Program Evaluation Summary .....                                    | 11.A-7        |
| 11.A.3.4      | DESIGN CONTROL.....  | 11.A-8        |
| 11.A.3.5      | PROCUREMENT CONTROL .....  | 11.A-9        |
| 11.A.3.6      | INSTRUCTIONS, PROCEDURES, AND DRAWINGS .....                           | 11.A-11       |
| 11.A.3.7      | DOCUMENT CONTROL.....  | 11.A-12       |
| 11.A.3.8      | CONTROL OF PURCHASED ITEMS AND SERVICES .....                          | 11.A-13       |
| 11.A.3.9      | IDENTIFICATION AND CONTROL OF MATERIALS,<br>PARTS, AND COMPONENTS..... | 11.A-14       |
| 11.A.3.10     | CONTROL OF SPECIAL PROCESSES .....                                     | 11.A-15       |
| 11.A.3.11     | INSPECTION.....  | 11.A-15       |
| 11.A.3.12     | TEST CONTROL .....   | 11.A-16       |
| 11.A.3.13     | CONTROL OF MEASURING AND TEST EQUIPMENT .....                          | 11.A-17       |
| 11.A.3.14     | HANDLING, STORAGE, AND SHIPPING.....                                   | 11.A-18       |
| 11.A.3.15     | INSPECTION, CONTROL, TESTING, AND OPERATING<br>STATUS .....            | 11.A-19       |
| 11.A.3.16     | CONTROL OF NONCONFORMING ITEMS .....                                   | 11.A-19       |
| 11.A.3.17     | CORRECTIVE ACTIONS.....  | 11.A-20       |
| 11.A.3.18     | QUALITY ASSURANCE RECORDS.....   | 11.A-21       |
| 11.A.3.19     | AUDITS .....   | 11.A-22       |
| 11.A.3.20     | PROVISIONS FOR CHANGE.....   | 11.A-23       |
| 11.A.3.21     | FIRE SUPPRESSION IROFS .....   | 11.A-24       |
| 11.A.3.21.1   | Fire Suppression QA Controls .....                                     | 11.A-24       |
| 11.A.3.21.2   | Summary of Fire Suppression QA Controls ..                             | 11.A-37       |

|        |  |             |
|--------|--|-------------|
| 11.A.4 | EVALUATION FINDINGS.....   | 11-37       |
| 11.A.5 | REFERENCES .....   | 11-38       |
| 12.0   | <b>MATERIAL CONTROL AND ACCOUNTING.....</b>  | <b>12-1</b> |
| 12.1   | INTRODUCTION .....   | 12-1        |
| 12.2   | EVALUATION FINDINGS.....   | 12-1        |
| 12.3   | REFERENCES .....   | 12-2        |
| 13.0   | <b>PHYSICAL SECURITY .....</b>   | <b>13-1</b> |
| 13.1   | INTRODUCTION .....   | 13-1        |
| 13.2   | EVALUATION FINDINGS.....   | 13-1        |
| 13.3   | REFERENCES .....   | 13-1        |
| 14.0   | <b>PHYSICAL SECURITY OF THE TRANSPORTATION OF SPECIAL NUCLEAR<br/>MATERIAL OF LOW STRATEGIC SIGNIFICANCE .....</b> | <b>14-1</b> |
| 14.1   | INTRODUCTION .....   | 14-1        |
| 14.2   | EVALUATION FINDINGS.....   | 14-1        |
| 14.3   | REFERENCES .....   | 14-1        |
| 15.0   | <b>HUMAN FACTORS ENGINEERING .....</b>   | <b>15-1</b> |
| 15.1   | INTRODUCTION .....   | 15-1        |
| 15.2   | EVLAUATION FINDINGS.....   | 15-1        |
| 15.3   | REFERENCES .....   | 15-1        |
| 16.0   | <b>ELECTRICAL POWER AND INSTRUMENTATION AND CONTROL SYSTEMS.....</b>   | <b>16-1</b> |
| 16.1   | INTRODUCTION .....   | 16-1        |
| 16.2   | EVALUATION FINDINGS.....   | 16-1        |
| 16.3   | REFERENCES .....   | 16-2        |
| 17.0   | <b>SAFETY EVALUATION REPORT PREPARERS.....</b>   | <b>17-1</b> |



|  |            |
|--|------------|
| <b>APPENDIX - ACCIDENT ANALYSIS .....</b>  | <b>A-1</b> |
| <b>A.1 INTRODUCTION .....</b>              | <b>A-1</b> |
| <b>A.2 ACCIDENT ANALYSIS SUMMARY .....</b> | <b>A-1</b> |

## TABLES

|                    |  |             |
|--------------------|--|-------------|
| <b>Table 1.2-1</b> | <b>Applicant Corporate Financial Assets and Bond Rating.....</b> | <b>1-8</b>  |
| <b>Table 1.2-2</b> | <b>Proposed Possession Limits .....</b>                          | <b>1-10</b> |
| <b>Table 3.3-1</b> | <b>Unmitigated Consequence Categories .....</b>                  | <b>3-29</b> |
| <b>Table 3.3-2</b> | <b>Unmitigated Likelihood Categories .....</b>                   | <b>3-30</b> |
| <b>Table 3.3-3</b> | <b>Unmitigated Risk Matrix .....</b>                             | <b>3-30</b> |

## EXECUTIVE SUMMARY

On June 26, 2009, General Electric-Hitachi Global Laser Enrichment LLC (GLE) (the applicant) submitted, to the U.S. Nuclear Regulatory Commission (NRC), an application requesting a license, under *Title 10 Code of Federal Regulations* (10 CFR) Parts 30, 40, and 70, to possess and use byproduct, source, and special nuclear material (SNM) in a laser-based uranium enrichment facility. GLE proposes that the facility be located in Wilmington, North Carolina, and have a nominal capacity of 6 million separative work units (SWUs). (A SWU is a unit of enrichment that measures the effort required to separate isotopes of uranium.) The facility will possess natural, depleted, and enriched uranium, and will enrich uranium up to a maximum of 8 weight percent uranium-235. The applicant also requested a facility clearance for classified information under 10 CFR Part 95.

The NRC staff conducted its safety review in accordance with NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility." The staff's safeguards review involved reviews of the applicant's Fundamental Nuclear Material Control Plan (FNMCP); the Physical Security Plan, the Nuclear Material Transportation Security Plan; and the Standard Practice Procedures Plan for the Protection of Classified Matter. The staff also reviewed the applicant's Quality Assurance Program Description and Radiological Contingency and Emergency Plan. Where the applicant's design or procedures should be supplemented, the NRC staff has identified license conditions to provide assurance of safe operation.

The applicant also submitted an Environmental Report, which was used to prepare, in a separate document, an Environmental Impact Statement for the facility.

A summary of NRC's review and findings in each of the review areas is provided below:

### General Information

The applicant provided an adequate description of the facility and processes so that the staff has an overall understanding of the relationships of the facility features as well as the function of each feature. Financial qualifications were properly explained and outlined in the application. The description of the site included important information about regional hydrology, geology, meteorology, the nearby population, and potential effects of natural phenomena at the facility.

### Organization and Administration

The applicant adequately described the responsibilities and associated resources for the design, construction, and operation of the facility and its plans for managing the project. The plans and commitments described in the application provide reasonable assurance that an acceptable organization, administrative policies, and sufficient competent resources have been established or committed for the design, construction, and safe operation of the facility.

### Integrated Safety Analysis (ISA) and ISA Summary

The applicant provided sufficient information about the site, facility processes, hazards, and types of accident sequences. The information provided addressed each credible event, the potential radiological and chemical consequences of the event, and the likelihood of the event.

For nuclear criticality safety (NCS) safe-by-design components, the applicant identified the hazards and demonstrated that the failure of those components would be highly unlikely. No mitigated event consequence exceeds the performance requirements of 10 CFR 70.61. The applicant also provided adequate information about items relied on for safety (IROFS). License conditions have been added to the license to ensure that IROFS boundaries will be defined using the applicant's IROFS boundary definition procedure and that the applicant will submit license amendment requests if digital instrumentation and controls are used in IROFS.

### Radiation Protection

The applicant provided sufficient information to evaluate the Radiation Protection Program. The application adequately describes: (a) the qualification requirements; (b) written radiation protection procedures; (c) the radiation work permit (RWP) program; (d) the program for ensuring that worker and public doses are as low as is reasonably achievable (ALARA); and (e) necessary training for all personnel who have access to radiologically restricted areas. The radiation survey and monitoring program is adequate to protect workers and members of the public who may be potentially exposed to radiation.

### Nuclear Criticality Safety

The applicant provided adequate information to evaluate the NCS program. The applicant committed to having an adequate group of qualified staff to develop, implement, and maintain the NCS program in accordance with the facility organization and administration and management measures. The program meets the regulatory requirements.

### Chemical Process Safety

The applicant adequately described and assessed accident consequences that could result from the handling, storage, or processing of licensed materials and that could have potentially significant chemical consequences and effects. The applicant performed hazard analyses that identified and evaluated those chemical process hazards and potential accidents and established safety controls that meet the regulatory requirements.

### Fire Safety

The applicant committed to reasonable engineered and administrative controls to minimize the risk of fires and explosions. The IROFS and defense-in-depth protection discussed in the applicant's ISA Summary, along with safety basis assumptions and the planned programmatic commitments in the license application meet safety requirements and provide reasonable assurance that the facility is protected against fire hazards.

### Emergency Management

The applicant provided an adequate Radiological Contingency and Emergency Plan, for the facility, which meets the regulatory requirements. The applicant commits to maintaining and executing an Emergency Plan for responding to the radiological and chemical hazards resulting from potential release of radioactive or chemically hazardous materials incident to the processing of licensed material. The requirements of the Emergency Plan are implemented through approved written procedures.

## Environmental Protection

The applicant committed to adequate environmental protection measures, including: (1) environmental and effluent monitoring; and (2) effluent controls to maintain public doses ALARA as part of the radiation protection program. The applicant's proposed controls are adequate to protect the environment and the health and safety of the public and comply with the regulatory requirements.

## Decommissioning

The applicant provided a conceptual decommissioning plan, for the facility, that addresses: (a) contamination control; (b) control of worker exposures and waste volumes; (c) waste disposal; (d) the final radiation survey; (e) control of SNM; (f) control of classified matter; and (g) recordkeeping for decommissioning.

The applicant provided a decommissioning funding plan, for the facility, that demonstrates that adequate funding will be available for decommissioning and that decommissioning will not pose a threat to public health and safety or the environment. The applicant also submitted an exemption request to allow for incremental funding for depleted uranium disposition based on depleted uranium tails generation rates. The decommissioning funding plan and the incremental approach for funding depleted uranium disposition costs will provide adequate assurance for decommissioning funding because sufficient funding will be available to decommission the facility and disposition the inventory of depleted uranium onsite at any point in time. The applicant also provided proposed language for a surety bond, with a standby trust agreement. The surety bond and standby trust agreement will be executed before the applicant takes possession of licensed material. The applicant will update the site-specific cost estimate at least every 3 years, to reflect inflation and changes in site inventories and conditions that could affect the cost of decommissioning. A license condition has been added to the license to ensure that the applicant takes possession of no licensed material until the surety bond and standby trust agreement are executed and are acceptable to NRC. The decommissioning funding plan is acceptable because it provides sufficient funding to ensure decommissioning and decontamination of the facility can be accomplished even if the licensee is unable to meet its financial obligations.

## Management Measures

The applicant provided information about management measures that will be applied to the project. The information describes: (a) the overall configuration management program and policy; (b) the maintenance program; (c) training; and (d) the process for the development, approval, and implementation of procedures. The applicant explained the audits and assessments program as well as incident investigations and records management system. The applicant committed to establishing and documenting surveillances, tests, and inspections to provide reasonable assurance of satisfactory performance of the IROFS. The proposed management measures are acceptable and meet the regulatory requirements in 10 CFR 70.62(d).

## Material Control and Accountability

The applicant provided information describing the FNMCP for the project. The FNMCP describes the programs to be used to control and account for SNM in the facility. The program meets the applicable regulatory requirements in Part 74.

### Physical Protection

The applicant provided information on the policies, methods, and procedures to be implemented to protect SNM of low strategic significance used and possessed at the facility. This information is acceptable and meets the requirements in Part 73.

The applicant also provided information on the protection of classified matter, including security controls and procedures, to ensure that classified matter is used, processed, stored, reproduced, transmitted, transported, and destroyed. This program is acceptable and in accordance with the regulatory requirements in 10 CFR Part 95 for a facility clearance.

### Transportation Security

The applicant provided information in the Nuclear Material Transportation Security Plan on the policies, methods, and procedures to be implemented to protect SNM of low strategic significance in transit to and from the facility. This information is acceptable.

### Human Factors Engineering

The applicant provided information in the Human Factors Engineering Program Plan describing its technical approach for considering human factors in the plant design and operations. This program is integrated into the integrated safety analysis process to ensure that IROFS will be reliable and available when needed. The approach is consistent with the recommendations in NUREG-0700, "Human-System Interface Design Review Guidelines," and NUREG-0711, "Human Factors Engineering Program Review Model," and is acceptable.

### Electrical and Instrumentation and Control Systems

The applicant provided information on its electrical and instrumentation and control systems as it applies to IROFS. For operation of IROFS, no electrical supplies are necessary as all engineered IROFS fail in a safe configuration on loss of electrical power. In addition, the applicant did not propose to use digital instrumentation and control systems. The NRC staff is imposing a license condition setting out the standards the applicant would be required to meet in the event that it applies digital instrumentation and control systems in the future. The information provided is acceptable.

## LIST OF ACRONYMS AND ABBREVIATIONS

|          |   |
|----------|---|
| AC       | alternating current   |
| ACI      | American Concrete Institute   |
| ADAMS    | Agencywide Documents Access and Management System                         |
| AEC      | active engineered control   |
| AEGL     | Acute Exposure Guideline Level  |
| AICHE    | American Institute of Chemical Engineers                                  |
| AIF      | Atomic Industrial Forum   |
| AISC     | American Institute of Steel Construction                                  |
| ALARA    | as low as is reasonably achievable  |
| ALI      | annual limit on intake  |
| ANI      | American Nuclear Insurers   |
| ANS      | American Nuclear Society  |
| ANSI     | American National Standards Institute                                     |
| ANSI/ISA | American National Standards Institute/International Society of Automation |
| ANSS     | Advanced National Seismic System  |
| AOA      | area of applicability   |
| ASCE     | American Society of Civil Engineers                                       |
| ASME     | American Society of Mechanical Engineers                                  |
| ASQ      | American Society for Quality  |
| ASTM     | American Society for Testing and Materials                                |
| BDC      | baseline design criteria  |
| bgs      | below ground surface  |
| BLEVE    | boiling liquid expanding vapor explosion                                  |
| BMS      | Building Management System  |
| C        | Celsius   |
| CAAS     | Criticality Accident Alarm System   |
| CCS      | Central Control System  |
| CEDE     | committed effective dose equivalent                                       |
| CEO      | Chief Executive Officer   |
| CFR      | Code of Federal Regulations   |
| cfs      | cubic foot per second   |
| cm       | centimeter  |
| cm/hr    | centimeters per hour  |
| CM       | configuration management  |
| CPI      | Consumer Price Index  |
| CSA      | criticality safety analysis   |
| DAC      | derived air concentration   |
| DBE      | design basis earthquake   |
| DC       | direct current  |
| DCE      | decommissioning cost estimate   |
| DCS      | Distributed Control System  |

|                             |  |
|-----------------------------|--|
| DFP                         | decommissioning funding plan                                       |
| DOE                         | U.S. Department of Energy  |
| DOS                         | U.S. Department of State   |
| DP                          | decommissioning plan   |
| DUF <sub>6</sub>            | depleted uranium hexafluoride                                      |
| EA                          | Environmental Assessment   |
| ECC                         | Emergency Control Center   |
| EDMS                        | Electronic Document Management System                              |
| EHS                         | environmental health and safety                                    |
| EIS                         | Environmental Impact Statement                                     |
| EO                          | emergency organization   |
| EOC                         | Emergency Operations Center  |
| EPA                         | U.S. Environmental Protection Agency                               |
| EPCRA                       | Emergency Planning and Community Right-to-Know                     |
| EPRI                        | Electric Power Research Institute                                  |
| ER                          | Environmental Report   |
| ERO                         | Emergency response organization                                    |
| ESCI                        | Emergency Services Consulting International                        |
| F                           | Fahrenheit   |
| FHA                         | fire hazards analysis  |
| FHWA                        | Federal Highway Administration                                     |
| Flashes/km <sup>2</sup> /yr | flashes per square kilometer per year                              |
| Flashes/mi <sup>2</sup> /yr | flashes per square mile per year                                   |
| FMRC                        | Factory Mutual Research Corporation                                |
| FMS                         | Financial Management Service                                       |
| FNMC                        | fundamental nuclear material control                               |
| FNMCPL                      | Fundamental Nuclear Material Control Plan                          |
| FOCI                        | foreign ownership, control, or influence                           |
| FR                          | <i>Federal Register</i>  |
| FSME                        | Office of Federal and State Materials and Environmental Management |
| FSRC                        | Facility Safety Review Committee                                   |
| ft                          | foot   |
| ft/day                      | foot per day   |
| ft/s                        | foot per second  |
| g                           | acceleration of gravity  |
| gal                         | gallon   |
| GE                          | General Electric Company   |
| GEHNEA                      | General Electric-Hitachi Nuclear Energy Americas                   |
| GET                         | general employee training  |
| GLE                         | General Electric-Hitachi Global Laser Enrichment                   |
| GNF-A                       | Global Nuclear Fuels - Americas                                    |
| gpm                         | gallons per minute   |
| HAZCOM                      | hazard communication   |
| HEGA                        | high efficiency gas absorption                                     |
| HEPA                        | high efficiency particulate air                                    |
| HF                          | hydrogen fluoride  |



|                     |  |
|---------------------|--|
| HFE                 | human factors engineering                            |
| Holdings            | GE-Hitachi Nuclear Energy Holdings                   |
| IAEA                | International Atomic Energy Agency                   |
| I&C                 | instrumentation and controls                         |
| IBC                 | International Building Code                          |
| IC                  | initial condition                                    |
| ICC                 | International Code Council, Inc.                     |
| ICRP                | International Commission on Radiation Protection     |
| IEEE                | Institute for Electrical and Electronics Engineering |
| in                  | inch   |
| in/hr               | inches per hour                                      |
| IROFS               | item relied on for safety                            |
| ISA                 | integrated safety analysis                           |
| ISG                 | Interim Staff Guidance                               |
| ISO                 | International Organization for Standardization       |
| $k_{\text{eff}}$    | effective neutron multiplication factor              |
| kg                  | kilogram   |
| km                  | kilometer  |
| km <sup>2</sup>     | square kilometer                                     |
| km/hr               | kilometers per hour                                  |
| kPa                 | kiloPascal   |
| KV                  | kilovolt   |
| LA                  | license application                                  |
| lb                  | pound  |
| LCS                 | Local Control System                                 |
| LEL                 | lower explosive limit                                |
| LLRW                | low-level radioactive waste                          |
| lpm                 | liters per minute                                    |
| m                   | meter  |
| m/day               | meters per day                                       |
| m/s                 | meters per second                                    |
| m <sup>3</sup> /sec | cubic meters per second                              |
| M&TE                | measuring and test equipment                         |
| MCA                 | moderator controlled area                            |
| MC&A                | material control and accounting                      |
| MCES                | Monitored Central Exhaust System                     |
| MDC                 | minimum detectable concentration                     |
| MEI                 | maximally exposed individual                         |
| mg                  | milligram  |
| mg/kg               | milligram per kilogram                               |
| mi                  | mile   |
| mi <sup>2</sup>     | square mile  |
| MMI                 | Modified Mercalli Intensity                          |
| MoS                 | margin of subcriticality                             |
| MOU                 | Memorandum of Understanding                          |
| MPF                 | main processing facility                             |

|                |  |
|----------------|--|
| mph            | miles per hour   |
| mrem           | milliRem   |
| mrem/yr        | milliRem per year  |
| mSv            | milliSievert   |
| mSv/yr         | milliSievert per year                                      |
| MSDS           | Material Safety Data Sheet                                 |
| MT             | metric ton   |
| M <sub>w</sub> | moment magnitude   |
| MW             | megawatt   |
| NAIC           | National Association of Insurance Commissioners            |
| NAVFAC         | Naval Facilities Engineering Command                       |
| NCDEM          | North Carolina Division of Emergency Management            |
| NCEER          | National Center for Earthquake Engineering Research        |
| NCGS           | North Carolina Geologic Survey                             |
| NCS            | nuclear criticality safety                                 |
| NDA            | nondestructive analysis                                    |
| NEI            | Nuclear Energy Institute                                   |
| NELAC          | National Environmental Laboratory Accreditation Conference |
| NESC           | National Electrical Safety Code                            |
| NEPA           | National Environmental Policy Act                          |
| NESHAPS        | National Emission Standards for Hazardous Air Pollutants   |
| NFPA           | National Fire Protection Association                       |
| NIOSH          | National Institute for Occupational Safety and Health      |
| NMSS           | Office of Nuclear Material Safety and Safeguards           |
| NMTSP          | Nuclear Material Transportation Security Plan              |
| NOAA           | National Oceanic and Atmospheric Administration            |
| NPDES          | National Pollutant Discharge Elimination System            |
| NRC            | U.S. Nuclear Regulatory Commission                         |
| NRR            | Office of Nuclear Reactor Regulation                       |
| NSIR           | Office of Nuclear Security and Incident Response           |
| NVLAP          | National Voluntary Laboratory Accreditation Program        |
| OJT            | on-the-job training  |
| OSHA           | U.S. Occupational Safety and Health Administration         |
| P&ID           | pipng and instrumentation diagram                          |
| PCS            | Process Control System                                     |
| pfod           | probability of failure on demand                           |
| PFPE           | perfluorinated polyether                                   |
| PGA            | peak ground acceleration                                   |
| PHA            | process hazard analysis                                    |
| PM             | preventive maintenance                                     |
| PMF            | probable maximum flood                                     |
| PMP            | probable maximum precipitation                             |
| PMT            | post-maintenance testing                                   |
| PNC            | potential non-compliance                                   |
| PPE            | personal protective equipment                              |
| psf            | pounds per square foot                                     |
| PSP            | Physical Security Plan                                     |
| PSM            | process safety management                                  |

|                                |   |
|--------------------------------|---|
| QA                             | quality assurance                                       |
| QAPD                           | Quality Assurance Program Description                   |
| QC                             | quality control   |
| QL                             | quality level   |
| QRA                            | quantitative risk assessment                            |
| RASCAL                         | Radiological Assessment System for Consequence Analysis |
| RCA                            | radiological controlled area                            |
| RC&EP                          | Radiological Contingency and Emergency Plan             |
| RCRA                           | Resource Conservation and Recovery Act                  |
| Rem                            | roentgen equivalent man                                 |
| RES                            | Office of Regulatory Research                           |
| RLETS                          | Radioactive Liquid Effluent Treatment System            |
| RM                             | records management                                      |
| RP                             | radiation protection                                    |
| RSC                            | Radiation safety Committee                              |
| Scf                            | standard cubic feet                                     |
| SER                            | Safety Evaluation Report                                |
| SILEX                          | Separation of Isotopes by Laser Excitation              |
| SM                             | Source Material   |
| SNM                            | Special Nuclear Material                                |
| SNM-LSS                        | Special Nuclear Material - Low Strategic Significance   |
| SPPP                           | Standard Practice Procedures Plan                       |
| SSC                            | structure, system, and component                        |
| Sv                             | Sievert   |
| SWC                            | surge withstand capability                              |
| SWSB                           | Solid Waste Storage Building                            |
| SWU                            | separative work unit                                    |
| Tc-99                          | technicium-99   |
| TEDE                           | total effective dose equivalent                         |
| Th-232                         | thorium-232   |
| Treasury                       | Department of the Treasury                              |
| TSP                            | Transportation Security Plan                            |
| <sup>235</sup> U               | uranium-235   |
| UDS                            | Uranium Disposition Services                            |
| UF <sub>4</sub>                | uranium tetrafluoride                                   |
| UF <sub>6</sub>                | uranium hexafluoride                                    |
| UIR                            | unusual incident report                                 |
| UL                             | Underwriters Laboratories                               |
| UCF                            | unit cost factor  |
| UO <sub>2</sub> F <sub>2</sub> | uranyl fluoride   |
| UPS                            | uninterruptible power supply                            |
| U.S.                           | United States   |
| USEC                           | United States Enrichment Corporation                    |
| USGS                           | U.S. Geological Survey                                  |
| USL                            | upper subcritical limit                                 |

WMP  
wt

Waste Minimization Plan  
weight

yr

year

## 1.0 GENERAL INFORMATION

### 1.1 FACILITY AND PROCESS DESCRIPTION

The purpose of the U.S. Nuclear Regulatory Commission's (NRC's or Commission's) review of the proposed General Electric-Hitachi Global Laser Enrichment (GLE) laser-based uranium enrichment facility and process description is to determine whether the application includes an overview of the facility layout and a summary description of the proposed processes. A more detailed description of the facility and processes is contained in the "Integrated Safety Analysis (ISA) Summary" (GLE, 2011a).

#### 1.1.1 REGULATORY REQUIREMENTS

The regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) 30.33(a)(2), 10 CFR 40.32(c), and 10 CFR 70.22(a)(2) and (7) require each application for a license to include information on the proposed activity and the equipment and facilities that will be used by the applicant to protect health and minimize danger to life and property. In addition, the regulations in 10 CFR 70.65(b)(1), (2), and (3) require each application to include a general description of the facility, with emphasis on those areas that could affect safety, including identification of the controlled area boundaries.

#### 1.1.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA

The guidance applicable to NRC's review of the facility and process description section of the License Application (LA) (GLE, 2011b) is contained in Chapter 1 of the "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," NUREG-1520 (NRC, 2002). The chapter is applicable in its entirety. For information regarding exemption requests, see Section 1.2.3.6, "Special Exemptions or Special Authorizations," of this chapter.

The acceptance criteria applicable to this review are contained in Section 1.1.4.3 of NUREG-1520 (NRC, 2002). The applicant's general information will be found acceptable if it presents information at a level of detail that is appropriate for general familiarization and understanding of the proposed facility and processes. In addition, the general information needs to summarize the information presented in the ISA Summary showing the overall facility layout on scaled drawings, including the site geographical and facility structural features, and describing the relationship of specific facility features to the major processes the will be undertaken. The general information also needs to include the major chemical or mechanical processes involving licensed material described in a summary form based on information in the ISA Summary, including the building locations of major processes; brief descriptions of the process steps; the chemical forms of the licensed material; the maximum amounts of licensed material in various building locations; and the types, amounts, and discharge points of waste material discharged to the environment. The application also needs to provide a summary identification of the raw materials, by-products, wastes, and finished products from the facility. This information needs to include trace quantities of impurities or contaminants characterized by identity and concentration and describe any moderators or reflectors with special characteristics.

### 1.1.3 STAFF REVIEW AND ANALYSIS

In Section 1.1 of the LA (GLE, 2011b), the applicant provides a summary description of the proposed laser-based uranium enrichment plant and processes. This description includes discussion of the major chemical and mechanical processes to be used in the facility. The facility is proposing to use a laser-based enrichment process to enrich uranium from its natural isotopic concentration of about 0.7 weight percent uranium-235 ( $^{235}\text{U}$ ) up to 8 weight percent  $^{235}\text{U}$ . The proposed plant will have a nominal enrichment capacity of 6 million Separative Work Units (SWUs). (A SWU is a measure of the effort required to perform isotopic separation.) The process uses uranium in the chemical form of uranium hexafluoride ( $\text{UF}_6$ ).  $\text{UF}_6$  used and produced in the facility will meet appropriate American Society for Testing and Materials (ASTM) material specifications. Gaseous  $\text{UF}_6$  passes through a laser, which excites the  $^{235}\text{U}$  atom, and separates that isotope from uranium-238. The technology is based on the classified Separation of Isotopes by Laser Excitation (SILEX) process developed by SILEX Systems Limited, an Australian company. The SILEX technology is being used by the applicant under the "Agreement for Cooperation between the United States of America and Australia Concerning Technology for the Separation of Isotopes of Uranium by Laser Excitation," signed on October 28, 1999 (DOS, 1999).

The proposed plant, if licensed, will be constructed in Wilmington, North Carolina, at an existing General Electric Company (GE) site. Currently, at the Wilmington site, GE fabricates commercial nuclear reactor fuel, services reactor control rod drive assemblies, fabricates nuclear reactor components, and builds aircraft engines. Section 1.3 of the LA (GLE, 2011b) presents a summary description of site features including geography, demographics, local transportation routes, land use, meteorology, hydrology, geology, and seismicity.

The applicant is proposing to construct an Operations Building having a  $\text{UF}_6$  Cylinder Shipping and Receiving Area; a  $\text{UF}_6$  Feed and Vaporization Area; a Product Withdrawal Area; a Tails Withdrawal Area; a Cascade/Gas Handling Area; a Blending Area; a Sampling Area; a Radioactive Waste Area; a Heating, Ventilation, and Air Conditioning Equipment Area; a Decontamination/Maintenance Area; a Laboratory Area; and a Laser Area. The facility will also include  $\text{UF}_6$  cylinder storage pads for feed, product, and tails cylinders, administration buildings, and other support buildings needed for equipment storage and the facility infrastructure. The tails storage pad will have a capacity for 9,000 tails cylinders to accommodate ten years of full capacity operations. Because the tails storage pad will be limited to 9,000 cylinders, which is less than the total number of tails cylinders that could be generated over the 40-year operating period of the facility (approximately 33,000 cylinders), the following license condition will be added:

*The licensee shall store no greater than 9,000 tails cylinders onsite. If the licensee wishes to store more than 9,000 tails cylinders onsite, it shall submit an amendment request describing its proposed storage expansion and the provisions to be used to ensure the protection of public and worker safety.*

The LA (GLE, 2011b) provides additional information on each of the facility buildings proposed be constructed, including drawings for each of these areas.

The applicant is proposing to use a  $\text{UF}_6$  feed process that will heat feed cylinders to vaporize the  $\text{UF}_6$  and remove light gases present in the cylinder. Light gases will flow through cold traps to remove any  $\text{UF}_6$  and chemical traps to remove any residual hydrogen fluoride. The feed process will not heat  $\text{UF}_6$  to temperatures high enough to produce liquid  $\text{UF}_6$ .

The purified UF<sub>6</sub> will flow into the cascades where it is enriched. Following enrichment, the product and tails streams will be withdrawn by cooling and desublimation. Product cylinders are brought to the blending station for blending to produce the customer's desired <sup>235</sup>U assay. The withdrawal and blending processes will not result in liquid UF<sub>6</sub>.

Before shipment to customers, product cylinders will be sampled to ensure that customer specifications are met. To meet appropriate sampling requirements, the UF<sub>6</sub> must be liquefied to produce homogeneous samples. Product cylinders will be heated in an autoclave using hot air. Following sampling, the cylinders will be cooled using cold air to solidify the UF<sub>6</sub>. The sampling station is the only area of the facility where liquid UF<sub>6</sub> will be present.

The proposed facility is expected to possess natural, enriched, and depleted uranium. It is expected to handle, on an annual basis, approximately 900 nominal 12.5-metric ton (MT) (14-ton) natural uranium feed cylinders.

Gaseous airborne effluents will be released from the proposed facility. Areas potentially contaminated with radioactive materials will be processed using high efficiency particulate air filters and high efficiency gas absorption filters. Gaseous effluents will be monitored to ensure that releases meet 10 CFR Part 20 and U.S. Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants airborne release limits.

Liquid discharges include contaminated process effluents, cooling tower blowdown, and sanitary and stormwater discharges. Liquid effluents containing radioactive materials will be processed using precipitation and evaporation. Following treatment and monitoring to ensure that 10 CFR Part 20 requirements are met, these liquids will be released to onsite treatment facilities prior to discharging with other wastewaters generated at the Wilmington site to the site outfall. All discharges will meet 10 CFR Part 20 and National Pollution Discharge Elimination System liquid effluent requirements.

Solid wastes expected to be generated include non-hazardous municipal and industrial, Class A radioactive, and hazardous wastes. Non-hazardous municipal and industrial solid wastes will be disposed of at applicable approved municipal and Resource Conservation and Recovery Act (RCRA) disposal facilities. Radioactive wastes will be disposed of at licensed low-level radioactive waste disposal facilities. Hazardous RCRA wastes will be properly treated and disposed of at permitted treatment and disposal facilities. Mixed low-level radioactive and chemically hazardous wastes are not expected to be generated at the facility. Depleted uranium tails will be stored onsite on the Tails Pad until they are transferred to another licensee for commercial use or they are designated for transfer to the U.S. Department of Energy (DOE) under Section 3113 of the USEC Privatization Act of 1996. The applicant is proposing a 9,000 12.5-MT (14-ton) cylinder Tails Pad capacity limit of depleted uranium tails cylinders to accommodate ten years of tails generation.

As stated above, the applicant provided information at a level of detail that is appropriate for general familiarization and understanding of the proposed facility and processes. The application summarizes the facility information contained in the ISA Summary (GLE, 2011a) and includes descriptions of the overall facility layout on scaled drawings, including the site geographical features and facility structural features and transportation rights-of-way. The summary also describes the relationship of specific facility features to the major processes that will be ongoing at the facility. The major chemical and mechanical processes involving licensable material are described in summary form, based in part on information presented in

the ISA Summary (GLE, 2011a). This description includes: (a) reference to the building locations of major process components; (b) brief descriptions of the process steps; (c) the chemical forms of licensable material in process; and (d) the types, amounts, and discharge points of waste material discharged to the environment from the processes. The applicant presented a summary identification of the raw material, by-products, waste, and finished products of the facility. Expected levels of trace impurities or contaminants would not exceed the levels specified in ASTM C996, "Standard Specification for Uranium Hexafluoride Enriched to Less than 5 % <sup>235</sup>U" (ASTM, 2004). The information the applicant provided meets the acceptance criteria in Sections 1.1.4.3(1), (2), (3), and (4) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 1.1.4 EVALUATION FINDINGS

The staff has reviewed the proposed general facility and process descriptions according to Section 1.1 of the Standard Review Plan. The applicant has adequately described: (1) the facility and processes so that the staff has an overall understanding of the relationships of the facility features; and (2) the function of each feature. Because the tails storage pad has a capacity for less than the total quantity of tails cylinders that could be generated over the 40-year life of the facility, the following license condition will be added:

*The licensee shall store no more than 9,000 tails cylinders onsite. If the licensee wishes to store more than 9,000 tails cylinders onsite, it shall submit an amendment request describing its proposed storage expansion and the provisions to be used to ensure the protection of public and worker safety.*

The staff concludes that the applicant has met the requirements and acceptance criteria in Sections 1.1.4.3(1), (2), (3) and (4) of NUREG-1520 (NRC, 2002) and general facility and process information is, therefore, acceptable.

## 1.2 INSTITUTIONAL INFORMATION

The purpose of NRC's review of the applicant's institutional information is to establish whether the license application includes adequate information identifying the applicant, the applicant's characteristics, and the proposed activity.

### 1.2.1 REGULATORY REQUIREMENTS

The regulations in 10 CFR 30.32(a) and 10 CFR 40.31(a) require each application for a license to include: (a) information on the identity of the applicant; (b) name, chemical and physical form, and maximum amount of licensed material that will be possessed; and (c) purpose for which the licensed material will be used. The regulations in 10 CFR 70.22(a) require each application for a license to include: (a) information on the corporation applying for a license; (b) the location of the principal office; (c) the names and citizenship of the principal officers; (d) information concerning ownership and control; (e) the proposed site activities; (f) financial qualifications; and (g) the name, amount, and specifications of the licensed material to be used. The regulations in 10 CFR 70.23(a)(5) require that the applicant appears to be financially qualified to engage in the proposed activities in accordance with the regulations. The regulations in 10 CFR Part 95 contain provisions for obtaining a facility security clearance. The regulations in 10 CFR 140.13b require applicants for uranium enrichment facilities to provide and maintain liability insurance.



## 1.2.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA

The acceptance criteria applicable to NRC's review of the institutional information section of the application are contained in 10 CFR 30.32, 10 CFR 40.31, 10 CFR 70.23(a)(5), 10 CFR Part 95, 10 CFR 140.13b, and Section 1.2.4.3 of NUREG-1520 (NRC, 2002). Chapter 1 of NUREG-1520 (NRC, 2002) is applicable to the proposed uranium enrichment facility in its entirety. The applicant's institutional information will be found acceptable if it provides a description of the identity of the applicant; whether the applicant is a corporation or other entity; the organization and principal offices of the applicant; the site location; the names and citizenship of the principal officers; information on control and ownership of the applicant, including foreign interests; and the presence and operations of any other company on the site to be licensed are described. The institutional information also needs to provide a description of the financial qualification of the applicant that demonstrates current and continued access to financial resources needed to engage in the proposed activities. The applicant needs to identify the radioactive materials to be possessed, including the maximum quantities, chemical and physical forms, and the specifications of the material. In addition, the applicant needs to provide a narrative description of the activities or processes to be used consistent with the description of the proposed uses in the ISA Summary. The applicant also needs to describe any special authorization and exemptions to be requested and how the applicant will protect classified information.

Section 1.2.3.6, "Special Exemptions or Special Authorization," of this Safety Evaluation Report (SER), addresses exemptions and special authorizations.

## 1.2.3 STAFF REVIEW AND ANALYSIS

### 1.2.3.1 Corporate Identity

In Section 1.2.1 of the LA (GLE, 2011b), the applicant provided information on its corporate organization. The applicant is GE-Hitachi Global Laser Enrichment, LLC. The applicant is a limited liability company chartered in the State of Delaware and is the only subsidiary of GE-Hitachi Nuclear Energy Americas, LLC (GEHNEA). GEHNEA is a Delaware limited liability company and a wholly-owned subsidiary of GE-Hitachi Nuclear Energy Holdings (Holdings). Holdings is a Delaware-chartered limited liability company and is a subsidiary of GENE Holding LLC, also a Delaware-chartered limited liability company. GENE Holding LLC is owned by GE, a United States corporation chartered in the State of New York, and minority owner Hitachi America, Ltd., which is wholly owned by Hitachi, Ltd., a Japanese corporation.

GLE has two minority owners, Cameco Enrichment Holdings, Ltd., a Delaware limited liability company, and GENE Holding LLC. Cameco Enrichment Holdings, Ltd., is wholly owned by Cameco US Holdings, Inc., a Nevada corporation, which is wholly owned by Cameco Corporation, a Canadian corporation. Cameco Enrichment Holdings, Ltd., has a 24 percent interest in GLE and GENE Holding LLC has a 13.5 percent interest in GLE.

Under the above ownership arrangement, GE maintains an indirect majority (51 percent ownership and controlling interest), and no foreign entity has the ability to exercise control over GLE operations and management or has access to, or use rights in, GLE's nonpublic enrichment technology, including classified information. GLE Governing Board resolutions and, as applicable, Governing Board member voting proxies are utilized to assure that only Governing Board members who are U.S. citizens with appropriate U.S. government clearances have access to, or exercise control over, activities affecting the protection of classified matter.

No other companies will be present or operating on the uranium enrichment plant property other than where the applicant has contracted such services. The principal location for business is Wilmington, North Carolina.

The applicant provided the name of the President of GLE, who is a citizen of the United States.

The above information meets the requirements in 10 CFR 70.22(a)(1) and the guidance in Section 1.2.4.3(1) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because it includes the full name and address of the applicant; the address and full description of the location of the proposed facility; the States of incorporation of the applicant and its parents; the names and citizenship of the applicant's principal officers; corporate information related to foreign control, ownership, and influence; primary owners and relationships to other component of the same ownership; and the presence and operations of any other company on the site.

#### 1.2.3.2 Foreign Ownership, Control, or Influence

The applicant provided foreign ownership, control, or influence (FOCI) information in its Facility Clearance Submittal (GLE, 2011c). With respect to the FOCI determination for GLE and its parents, NRC staff received a letter from the DOE, dated May 19, 2010 (DOE, 2010), that a preliminary favorable FOCI determination rendered on May 17, 2010, has revealed that the degree and extent of FOCI over GLE and GEHNEA do not pose an undue risk to national security and there are no restrictions placed on GLE and GEHNEA for reasons of FOCI. The NRC accepts this finding by DOE based on an Interagency Agreement between NRC and DOE dated May 6, 2002 (DOE, 2002). NRC staff also reviewed amendments to the original FOCI submittal to reflect personnel changes in the GLE and GLE parent organizations. These amendments were consistent with the DOE determination and are, therefore, acceptable.

#### 1.2.3.3 Financial Qualifications

The governing regulations for financial qualifications for this application are 10 CFR 70.22(a)(8) and 10 CFR 70.23(a)(5).

Section 70.22(a)(8) of 10 CFR states:

“Each application for a license shall contain...[p]roposed procedures to protect health and minimize danger to life or property...[w]here the nature of the proposed activities is such as to require consideration of the applicant's financial qualifications to engage in the proposed activities in accordance with the regulations in this chapter, the Commission may request the applicant to submit information with respect to his financial qualifications.”

Section 70.23(a)(5) of 10 CFR states:

“Where the nature of the proposed activities is such as to require consideration by the Commission, that the applicant appears to be financially qualified to engage in the proposed activities in accordance with the regulations in this part;”

In addition, the staff took into consideration the Commission's ruling in Louisiana Energy Services, L.P. (Claiborne Enrichment Center), CLI-97-15, 46 NRC 294 (1997), which addressed an application by Louisiana Energy Services to construct and operate a uranium enrichment

facility pursuant to 10 CFR Part 70. Among other things, the ruling held that “the NRC is not required as a matter of law to apply the strict financial qualification provisions of Part 50 to all Part 70 license applications.” The Commission concluded that “the general language of Part 70 leaves the Commission free to review the reasonableness of an applicant’s financial plan in light of all relevant circumstances,” which might or might not lead to application of any or all of the criteria stated in Part 50.

#### 1.2.3.3.1 Evaluation of Cost Estimate to Construct and Operate the Facility

In Section 1.2.2.1 of the LA (GLE, 2011b), the applicant provided an estimate of the total capital investment required to construct a 6 million SWU facility, excluding capital depreciation, UF<sub>6</sub> tails disposition, decommissioning, and any replacement equipment required during the life of the facility. The estimated cost considered the costs of NRC licensing, site preparation, design, construction, long lead time manufacturing, installation, and testing and start-up.

The applicant stated that the cost estimate is based on a phased construction approach that is expected to take approximately 8 years from the time the license is issued to reach the full 6 million SWU capacity. The applicant plans to construct the proposed facility in 1 million SWU phases. After the first 1 million SWU phase is completed, additional 1 million SWU increments will be constructed at 1-year intervals. The applicant is expected to start production from the first phase approximately three years from issuance of the NRC license.

Based on the information provided, staff considers that the project cost estimate presented by the applicant provides a reasonable estimate of the financial resources needed to construct and operate the facility.

#### 1.2.3.3.2 Evaluation of Financial Qualifications

In Section 1.2.2.2 of the LA (GLE, 2011b), the applicant made commitments that construction of the first phase would not commence before funding is fully committed. Of this full funding (equity and/or debt), the applicant will have in place: (1) minimum equity contributions of 30 percent of the estimated project cost of the first phase from the parents and affiliates of the partners; and (2) firm commitments ensuring funds for the remaining project costs (GLE, 2011b). Construction of the subsequent incremental phases will have the same requirements listed for the first phase, with the caveat that expected profits from Phase 1 sales may be used as a funding source as well.

GLE has no reported income statements since its inception. As stated in Section 1.2.2.3 of the LA (GLE, 2011b), GLE is currently funded by three parent companies, General Electric, Hitachi, and Cameco. The parent organizations have contributed cash and notes to fund the project through the design validation stage of the program and stand committed to provide additional funding pending the successful validation of the design concept. As stated above, the applicant currently expects to fund a portion of the construction costs through additional equity contributions provided by the parent companies. The applicant identified sources of debt and equity for construction, however, the applicant does state that other funding options may be explored including, but not limited to, additional equity owners or long-term debt instruments.

The applicant provided a summary of each parent company’s total assets for the year ending December 31, 2009. All three of the parent organizations are publicly traded and have a Standard & Poor’s credit rating of BBB+ or higher, as referenced in Table 1.2-1, below.

**Table 1.2-1  
Applicant Corporate Financial Assets and Bond Rating**

| <u>Parent Company</u> | <u>Total Assets<br/>(US\$ billion)</u> | <u>S&amp;P Credit<br/>Rating</u> |
|-----------------------|--|----------------------------------|
| GE                    | 782                                    | AA+                              |
| Hitachi Ltd.          | 112                                    | BBB+                             |
| Cameco Corp.          | 7.21                                   | BBB+                             |

To ensure the applicant meets the financial qualifications requirements pursuant to 10 CFR 70.23(a)(5), the staff is imposing the following license condition, which is consistent with the approach previously accepted by the staff in Section 1.2.3.3.2 of NUREG-1851, "Safety Evaluation Report for the American Centrifuge Plant in Piketon, Ohio" (NRC, 2006a):

*Construction of each 1 million Separative Work Unit phase shall not commence before funding for that increment is available or committed. Prior to initiation of such phase, the licensee shall make available for NRC inspection, documentation of the budgeted costs, the source of funds available or committed, and changes to actual costs or funding of previous phases.*

The NRC staff finds that, based on the financial information submitted in the application describing the applicant's current and continuing access to the financial resources necessary to engage in the proposed activity, there is reasonable assurance that applicant is financially qualified to build and operate the proposed uranium enrichment facility and meets the financial qualification requirements for the proposed activities in accordance with 10 CFR 70.22(a)(8), 10 CFR 70.23(a)(5), Commission direction in CLI-97-15, and the guidance in Section 1.2.4.3(2) of NUREG-1520 (NRC, 2002), subject to the above license condition.

#### 1.2.3.4 Liability Insurance

Under 10 CFR 140.13b, a uranium enrichment facility is required to carry liability insurance to cover public claims arising from any occurrence, within the U.S. that causes, within or outside the U.S., bodily injury, sickness, disease, death, loss of, or damage to, property, or loss of use of property arising from the radioactive, toxic, explosive, or other hazardous properties of chemicals containing licensed material. The coverage would also apply to chemicals produced from licensed material. The amount of liability insurance required may be furnished and maintained in the form of either an effective facility form policy of liability insurance from nuclear facility underwriters, such other type of liability insurance as the NRC may approve, or a combination of the foregoing. As discussed in Section 1.2.2.4 of the LA (GLE, 2011b), the applicant is proposing to have and maintain up to \$200 million of liability insurance to satisfy the 10 CFR 140.13b requirements.

American Nuclear Insurers (ANI) currently provides \$200 million in coverage for the GE fuel fabrication facility located at the GE site (GLE, 2011b). The applicant provided a Certificate of Insurance that identifies the proposed uranium enrichment site to be covered under the existing fuel fabrication facility policy (GLE, 2011b). ANI indicated that \$200 million is the maximum limit of liability it will provide for the GE site because the fuel manufacturing operations create a

legacy exposure that restricts how much insurance capacity ANI is willing to provide (ANI, 2010).

NRC staff finds that the Certificate of Insurance meets the proof of liability insurance requirements in 10 CFR 140.13b to issue the license. In addition, the applicant's commitment to provide and maintain nuclear liability insurance in an amount of up to \$200 million prior to the receipt of licensed material and throughout operation of the facility is sufficient to fulfill NRC regulatory requirements in 10 CFR 140.13b. NRC staff finds that the \$200 million amount of liability insurance is acceptable because it is the maximum amount available from private sources. If however, the applicant chooses to provide liability insurance at a level less than \$200 million prior to the issuance of the license, the following license condition is proposed:

*The licensee shall provide proof of full liability insurance of \$200 million, as required by 10 CFR 140.13b, at least 30 days prior to the planned date for obtaining licensed material. If the licensee is proposing to provide less than \$200 million of liability insurance coverage, the licensee shall provide, to the NRC for review and approval, an evaluation supporting liability insurance coverage in amounts less than \$200 million at least 120 days prior to the planned date for obtaining licensed material.*

#### 1.2.3.5 Type, Quantity, and Form of Licensed Material

Table 1-7 of the LA (GLE, 2011b) lists the type, quantity, and form of the licensed material proposed for possession. The applicant proposes to use and possess up to 2,600 MT (2,870 tons) of special nuclear material containing up to 8 weight percent  $^{235}\text{U}$  and up to 140,000 MT (154,000 tons) of source material as depleted or natural uranium. The applicant also expects to use additional source and by-product material in calibration sources and will amend the LA when these calibration sources are selected. The quantities of Technetium-99 (Tc-99) and transuranics from residual contamination as a consequence of the historical feed of recycled uranium at other facilities are expected to have no significant radiological impact. The proposed possession limits are summarized in Table 1.2-2 below.

The applicant is proposing to enrich up to 8 weight percent  $^{235}\text{U}$ . However, the applicant is not expected to generate enriched material above 5 weight percent  $^{235}\text{U}$  in the near future as current nuclear power plants do not need enrichments at assays above 5 weight percent. In addition, 2.5-ton (2.3-MT) cylinders used to transport enrichment material are not approved for use above 5 weight percent  $^{235}\text{U}$ . NRC staff reviewed the application on the basis of producing enrichment levels of up to 8 weight percent  $^{235}\text{U}$ . However, NRC staff is imposing the following license condition to ensure that uranium enriched to up to 8 weight percent can be transported safely in approved product cylinders:

*The licensee shall provide a minimum 60-day notice to NRC before initial product withdrawal of licensed material exceeding 5 weight percent  $^{235}\text{U}$  enrichments. This notice shall identify the necessary equipment and operational changes to support customer product shipments at these assays.*

The applicant included Tc-99 and transuranics in Table 1-7 of the LA (GLE, 2011b). These radionuclides may exist at the facility in the form of process contaminants and waste or material held in cylinders from previous recycled uranium. The applicant has committed to comply with the requirements of ASTM C787 (ASTM 2006), "Standard Specification for Uranium Hexafluoride for Enrichment," or ASTM C996 (ASTM, 2004). These standards contain purity requirements for uranium enrichment feed and enriched product. NRC considered the

applicant's commitments to ASTM C787 (ASTM, 2006) and ASTM C996 (ASTM, 2004) an acceptable means for ensuring that the Tc-99 and transuranic possession limits contained in Table 1-7 of the LA (GLE, 2011b) are not exceeded.

**Table 1.2-2  
Proposed Possession Limits**

| Source or Special Nuclear Material   | Physical and Chemical Form  | Maximum Amount to be Possessed at Any One Time  |
|--|---|---|
| Uranium (natural and depleted) and daughter products   | Physical: Solid, Liquid, and Gas<br><br>Chemical: UF <sub>6</sub> , UF <sub>4</sub> , UO <sub>2</sub> F <sub>2</sub> , oxides and other compounds | 140,000,000 kg (308,000,000 lbs)  |
| Uranium enriched in isotope <sup>235</sup> U up to 8 percent by weight and uranium daughter products | Physical: Solid, Liquid, and Gas<br><br>Chemical: UF <sub>6</sub> , UF <sub>4</sub> , UO <sub>2</sub> F <sub>2</sub> , oxides and other compounds | 2,600,000 kg (5,720,000 lbs)  |
| Tc-99, transuranic isotopes and other contamination  | Any   | Amount that exists as contamination as a consequence of the historical feed of recycled uranium at other facilities |

Note: Tc-99 - Technetium-99  
 UF<sub>4</sub> - Uranium Tetrafluoride  
 UO<sub>2</sub>F<sub>2</sub> - Uranyl Fluoride

As stated above, the applicant identified the elemental name, maximum quantity, and specifications, including the chemical and physical forms, of the licensed material that the applicant proposes to acquire, deliver, receive, possess, produce, use, transfer, or store. The applicant also identified the isotopic content and amount of enrichment by percent of the licensed material. The information provided by the applicant meets the regulatory requirements in 10 CFR 70.22(a)(4) and the guidance in Section 1.2.4.3(3) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 1.2.3.6 Authorized Uses

As discussed in Section 1.2.4 of the LA (GLE, 2011b), the application is for the issuance of licenses under 10 CFR Parts 30, 40, and 70 that would be effective for a 40-year period. The applicant is proposing to use special nuclear material and source material in the enrichment of uranium. The uranium enrichment services would be sold to clients for the production of low-enriched uranium that would be ultimately used in the manufacture of fuel for commercial nuclear power plants. Enrichment services may also be provided to the U.S. government.

As discussed in Section 1.2.3 of the LA (GLE, 2011b), byproduct material would be used in instrument calibration sources and may be present as contamination as a consequence of the historical feed of recycled uranium at other enrichment facilities. Feed cylinders that have been previously used to transport or store recycled uranium must be decontaminated before being allowed on the facility site. In addition, natural UF<sub>6</sub> supplied to the facility will meet ASTM C787 (ASTM, 2006), and periodic audits of suppliers will be performed to ensure that these conditions are met. The applicant intends to identify specific byproduct calibration sources in future license amendment requests. As discussed in Section 1.2.6 of the LA (GLE, 2011b), the applicant also requested approval of a classified-matter facility clearance under 10 CFR Part 95.

As stated above, the applicant provided a summary, non-technical description for each activity or process in which the applicant proposed to acquire, deliver, receive, possess, produce, use, process, transfer, or store licensed material. The authorized uses of licensed material proposed for the facility are described and are consistent with the Atomic Energy Act of 1954, as amended. The description is also consistent with more detailed process descriptions submitted as part of the ISA Summary (GLE, 2011a), as reviewed under Chapter 3 of this SER. The information provided by the applicant meets the guidance in Section 1.2.4.3(4) of NUREG-1520 (NRC, 2002) and the regulatory requirements in 10 CFR 70.22(a)(4) and is, therefore, acceptable.

#### 1.2.3.7 Special Exemptions or Special Authorizations

In Section 1.2.5 of the LA (GLE, 2011b), the applicant requested two special authorizations and five exemptions to the regulations.

##### 1.2.3.7.1 Authorization to Use Branch Technical Position for Release of Materials for Unrestricted Use

In Section 1.2.5.1 of the LA (GLE, 2011b), the applicant requested a special authorization to use the guidelines for contamination and exposure rate limits developed by NRC for release of items for unrestricted use. The applicant requested to use “Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material” (NRC, 1993) for decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The use of the requested guidelines is consistent with the acceptance criteria in Section 4.4.7.3(12) of NUREG-1520 (NRC, 2002) and the special authorization request is, therefore, acceptable. The use of these guidelines is also discussed in Section 4.7.13 of the LA (GLE, 2011b) and Section 4.3.7 of this SER.

The following license condition will be added to the License:

*The Licensee shall release materials, equipment, and facilities for unrestricted use in accordance with “Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material.”*

#### 1.2.3.7.2 Authorization to Make Certain License Application Changes Without Prior NRC Approval

In Section 1.2.5.5 of the LA (GLE, 2011b), the applicant requested authorization to make changes to the license commitments that do not decrease the effectiveness of its commitments without prior approval of NRC. For changes that decrease the effectiveness of its commitments, the applicant committed to requesting license amendments and to not implement the changes until NRC approval is obtained. Changes that could be made without NRC prior approval are changes for which there is no degradation in the safety commitments in the license and for which the change, test, or activity does not conflict with any condition specifically stated in the license. Records of such changes would be maintained, including the technical justification and management approval, in dedicated records available to NRC inspectors. A report containing a description of each change and appropriate revised sections of the LA would be submitted to the NRC within three months of implementing these changes. Staff reviewed this authorization request and because this request is consistent with the change provisions in 10 CFR 70.72 for changes to the ISA Summary, the staff finds that the authorization request is acceptable. The following license condition will be added for this authorization:

*The licensee shall not make changes to the License Application that decreases the effectiveness of safety commitments, without prior NRC approval. For those changes, the licensee shall submit to the NRC, for review and approval, an application to amend the license. Such changes shall not be implemented until approval is granted.*

*Upon documentation of completion of a change for a facility or process, the licensee may make changes in the facility or process as presented in the License Application, or conduct tests or activities not presented in the License Application, without prior NRC approval, subject to the following conditions:*

- 1. There is no degradation in the safety commitments in the License; and*
- 2. The change, test, or activity does not conflict with any condition specifically stated in the License.*

*Records of such changes shall be maintained, including technical justification and management approval, in dedicated records to enable NRC inspection upon request at the facility. A report containing a description of each such change, and appropriate revised sections to the License Application, shall be submitted to the NRC within three months of implementing the change.*

#### 1.2.3.7.3 Exemption to Use International Commission on Radiological Protection Publication No. 68

In Section 1.2.5.4 of the LA (GLE, 2011b), the applicant requested a special authorization to use the derived air concentration (DAC) and annual limit on intake (ALI) values based on dose coefficients published in International Commission on Radiological Protection (ICRP) Publication No. 68, "Dose Coefficients for Intakes of Radionuclides by Workers" (ICRP, 1995a). This is considered an exemption request from the requirements of 10 CFR Part 20. The Commission by Staff Requirements Memorandum, dated April 21, 1999 (NRC, 1999a), authorized the staff to grant such requests on a case-by-case basis based on the staff Commission Paper, SECY-99-077 (NRC, 1999b).



As stated in SECY-99-077 (NRC, 1999b), one of the major changes incorporated in the revised Part 20 was the manner in which internal exposure to radioactive materials is regulated. Before the revision, NRC regulated internal exposures by limiting the amounts of radioactive materials that may be taken into the body over specified time periods. The revised Part 20 eliminated regulation based on intakes and, instead, regulated on the basis of the dose that resulted from those intakes. The internal dose from intake of radioactive material is referred to in Part 20 as the committed effective dose equivalent (CEDE). The change to regulation of dose instead of intake was prompted in part by similar changes in the recommendations provided by national and international bodies, and also by the desire to end the traditional treatment of internal and external doses as two distinct and separate entities. A consequence of the dose-based rule is that compliance would not necessarily be constrained by use of a specific set of parameters to calculate the dose. Part 20, in fact, allows certain adjustments to be made to the model parameters if specific information is available, such as adjustments when the particle size of airborne radioactive material is known, rather than using a default particle size. However, Part 20 also specifies certain protection requirements in the rule in terms of the quantities tabulated in Appendix B, the ALI and the DAC, rather than in terms of dose. Thus, requirements such as posting of airborne radioactivity areas, monitoring for intakes of radioactive materials, establishment of bioassay programs, and use of respirators are explicitly tied to the measurable quantities, rather than to a dose. This approach was taken to assure that these criteria would be easy to implement, and not impose an undue calculation burden on a licensee.

As stated in SECY-99-077 (NRC, 1999b), the models used in Part 20 to regulate internal dose are those described in ICRP Publications 26 (ICRP, 1977) and 30 (ICRP, 1978), adopted by ICRP in 1977 and 1978, respectively. Much of the basic structure of these models was developed in 1966, although some of its components and parameters were altered somewhat between 1966 and their formal adoption by ICRP in 1978. In 1991, the final 10 CFR Part 20 revision rule was published revising 10 CFR Part 20 to incorporate the revised ICRP guidance, and in 1991 ICRP published a major revision of its radiation protection recommendations in ICRP Publication 60 (ICRP, 1991). In the several years following this revision, ICRP published a series of reports in which it described the components of an extensively updated and revised internal dosimetry model. These reports include ICRP Publications 66 (ICRP, 1995b), 67 (ICRP, 1994), 68 (ICRP, 1995a), 71 (ICRP, 1996a), 72 (ICRP, 1996b), and 78 (ICRP, 1999). Because internal dose calculations in 10 CFR Part 20 are currently based on ICRP Publications 26 (ICRP, 1977) and 30 (ICRP, 1978), NRC licensees must obtain an exemption to be permitted to use the revised and updated internal dosimetry models. Although the dose per unit intake calculated using the new models does not differ by more than a factor of about two from the values in Part 20 for most radio nuclides, the differences are substantial for some, particularly for the isotopes of thorium, uranium, and some of the transuranic radionuclides. For example, for inhalation of insoluble thorium-232 ( $^{232}\text{Th}$ ), the CEDE per unit intake calculated using the revised ICRP lung model is a factor of about 15 times lower than that in Part 20.

The staff has concluded during its license review that the licensee's Radiation Safety Program is sufficiently sophisticated by training and expertise to utilize the ICRP Model in a manner equivalent to those listed in 10 CFR 20.1201(d), i.e., doses less than NRC's regulatory limit of 5 rems. Therefore, the applicant's request for an exemption under 10 CFR 20.2301 is acceptable, because it gives its workers equivalent radiological protection as required by 10 CFR Part 20.

Under 10 CFR 30.11, 10 CFR 40.14, and 10 CFR 70.17, the Commission may grant exemptions from the requirements of the regulations as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. NRC staff evaluated the exemption request and determined that such

exemption is not prohibited by law. Staff also determined that, because the dose modeling approach proposed by the applicant will provide adequate dose modeling approach consistent with international guidance, the approach will not endanger life or property or the common defense and security. Because the dose modeling approach will reduce the applicant's expenses by using more accurate dose estimates, the staff has determined that the proposed approach will be in the public interest by reducing unnecessary regulatory costs. Therefore, the staff grants the requested exemption as provided in Section 1.2.5.4 of the LA (GLE, 2011b). The following license condition will be included in the license to address the applicant's commitments for dose modeling:

*The Licensee is granted an exemption to the requirements in 10 CFR Part 20, Appendix B, related to the use of dose coefficients for determining derived air concentrations and annual limit on intake values, and shall use, in accordance with approved procedures, the derived air concentration and annual limit on intake values based on dose coefficients published in International Commission of Radiological Protection Publication No. 68, "Dose Coefficients for Intakes of Radionuclides by Workers," in lieu of the values in Appendix B of 10 CFR Part 20.*

#### 1.2.3.7.4 Exemption to Radioactive Material Labeling Requirements

In Section 1.2.5.2 of the LA (GLE, 2011b), the applicant requested an exemption to the radioactive material labeling requirements in 10 CFR 20.1904. Instead, the applicant commits to posting signs at all entrances into Radiologically Controlled Areas in which radioactive materials are processed, used, or stored with a sign stating, "Every container in this area may contain radioactive material." The exemption is acceptable because review of the Radiation Protection Program and training demonstrates this provides adequate protection and security.

Under 10 CFR 30.11, 10 CFR 40.14, and 10 CFR 70.17, the Commission may grant exemptions from the requirements of the regulations as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. NRC staff evaluated the exemption request and determined that such exemption is not prohibited by law. Staff also determined that, because the posting approach proposed by the applicant will provide adequate posting to alert workers of the presence of radioactive material areas and to take precautions to avoid or minimize exposure, the approach will not endanger life or property or the common defense and security. Because the posting approach will reduce the applicant's expenses from having to label every individual container of radioactive material, the staff has determined that the proposed approach will be in the public interest by reducing unnecessary regulatory costs. Therefore, the staff grants the requested exemption as provided in Section 1.2.5.2 of the LA (GLE, 2011b). The following license condition will be included in the license to address the applicant's commitments for posting:

*The Licensee is granted an exemption to the labeling requirements in 10 CFR 20.1904, and shall instead post areas within Radiological Controlled Areas in which radioactive materials are processed, used, or stored with a sign stating, "Every container in this area may contain radioactive material."*

#### 1.2.3.7.5 Exemption to Decommissioning Financial Assurance Requirements

In Sections 1.2.5.3 and 10.2.2 of the LA (GLE, 2011b), the applicant requested an exemption to the decommissioning financial assurance requirements in 10 CFR 40.36(d) and 10 CFR 70.25(e) to allow incremental funding of the required decommissioning funding plan. Under the

requirements in 10 CFR 70.25(a), an applicant for a license for a uranium enrichment facility must provide a decommissioning funding plan. Under the requirements 10 CFR 40.36(d) and 10 CFR 70.25(e), a decommissioning funding plan must contain a certification that financial assurance for decommissioning has been obtained in the amount of the cost estimate for decommissioning. The applicant is requesting that it be granted an exemption to 10 CFR 40.36 and 10 CFR 70.25 to provide incremental funding for decommissioning to reflect its expected depleted uranium tails generation rate. As discussed in Section 1.2.5.3 of the LA (GLE, 2011b), the applicant stated that it would initially provide full funding for the projected cost of facility decontamination and decommissioning at the time the applicant takes possession of licensed material assuming a 6-million SWU capacity. The applicant will also provide NRC with revised funding instruments for depleted uranium disposition on an annual, forward-looking basis. The applicant will also adjust other decommissioning costs periodically, and no less frequently than every three years as required by 10 CFR 40.36(d) and 10 CFR 70.25(e). NRC staff will review revisions to the cost estimate and the financial instrument, which are presented before the applicant takes possession of licensed material. NRC staff will also review all subsequent revisions to the cost estimate and financial instruments.

Under 10 CFR 40.14 and 10 CFR 70.17, the Commission may grant exemptions from the requirements of the regulations as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. NRC staff evaluated the exemption request and determined that such exemption is not prohibited by law. Staff also determined that, because the incremental funding approach proposed by the applicant will provide funding for all the applicant's decommissioning obligations at any point in time, the approach will not endanger life or property or the common defense and security. Because the incremental funding approach will reduce the applicant's expenses from having to fund a 40-year decommissioning obligation when, in actuality, the decommissioning obligations prior to the end of the 40-year operating period are less, the staff has determined that the proposed approach will be in the public interest by reducing unnecessary regulatory costs. Therefore, the staff grants the requested exemption as provided in Section 1.2.5.3 of the LA (GLE, 2011b). The following license condition will be included in the license to address the applicant's commitments for updating the decommissioning funding plan over time:

*The Decommissioning Funding Plan shall be updated as follows:*

- a. *The Licensee shall provide to NRC for review an updated Decommissioning Funding Plan at least six months prior to the planned date for obtaining licensed material, and subsequently, after resolution of any NRC comments, final executed copies of the financial assurance instruments shall be provided to NRC at least 21 days prior to receipt of licensed material. The amount of the financial assurance instrument shall be updated to current year dollars and include any applicable change to the decommissioning cost estimate.*
- b. *In the first executed financial assurance instrument submitted prior to receipt of licensed material, the licensee shall provide full funding for decontamination and decommissioning of the full-size facility.*
- c. *In the first executed financial assurance instrument submitted prior to receipt of licensed material, the licensee shall provide funding for the disposition of depleted uranium tails in an amount needed to disposition the first year of depleted uranium tails generation. The cost estimate shall include an update to the DOE depleted uranium disposition cost estimate. The total amount funded*

*for depleted uranium disposition shall be no less than the updated DOE cost estimate.*

- d. Subsequent updated decommissioning funding estimates and revised funding instruments for facility decommissioning shall be provided for review, at a minimum, every three years. Any proposed reduction in the funding estimate based on operational changes shall be submitted six months prior to the change.*
- e. Subsequent updated decommissioning cost estimates and revised funding instruments for depleted uranium disposition shall be provided for review annually on a forward-looking basis to reflect projections of depleted uranium byproduct generation. The cost estimate shall include an update to the DOE depleted uranium disposition cost estimate. The total amount funded for depleted uranium disposition shall be no less than the updated DOE cost estimate.*

This license condition is discussed further in Section 10.3.2.2 of this SER.

#### 1.2.3.7.6 Exemption to 10 CFR Part 21.3 Definitions

In Section 1.2.5.6 of the LA (GLE, 2011b), the applicant requested an exemption from NRC regulations to replace the definitions of “basic component,” “commercial grade item,” “critical characteristics,” “dedication,” and “dedicating entity” as they apply to facilities licensed pursuant to 10 CFR Part 70 with modified definitions.

The regulations in 10 CFR 21.3 define a “basic component” as it applies to uranium enrichment and fuel fabrication facilities as follows:

“[A] structure, system, or component, or part thereof, that affects their safety function, that is directly procured by the licensee of a facility or activity subject to the regulations in this part and in which a defect or failure to comply with any applicable regulation in this chapter, order, or license issued by the Commission could create a substantial safety hazard.”

The applicant proposed revising the definition of “basic component” to link it to Items Relied on for Safety (IROFS) and to remove the direct procurement requirement, since some items may be procured at the subsupplier level. As revised, the definition of “basic component” proposed by the applicant would read as follows:

“Basic Component: A structure, system, or component (SSC), or part thereof, designated as an IROFS identified as QL-1 or QL-2, that affects the IROFS function, that is directly procured by the licensee of a facility or activity subject to the regulations in 10 CFR 70 and in which a defect or failure to comply with any applicable regulation in 10 CFR 70, order, or license issued by the U.S. Nuclear Regulatory Commission could create a substantial safety hazard (i.e., exceed the performance requirements of 10 CFR 70.61). Basic Components include QL-1 and QL-2 identified IROFS-related design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services that are associated with the component hardware, whether these services are performed by the component supplier or others.

When applied to IROFS identified as QL-NFPA, a basic component is a SSC, or part thereof, that affects the safety function of the IROFS that is directly procured by the licensee or a facility or activity subject to the requirements of the National Fire Protection Association (NFPA) Code of Record, and in which a defect or failure to comply with requirements of the NFPA Code of Record could create a substantial safety hazard. Basic component includes QL-NFPA identified IROFS-related design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services that are associated with the component hardware, whether these services are performed by the component supplier or others, to the extent required by the NFPA Code of Record.”

The regulations in 10 CFR 21.3 define a “commercial grade item” as it applies to uranium enrichment and fuel fabrication facilities as follows:

“[A]n item that is: (i) Not subject to design or specification requirements that are unique to those facilities or activities; (ii) Used in applications other than those facilities or activities; and (iii) To be ordered from the manufacturer/supplier on the basis of specifications set forth in the manufacturer's published product description (for example, a catalog).”

The applicant proposed revising the definition to enable the procurement and dedication of items or services with unique design or specification requirements that may not be common to other facilities or be able to be ordered from a catalog. The definition of commercial grade items as it applies to fire suppression IROFS is maintained consistent with the original definition in 10 CFR 21.3 as it is expected that fire suppression IROFS will be available for direct purchase from established manufacturer specifications that comply with National Fire Protection Association (NFPA) codes and standards. As revised, the proposed definition of “commercial grade item” would read as follows:

“Commercial-Grade Item: An SSC, or part thereof, that affects its QL-1 and/or QL-2 identified IROFS function, which is not designed and manufactured as a Basic Component. Commercial-grade items do not include items where the design and manufacturing processes require in-process inspections and verifications to ensure that defect or failures to comply are identified and corrected (i.e., one or more critical characteristics of the item cannot be verified).

When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), commercial grade item means an item that is (1) not subject to design or specification requirements that are unique to facilities or activities; (2) used in applications other than those facilities and activities; and (3) to be ordered from the manufacturer/supplier on the basis of specifications set forth in the manufacture[r]’s published product description.”

This modification is necessary in order for the applicant to be able to procure material, equipment, and services from entities that do not apply quality assurance programs that meet the requirements of the Quality Assurance Program Description (QAPD) (GLE, 2011d) and to allow commercial procurement of items that are not readily available as catalog items. The definitions do maintain the important distinction that is identified in 10 CFR 21.3 requiring that commercial grade items cannot be items where in process inspections or tests are required to verify one or more critical characteristics. Those items would be required to be purchased as basic components.

The regulations in 10 CFR 21.3 do not provide a definition of “critical characteristics” as applicable to uranium enrichment and fuel fabrication facilities. The applicant proposed a definition for “critical characteristics” that is comparable to that established for Part 50 facilities, with the exception that it refers to the item’s IROFS function instead of its safety function. However, the link to safety is inherent in an item’s identification as an IROFS. As revised, the proposed definition of “critical characteristics” would read as follows:

“Critical Characteristics: Those important to design, material, and performance characteristics of a commercial-grade item that, once verified, will provide reasonable assurance that the item will perform its intended QL-1 and/or QL-2 identified IROFS function.

When applied to items identified as QL-NFPA, critical characteristics are those important to design, material, and performance characteristics of a commercial grade item that will provide reasonable assurance that the item will perform its intended QL-NFPA identified IROFS function.”

The regulations in 10 CFR 21.3 define “dedication” as it applies to uranium enrichment and fuel fabrication facilities by stating that dedication occurs after receipt when that item is designated for use as a basic component. The applicant proposed revising the definition to provide more specific guidance with respect to the purpose of dedication and the measures taken in order to accomplish dedication. As revised, the proposed definition of “dedication” would read as follows:

“Dedication: An acceptance process undertaken to provide reasonable assurance that a commercial-grade item to be used as a Basic Component will perform its intended QL-1 and/or QL-2 IROFS function and, in this respect, is deemed equivalent to an item designed and manufactured under QL-1 or QL-2 requirements in accordance with the GLE QAPD. This assurance is achieved by identifying the critical characteristics of the item and verifying their acceptability by inspections, tests, or analyses performed by the purchaser or third-party dedicating entity after delivery, supplemented as necessary by one or more of the following: commercial grade surveys, product inspections or witness at holdpoints at the manufacturer’s facility, and analysis of historical records for acceptable performance. In all cases, the dedication process must be conducted in accordance with the applicable provisions of the GLE QAPD. The process is considered complete when the item is designated for use as a basic component applicable to QL-1 and/or QL-2 IROFS.

When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), the dedication process is applied to commercial-grade items to be used as basic components to provide reasonable assurance that they will perform their intended QL-NFPA identified IROFS function and are deemed equivalent to an item designed and manufactured under QL-NFPA requirements in accordance with the GLE QAPD. This assurance is achieved by confirming that the commercial-grade item is manufactured to established, acceptable national codes or standards that include one or more independent product endorsement based on qualification testing or periodic testing of selected characteristics of the item except in cases where such listing/approval is not required by codes and standards. In all cases, the applicable provisions of the GLE QAPD will be used to conduct the dedication process. The process is considered complete when the commercial-grade item is designated as a basic component.”

The definition, as revised, is more comprehensive than the one identified in 10 CFR Part 21 and will foster the implementation of a dedication process by the applicant that identifies the critical characteristics of QL-1 and QL-2 IROFS and performs necessary measures to verify the acceptability of such characteristics. The dedication process for fire suppression IROFS will ensure that commercial grade items comply with NFPA codes and standards and QAPD (GLE, 2011d) controls.

The regulations in 10 CFR 21.3 do not define “dedicating entity” as it applies to uranium enrichment and fuel fabrication facilities. The applicant proposed a definition that is comparable to that identified in 10 CFR Part 21 for Part 50 facilities. The proposed definition of dedication would read as follows:

“Dedicating Entity: The organization that performs the dedication process for QL-1 and QL-2 identified IROFS. Dedication may be performed by the manufacturer of the item, a third-party dedicating entity, or the licensee itself. The dedicating entity, pursuant to 10 CFR 21.21(c), is responsible for identifying and evaluating deviations, reporting defects and failure to comply for the dedicated item, and maintaining auditable records of the dedication process. In cases where the Licensee applies the commercial-grade item procurement strategy and performs the dedication process, the licensee would assume full responsibility as the dedicating entity.

When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), the dedicating entity is the licensee. The licensee, pursuant to 10 CFR 21.21(c), is responsible for reporting defects and failure[s] to comply for the dedicated item, maintaining auditable records of the dedication process, and assumes full responsibility as the dedicating entity.”

The staff finds that the proposed definitions for “basic component,” “commercial grade item,” “critical characteristics,” “dedication,” and “dedicating entity” as they apply to the applicant are acceptable for providing reasonable assurance that IROFS will be available and reliable to perform their safety functions. As provided in the LA (GLE, 2011b), the proposed definitions describe procurement, verification, and dedication measures that will be adequate to ensure that items purchased as basic components or dedicated will perform their IROFS function.

Under 10 CFR 30.11, 10 CFR 40.14, and 10 CFR 70.17, the Commission may grant exemptions from the requirements of the regulations as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. NRC staff evaluated the exemption request and determined that such exemption is not prohibited by law. Staff also determined that, because the 10 CFR Part 21 definitions proposed by the applicant provide definitions that will ensure that IROFS will be available and reliable to perform their safety functions when needed, the approach will not endanger life or property or the common defense and security. Because the proposed 10 CFR Part 21 definitions will reduce the applicant’s expenses in implementing its quality assurance program by enabling the applicant to procure equipment not readily available from vendors that have 10 CFR Part 50, Appendix B, quality assurance programs. For these cases, vendors may be unwilling to develop 10 CFR Part 50, Appendix B, quality assurance programs or pass back development costs of new quality assurance programs directly to the applicant. Therefore, the staff has determined that the proposed approach will be in the public interest by reducing unnecessary regulatory costs. Therefore, the staff grants the requested exemption as provided in Section 1.2.5.6 of the LA (GLE, 2011b). The following license condition will be included in the license to address the applicant’s proposed changes to the definitions in 10 CFR Part 21:

*The Licensee is granted an exemption from the definitions of “basic component,” “commercial grade item,” “critical characteristics,” “dedication,” and “dedicating entity” in 10 CFR Part 21.3, as replaced by the following:*

*Basic Component: A structure, system, or component (SSC), or part thereof, designated as an IROFS identified as QL-1 or QL-2, that affects the IROFS function, that is directly procured by the licensee of a facility or activity subject to the regulations in 10 CFR 70 and in which a defect or failure to comply with any applicable regulation in 10 CFR 70, order, or license issued by the U.S. Nuclear Regulatory Commission could create a substantial safety hazard (i.e., exceed the performance requirements of 10 CFR 70.61). Basic Components include QL-1 and QL-2 identified IROFS-related design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services that are associated with the component hardware, whether these services are performed by the component supplier or others.*

*When applied to IROFS identified as QL-NFPA, a basic component is a SSC, or part thereof, that affects the safety function of the IROFS that is directly procured by the licensee or a facility or activity subject to the requirements of the National Fire Protection Association (NFPA) Code of Record, and in which a defect or failure to comply with requirements of the NFPA Code of Record could create a substantial safety hazard. Basic component includes QL-NFPA identified IROFS-related design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services that are associated with the component hardware, whether these services are performed by the component supplier or others, to the extent required by the NFPA Code of Record.*

*Commercial-Grade Item: An SSC, or part thereof, that affects its QL-1 and/or QL-2 identified IROFS function, which is not designed and manufactured as a Basic Component. Commercial-grade items do not include items where the design and manufacturing processes require in-process inspections and verifications to ensure that defect or failures to comply are identified and corrected (i.e., one or more critical characteristics of the item cannot be verified).*

*When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), commercial grade item means an item that is (1) not subject to design or specification requirements that are unique to facilities or activities; (2) used in applications other than those facilities and activities; and (3) to be ordered from the manufacturer/supplier on the basis of specifications set forth in the manufacture[r]’s published product description.*

*Critical Characteristics: Those important to design, material, and performance characteristics of a commercial-grade item that, once verified, will provide reasonable assurance that the item will perform its intended QL-1 and/or QL-2 identified IROFS function.*

*When applied to items identified as QL-NFPA, critical characteristics are those important to design, material, and performance characteristics of a commercial grade item that will provide reasonable assurance that the item will perform its intended QL-NFPA identified IROFS function.*



*Dedication: An acceptance process undertaken to provide reasonable assurance that a commercial-grade item to be used as a Basic Component will perform its intended QL-1 and/or QL-2 IROFS function and, in this respect, is deemed equivalent to an item designed and manufactured under QL-1 or QL-2 requirements in accordance with the GLE QAPD. This assurance is achieved by identifying the critical characteristics of the item and verifying their acceptability by inspections, tests, or analyses performed by the purchaser or third-party dedicating entity after delivery, supplemented as necessary by one or more of the following: commercial grade surveys, product inspections or witness at holdpoints at the manufacturer's facility, and analysis of historical records for acceptable performance. In all cases, the dedication process must be conducted in accordance with the applicable provisions of the GLE QAPD. The process is considered complete when the item is designated for use as a basic component applicable to QL-1 and/or QL-2 IROFS.*

*When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), the dedication process is applied to commercial-grade items to be used as basic components to provide reasonable assurance that they will perform their intended QL-NFPA identified IROFS function and are deemed equivalent to an item designed and manufactured under QL-NFPA requirements in accordance with the GLE QAPD. This assurance is achieved by confirming that the commercial-grade item is manufactured to established, acceptable national codes or standards that include one or more independent product endorsement based on qualification testing or periodic testing of selected characteristics of the item except in cases where such listing/approval is not required by codes and standards. In all cases, the applicable provisions of the GLE QAPD will be used to conduct the dedication process. The process is considered complete when the commercial-grade item is designated as a basic component.*

*Dedicating Entity: The organization that performs the dedication process for QL-1 and QL-2 identified IROFS. Dedication may be performed by the manufacturer of the item, a third-party dedicating entity, or the licensee itself. The dedicating entity, pursuant to 10 CFR 21.21(c), is responsible for identifying and evaluating deviations, reporting defects and failure to comply for the dedicated item, and maintaining auditable records of the dedication process. In cases where the Licensee applies the commercial-grade item procurement strategy and performs the dedication process, the licensee would assume full responsibility as the dedicating entity.*

*When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), the dedicating entity is the licensee. The licensee, pursuant to 10 CFR 21.21(c), is responsible for reporting defects and failure[s] to comply for the dedicated item, maintaining auditable records of the dedication process, and assumes full responsibility as the dedicating entity.*

#### 1.2.3.7.7 Exemption to Criticality Accident Alarm System Requirements

In Section 1.2.5.7 of the LA (GLE, 2011b), the applicant requested an exemption for the use of a Criticality Accident Alarm System (CAAS) to cover the UF<sub>6</sub> Cylinder Storage Pads, the Trailer Storage Area, and the UF<sub>6</sub> Cylinder Staging Area. In Section 5.3.6.3 of this SER, the staff evaluated the request for an exemption to 10 CFR 70.24 for the UF<sub>6</sub> Cylinder Storage Pads, Trailer Storage Area, and UF<sub>6</sub> Cylinder Staging Area and the risk levels associated with granting the exemption. Based on this review, the staff finds that there is a low risk of a criticality

accident with product cylinders in these areas. In addition, the staff finds that the installation of a CAAS in these areas would not significantly reduce the risk to the workers or the public.

Under 10 CFR 70.17, the Commission may grant exemptions from the requirements of the regulations as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. NRC staff evaluated the exemption request and determined that such exemption is not prohibited by law. Staff also determined that the installation of a CAAS in the UF<sub>6</sub> Cylinder Storage Pads, the Trailer Storage Area, and the UF<sub>6</sub> Cylinder Staging Area would not significantly reduce the risk to the workers or the public because there is a low risk of a criticality accident with product cylinders in these areas. Therefore, the approach will not endanger life or property or the common defense and security. Because the proposed approach will reduce the applicant's expenses in implementing its nuclear criticality safety program, the staff has determined that the proposed approach will be in the public interest by reducing unnecessary regulatory costs. Therefore, the staff grants the requested exemption as provided in Section 1.2.5.7 of the LA (GLE, 2011b). The following license condition will be included in the license to address the applicant's proposed changes to the CAAS program:

*The Licensee is granted an exemption to the requirements in 10 CFR 70.24, which require the Licensee to maintain a criticality accident alarm system, for the UF<sub>6</sub> Cylinder Storage Pads, the Trailer Storage Area, and the UF<sub>6</sub> Cylinder Staging Area.*

#### 1.2.3.7.8 Exemption to Criticality Accident Alarm System ISA Requirements

The regulations in 10 CFR 70.65(b)(4) require that the ISA Summary contain information that demonstrates compliance with the criticality monitoring and alarm requirements of 10 CFR 70.24. The ISA Summary (GLE, 2011a) did not contain sufficient information regarding the CAAS, because the detailed CAAS designs have not been completed at this time. Because a criticality cannot occur if there is no fissionable material onsite, an operating CAAS is not needed until the applicant obtains licensed material. Therefore, the staff is granting an exemption to the requirements in 10 CFR 70.65(b)(4) and is imposing the following license condition to ensure that the regulatory requirement is met before the licensee obtains licensed material:

*The Licensee is granted an exemption to the requirements in 10 CFR 70.65(b)(4) to require that the ISA Summary contain information that demonstrates compliance with the criticality monitoring and alarm requirements of 10 CFR 70.24. At least 90 days prior to obtaining licensed material, the Licensee shall submit to the NRC for approval the Criticality Accident Alarm System design information to demonstrate compliance with 10 CFR 70.65(b)(4) for all areas for which the NRC has not granted an exemption to 10 CFR 70.24, and in which special nuclear material is handled, used, stored, or transported (including outdoor transport routes), and include this information in the ISA Summary.*

Under 10 CFR 70.17, the Commission may grant exemptions from the requirements of the regulations as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. NRC staff determined that such exemption is not prohibited by law. The applicant indicated that CAAS coverage will be necessary for the Operations Building (except the laser area, which does not contain SNM), classified storage area, and unclassified storage area. These areas plus those areas where an

exemption to the CAAS requirements have been requested in Section 1.2.5.7 of the LA (GLE, 2011b) covers the primary areas where fissile material is expected to be handled, used, or stored. Coverage of transport paths between these areas was not listed in the LA (GLE, 2011b); however, coverage of these areas is expected and can be verified once the final CAAS system layout is determined. The staff determined that the applicant's commitments regarding which areas will have criticality alarms, and with the above imposed license condition, are sufficient to provide reasonable assurance that CAAS coverage of the needed areas of the facility be provided. (There is no need to provide detector coverage in areas where the presence of special nuclear material is not credible, because criticality cannot occur without the presence of fissionable material.) Therefore, the approach will not endanger life or property or the common defense and security. Because the proposed approach will reduce the applicant's expenses in implementing its nuclear criticality safety program, the staff has determined that the proposed approach will be in the public interest by reducing unnecessary regulatory costs. Therefore, the staff grants this exemption.

#### 1.2.3.7.9 Exemption to Material Control and Accounting Requirements

The regulations in 10 CFR 70.74.33(c)(5) require that a licensee establish, document, and maintain a detection program, independent of production, that provides high assurance of detecting:

- i. Production of uranium enriched to 10 percent or more in the U<sup>235</sup> isotope, to the extent that special nuclear material of moderate strategic significance could be produced within any 370 calendar day period;
- ii. Production of uranium enriched to 20 percent or more in the U<sup>235</sup> isotope; and
- iii. Unauthorized production of uranium of low strategic significance.

In Section 9 of the Fundamental Nuclear Material Control Plan (FNMCP) (GLE, 2010a), the applicant described a program for precluding and detecting unauthorized production of enriched uranium, including monitoring of the enrichment within the process system and monitoring of material quantities against possession limits.

However, because the final facility design is not yet in-place, the applicant has not analyzed potentially credible diversion scenarios by which unauthorized enrichment activities can take place. The staff determined that the applicant needs to provide a detailed analysis of potentially credible diversion scenarios by which unauthorized enrichment activities and unauthorized production of enriched uranium could occur. In addition, the applicant needs to conduct a detailed analysis of the processes and determine, based on the credible diversion scenarios, the management measures that are best suited to satisfy the detection program goals. Therefore, NRC is granting an exemption to 10 CFR 74.33(c)(5) and is imposing the following license condition requiring the submittal of the detailed analyses for review and approval as follows:

*"The Licensee is granted an exemption to the requirements in 10 CFR 74.33(c)(5) to require that a licensee establish, document, and maintain a materials control and accounting detection program, independent of production. To meet the requirements of 10 CFR 74.33(c)(5) for establishing a detection program for unauthorized enrichment activities, the Licensee shall submit for review and approval 90 days prior to receipt of licensed material, a description of its detection program for unauthorized enrichment activities to include a detailed analysis of conceptual and credible diversion scenarios for unauthorized production of enriched uranium, and related management measures that*

*provide high assurance of detecting unauthorized production of enriched uranium. NRC approval of the detection program, as required under 10 CFR 74.33(c)(5), is required prior to the Licensee's receipt of licensed material."*

Under 10 CFR 70.17, the Commission may grant exemptions from the requirements of the regulations as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. NRC staff determined that such exemption is not prohibited by law. The applicant indicated that because a final facility design is not yet in-place, it cannot provide a detailed analysis of potentially credible diversion scenarios by which unauthorized enrichment activities and unauthorized production of enriched uranium could occur. The staff determined that the applicant's commitments in the FNMCP (GLE, 2010a) with the above imposed license condition are sufficient to provide reasonable assurance that the detection program required under 10 CFR 74.33(c)(5) can be established, documented, and maintained. Therefore, the approach will not endanger life or property or the common defense and security. Because the proposed approach will reduce the applicant's expenses in implementing its material control and accounting program, the staff has determined that the proposed approach will be in the public interest by reducing unnecessary regulatory costs. Therefore, the staff grants this exemption.

#### 1.2.3.8 Security of Classified Matter

The purpose of this review is to verify that the applicant provided sufficient information to conclude that there is an adequate Standard Practice Procedures Plan (SPPP) for the protection of classified matter for the buildings and facilities associated with the proposed facility to be located in Wilmington, North Carolina, and a facility clearance can be issued.

The applicant submitted its "Standard Practice Procedures Plan (SPPP) for the Protection of Classified Matter for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility," SPPP-03, (GLE, 2010b) for the proposed facility with its LA (GLE, 2011b). SPPP-03 (GLE, 2010b) addresses the applicant's proposed classified information security programs. SPPP-03 (GLE, 2010b) outlines the facility's proposed security procedures and controls to ensure that classified matter is used, processed, stored, reproduced, transmitted, transported, and destroyed in accordance with the requirements of 10 CFR Part 95. In addition to SPPP-03 (GLE, 2010b), submitted with the LA (GLE, 2011b), the applicant also has an approved SPPP, "Standard Practice Procedures Plan for the Protection of Classified Matter Global Laser Enrichment Wilmington NC Facility," SP-01, (GLE, 2011e) for existing applicant facilities. In the future, when detailed design of the commercial facility is available, the applicant may combine SP-01 (GLE, 2011e) and SPPP-03 (GLE, 2010b) into a single SPPP. Such a consolidation of the plans would require NRC approval under the change process presented in Section 1.2 of SPPP-03 (GLE, 2010b). In the meantime, however, the applicant will maintain the two separate plans.

#### 1.2.3.8.1 Regulatory Requirements

The regulations in 10 CFR 70.22(m) require applicants to provide a full description of a security program to protect against theft, and to protect against unauthorized viewing of classified enrichment equipment, and unauthorized disclosure of classified matter in accordance with the requirements of 10 CFR Parts 25 and 95. The regulations in 10 CFR 95.15(b) address the application requirements for a SPPP.

#### 1.2.3.8.2 Regulatory Acceptance Criteria

The applicant's SPPP-03 (GLE, 2010b) was reviewed for compliance with the requirements of 10 CFR Part 95, by using "Standard Practice Procedures Plan Standard Format and Content for the Protection of Classified Matter for NRC Licensees, Certificate Holder, or Other Activities as the Commission May Determine" (NRC, 2006b). In addition, the staff also used the recommendations in Nuclear Energy Institute (NEI) 08-11, "Information Security Program Guidelines for Protection of Classified Material at Uranium Enrichment Facilities" (NEI, 2009).

#### 1.2.3.8.3 Staff Review and Analysis

The staff reviewed and evaluated information provided by the applicant in the facility's proposed security procedures and controls to ensure that classified matter is used, processed, stored, reproduced, transmitted, transported, and destroyed in accordance with the requirements of 10 CFR Part 95 and found it to satisfy the requirements of 10 CFR Part 95. The applicant made commitments in SPPP-03 (GLE, 2010b) to meet the requirements of 10 CFR Part 95 by providing an acceptable SPPP that establishes controls to ensure that classified matter is used, processed, stored, reproduced, transmitted, transported, and destroyed only under conditions that will provide adequate protection and prevent access by unauthorized persons. SPPP-03 (GLE, 2010b) is also consistent with the guidelines in NEI 08-11 (NEI, 2009). The FOCI review required by 10 CFR 95.17 is discussed in Section 1.2.3.2 of this SER. By meeting these requirements, the applicant complies with the requirements of 10 CFR 70.22(m). On the basis of these findings, the staff concludes that SPPP-03 (GLE, 2010b) is acceptable. Final approval for implementation of SPPP-03 (GLE, 2010b) will not occur until the commercial facility buildings and associated facilities are constructed and inspected to ensure compliance with commitments in SPPP-03 (GLE, 2010b) and the requirements in 10 CFR Part 95.

### 1.2.4 EVALUATION FINDINGS

The staff reviewed the institutional information for the proposed uranium enrichment facility, according to Section 1.2 of NUREG-1520 (NRC, 2002). The applicant has adequately described and documented the corporate identity, structure, and financial information, and is in compliance with those parts of 10 CFR 30.32, 10 CFR 40.31, 10 CFR 70.22, and 10 CFR 70.65 related to institutional information.

The staff reviewed the information provided on financial qualifications. The NRC staff finds that, based on the financial information submitted in the application describing the applicant's current and continuing access to the financial resources necessary to engage in the proposed activity, there is reasonable assurance that the applicant is financially qualified to build and operate the proposed uranium enrichment facility subject to the following license condition:

*Construction of each 1 million Separative Work Unit phase shall not commence before funding for that increment is available or committed. Prior to initiation of such phase, the licensee shall make available for NRC inspection, documentation of the budgeted costs, the source of funds available or committed, and changes to actual costs or funding of previous phases.*

The staff reviewed the information provided by the applicant on liability insurance. This information meets the requirements of 10 CFR 140.13b. Because full liability insurance coverage is not currently in place, NRC staff is imposing the following license condition:

*The licensee shall provide proof of full liability insurance as required by 10 CFR 140.13b, at least 30 days prior to the planned date for obtaining licensed material. If the licensee is proposing to provide less than \$200 million of liability insurance coverage, the licensee shall provide, to the NRC for review and approval, an evaluation supporting liability insurance coverage in amounts less than \$200 million at least 120 days prior to the planned date for obtaining licensed material.*

The staff reviewed the applicant's request for possessing uranium enriched in  $^{235}\text{U}$  up to 8 weight percent. If a license is issued and operations begin at the proposed facility, the applicant is not anticipated to initially produce uranium above 5 weight percent because no demand for enriched product above this amount is expected during the next several years. However, before operations to produce uranium above 5 weight percent in initiated, NRC staff is imposing the following license condition to ensure that appropriate programs are in-place to identify the necessary equipment and operational programs, including the availability of appropriate transportation containers:

*The licensee shall provide a minimum 60-day notice to NRC before initial customer product withdrawal of licensed material exceeding 5 weight percent  $^{235}\text{U}$  enrichment. This notice shall identify the necessary equipment and operational changes to support customer product shipments for these assays.*

In addition, in accordance with 10 CFR 30.32, 10 CFR 40.31, and 10 CFR 70.22(a)(2) and (4), the applicant has adequately described the types, forms, and quantities and proposed purpose and authorized uses of licensed materials to be permitted at the facility.

The applicant provided information on five exemption requests and two special authorizations. The exemption requests are related to ICRP Publication 68 (ICRP, 1995a) dose modeling recommendations, decommissioning funding, radioactive material labeling, Part 21.3 definitions, and CAAS requirements and all meet the requirements of 10 CFR 30.11, 10 CFR 40.14, and 10 CFR 70.17, as applicable. The special authorizations relate to the use of NRC recommended guidelines of contamination and exposure rate levels for the release of items for unrestricted use and a process for changing licensee commitments in the LA without NRC approval for changes that do not decrease the effectiveness of the commitments. The special authorization requests are consistent with NRC policy and are acceptable. The following license conditions will be added for the above exemptions and authorizations:

1. *The Licensee shall release materials, equipment, and facilities for unrestricted use in accordance with "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material."*
2. *The licensee shall not make changes to the License Application that decreases the effectiveness of safety commitments, without prior NRC approval. For those changes, the licensee shall submit to the NRC, for review and approval, an application to amend the license. Such changes shall not be implemented until approval is granted.*

*Upon documentation of completion of a change for a facility or process, the licensee may make changes in the facility or process as presented in the Licensee Application, or conduct tests or activities not presented in the License Application, without prior NRC approval, subject to the following conditions:*

- a. There is no degradation in the safety commitments in the License Application; and*
- b. The change, test, or activity does not conflict with any condition specifically stated in the License.*

*Records of such changes shall be maintained, including technical justification and management approval, in dedicated records to enable NRC inspection upon request at the facility. A report containing a description of each such change, and appropriate revised sections to the License, shall be submitted to the NRC within three months of implementing the change.*

- 3. The Licensee is granted an exemption to the requirements in 10 CFR Part 20, Appendix B, related to the use of dose coefficients for determining derived air concentrations and annual limit on intake values, and shall use, in accordance with approved procedures, the derived air concentration and annual limit on intake values based on dose coefficients published in International Commission of Radiological Protection Publication No. 68, "Dose Coefficients for Intakes of Radionuclides by Workers," in lieu of the values in Appendix B of 10 CFR Part 20.*
- 4. The Licensee is granted an exemption to the labeling requirements in 10 CFR 20.1904, and shall instead post areas within Radiological Controlled Areas in which radioactive materials are processed, used, or stored with a sign stating, "Every container in this area may contain radioactive material."*
- 5. The Decommissioning Funding Plan shall be updated as follows:*
  - a. The Licensee shall provide to NRC for review an updated Decommissioning Funding Plan at least six months prior to the planned date for obtaining licensed material, and subsequently, after resolution of any NRC comments, final executed copies of the financial assurance instruments shall be provided to NRC at least 21 days prior to receipt of licensed material. The amount of the financial assurance instrument shall be updated to current year dollars and include any applicable change to the decommissioning cost estimate.*
  - b. In the first executed financial assurance instrument submitted prior to receipt of licensed material, the licensee shall provide full funding for decontamination and decommissioning of the full-size facility.*
  - c. In the first executed financial assurance instrument submitted prior to receipt of licensed material, the licensee shall provide funding for the disposition of depleted uranium tails in an amount needed to disposition the first year of depleted uranium tails generation. The cost estimate shall include an update to the DOE depleted uranium disposition cost*

*estimate. The total amount funded for depleted uranium disposition shall be no less than the updated DOE cost estimate.*

- d. Subsequent updated decommissioning funding estimates and revised funding instruments for facility decommissioning shall be provided for review, at a minimum, every three years. Any proposed reduction in the funding estimate based on operational changes shall be submitted six months prior to the change.*
- e. Subsequent updated decommissioning cost estimates and revised funding instruments for depleted uranium disposition shall be provided for review annually on a forward-looking basis to reflect projections of depleted uranium byproduct generation. The cost estimate shall include an update to the DOE depleted uranium disposition cost estimate. The total amount funded for depleted uranium disposition shall be no less than the updated DOE cost estimate.*

- 6. The Licensee is granted an exemption from the definitions of “basic component,” “commercial grade item,” “critical characteristics,” “dedication,” and “dedicating entity” in 10 CFR Part 21.3, as replaced by the following:*

*Basic Component: A structure, system, or component (SSC), or part thereof, designated as an IROFS identified as QL-1 or QL-2, that affects the IROFS function, that is directly procured by the licensee of a facility or activity subject to the regulations in 10 CFR 70 and in which a defect or failure to comply with any applicable regulation in 10 CFR 70, order, or license issued by the U.S. Nuclear Regulatory Commission could create a substantial safety hazard (i.e., exceed the performance requirements of 10 CFR 70.61). Basic Components include QL-1 and QL-2 identified IROFS-related design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services that are associated with the component hardware, whether these services are performed by the component supplier or others.*

*When applied to IROFS identified as QL-NFPA, a basic component is a SSC, or part thereof, that affects the safety function of the IROFS that is directly procured by the licensee or a facility or activity subject to the requirements of the National Fire Protection Association (NFPA) Code of Record, and in which a defect or failure to comply with requirements of the NFPA Code of Record could create a substantial safety hazard. Basic component includes QL-NFPA identified IROFS-related design, analysis, inspection, testing, fabrication, replacement of parts, or consulting services that are associated with the component hardware, whether these services are performed by the component supplier or others, to the extent required by the NFPA Code of Record.*

*Commercial-Grade Item: An SSC, or part thereof, that affects its QL-1 and/or QL-2 identified IROFS function, which is not designed and manufactured as a Basic Component. Commercial-grade items do not include items where the design and manufacturing processes require in-process inspections and verifications to ensure that defect or failures to comply are identified and corrected (i.e., one or more critical characteristics of the item cannot be verified).*



*When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), commercial grade item means an item that is (1) not subject to design or specification requirements that are unique to facilities or activities; (2) used in applications other than those facilities and activities; and (3) to be ordered from the manufacturer/supplier on the basis of specifications set forth in the manufacture[r]'s published product description.*

*Critical Characteristics: Those important to design, material, and performance characteristics of a commercial-grade item that, once verified, will provide reasonable assurance that the item will perform its intended QL-1 and/or QL-2 identified IROFS function.*

*When applied to items identified as QL-NFPA, critical characteristics are those important to design, material, and performance characteristics of a commercial grade item that will provide reasonable assurance that the item will perform its intended QL-NFPA identified IROFS function.*

*Dedication: An acceptance process undertaken to provide reasonable assurance that a commercial-grade item to be used as a Basic Component will perform its intended QL-1 and/or QL-2 IROFS function and, in this respect, is deemed equivalent to an item designed and manufactured under QL-1 or QL-2 requirements in accordance with the QAPD. This assurance is achieved by identifying the critical characteristics of the item and verifying their acceptability by inspections, tests, or analyses performed by the purchaser or third-party dedicating entity after delivery, supplemented as necessary by one or more of the following: commercial grade surveys, product inspections or witness at holdpoints at the manufacturer's facility, and analysis of historical records for acceptable performance. In all cases, the dedication process must be conducted in accordance with the applicable provisions of the QAPD. The process is considered complete when the item is designated for use as a basic component applicable to QL-1 and/or QL-2 IROFS.*

*When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), the dedication process is applied to commercial-grade items to be used as basic components to provide reasonable assurance that they will perform their intended QL-NFPA identified IROFS function and are deemed equivalent to an item designed and manufactured under QL-NFPA requirements in accordance with the QAPD. This assurance is achieved by confirming that the commercial-grade item is manufactured to established, acceptable national codes or standards that include one or more independent product endorsement based on qualification testing or periodic testing of selected characteristics of the item except in cases where such listing/approval is not required by codes and standards. In all cases, the applicable provisions of the QAPD will be used to conduct the dedication process. The process is considered complete when the commercial-grade item is designated as a basic component.*

*Dedicating Entity: The organization that performs the dedication process for QL-1 and QL-2 identified IROFS. Dedication may be performed by the manufacturer of the item, a third-party dedicating entity, or the licensee itself. The dedicating entity, pursuant to 10 CFR 21.21(c), is responsible for identifying and evaluating*

*deviations, reporting defects and failure to comply for the dedicated item, and maintaining auditable records of the dedication process. In cases where the Licensee applies the commercial-grade item procurement strategy and performs the dedication process, the licensee would assume full responsibility as the dedicating entity.*

*When applied to items identified as QL-NFPA (being items in facilities and activities licensed pursuant to 10 CFR 70), the dedicating entity is the licensee. The licensee, pursuant to 10 CFR 21.21(c), is responsible for reporting defects and failure[s] to comply for the dedicated item, maintaining auditable records of the dedication process, and assumes full responsibility as the dedicating entity.*

7. *The Licensee is granted an exemption to the requirements in 10 CFR 70.24, which require the Licensee to maintain a criticality accident alarm system, for the UF<sub>6</sub> Cylinder Storage Pads, the Trailer Storage Area, and the UF<sub>6</sub> Cylinder Staging Area.*
8. *The Licensee is granted an exemption to the requirements in 10 CFR 70.65(b)(4) to require that the ISA Summary contain information that demonstrates compliance with the criticality monitoring and alarm requirements of 10 CFR 70.24. At least 90 days prior to obtaining licensed material, the Licensee shall submit to the NRC for approval Criticality Accident Alarm System design information to demonstrate compliance with 10 CFR 70.65(b)(4) for all areas in which NRC has not granted an exemption to 10 CFR 70.24, and in which special nuclear material is handled, used, stored, or transported (including outdoor transport routes), and include this information in the ISA Summary.*
9. *“The licensee is granted an exemption to the requirements in 10 CFR 74.33(c)(5) to require that a licensee establish, document, and maintain a materials control and accounting detection program, independent of production. In order to meet the requirements of 10 CFR 74.33(c)(5) for establishing a detection program for unauthorized enrichment activities, the applicant shall submit for review and approval 90 days prior to receipt of licensed material, a description of its detection program for unauthorized enrichment activities to include a detailed analysis of conceptual and credible diversion scenarios for unauthorized production of enriched uranium, and related management measures that provide high assurance of detecting unauthorized production of enriched uranium. NRC approval of the detection program, as required under 10 CFR 74.33(c)(5), is required prior to the Licensee’s receipt of licensed material.”*

The NRC staff reviewed the applicant’s SPPP for the protection of classified matter (GEH, 2010c) and found it to satisfy the requirement of 10 CFR Part 95. The staff concludes that the applicant has met the requirements and acceptance criteria applicable to this section.

### **1.3 SITE DESCRIPTION**

The purpose of a site description review is to determine whether the information provided by an applicant adequately describes the geographic, demographic, meteorological, geologic, hydrologic, and seismologic characteristics of the site and the surrounding area. The site

description is a summary of the information that the applicant used in preparing the Environmental Report (ER), Emergency Plan, and ISA Summary.

### 1.3.1 REGULATORY REQUIREMENTS

The regulations in 10 CFR 30.33, 10 CFR 40.32, 10 CFR 70.22(a), and 10 CFR 70.65(b)(1) require each application to include a general description of the site, with emphasis on those factors that could affect safety (i.e., nearby facilities, meteorology, and seismology).

### 1.3.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA

The acceptance criteria applicable to the NRC review of the site description section of the application are contained in Section 1.3.4.3 of NUREG-1520 (NRC, 2002). The applicant's site description will be found acceptable if it describes the site geography, demographics, meteorology, hydrology, geology, and seismology in a manner that is consistent with the detailed information in the ISA Summary, the ER, and the emergency plan.

### 1.3.3 STAFF REVIEW AND ANALYSIS

#### 1.3.3.1 Site Geography

##### 1.3.3.1.1 Location

The site geography of the proposed site is described in Section 1.3.1 of the LA (GLE, 2011b) and Sections 2.1, 2.2, 2.3, and 2.4 of the ISA Summary (GLE, 2011a).

The proposed site is in Wilmington, North Carolina, on about 40 hectares (100 acres) in the north-central sector of an existing 656-hectare (1621-acre) site owned by GE 9.6 kilometers (km) (6 miles (mi)) north of the City of Wilmington. The site is located west of North Carolina Highway 133, Castle Hayne Road, and north of Interstate 140, which borders the south side of the GE property. The Northeast Cape Fear River borders the GE property to the west. Figure 1-2 in the LA (GLE, 2011b) shows the location of the proposed facility in relation to the City of Wilmington, the Northeast Cape Fear River, local communities, Wilmington International Airport, and Interstate Highways I-40 and I-140. Figure 1-3 in the LA (GLE, 2011b) depicts the GE property boundary and the proposed enrichment facility controlled area boundary.

Vehicular access to the site is from two entrances on Castle Hayne Road and the Interstate I-40 interchange at Castle Hayne Road. There is no rail access to the site.

The proposed site is typical of coastal North Carolina, with gently rolling land with rivers, creeks, swamps, and marshlands. The site has an average elevation of 12.2 meters (m) (40 feet (ft)) above sea level. The site is partially developed and GE operates a nuclear fuel manufacturing facility, a nuclear components service center, and an aircraft engine manufacturing facility at the location. The area in the immediate vicinity of the GE property contains farms, single-family residences, and light commercial operations.

The nearest communities are Wrightsboro, located to the south of the proposed site, Skippers Corner to the east, and Castle Hayne to the north.

#### 1.3.3.1.2 Nearby Highways

The applicant discusses nearby highways in Section 2.2.1 of the ISA Summary (GLE, 2011a). Several highways and roads are either near or at the boundary of the GE site. The shortest distance from the proposed facility site is more than 3,200 m (10,500 ft) to Interstate Highway I-40; more than 1,370 m (4,500 ft) to Interstate Highway I-140; more than 1,920 m (6,300 ft) to North Carolina Highway 133; and fewer than 457 m (1,500 ft) to a local road north of the site (GLE, 2011a).

#### 1.3.3.1.3 Railroads

The applicant discusses nearby railroads in Section 2.2.2 of the ISA Summary (GLE, 2011a). The CSX Corporation provides freight service to the region and the nearest railroad line is more than 1,610 m (5,280 ft) away from the proposed facility. There is no railroad access at the GE site.

#### 1.3.3.1.4 Waterways

The applicant discusses nearby waterways in Section 2.2.3 of the ISA Summary (GLE, 2011a). Several waterways that may maintain waterborne barges are near the proposed site. The proposed facility is 4,800 m (15,800 ft) from Cape Fear River; 1,600 m (5,400 ft) from Northeast Cape Fear River; and more than 8,000 m (26,400 ft) from the Intracoastal Waterway and Port of Wilmington (GLE, 2011a). The distance from the proposed facility is approximately 1,201 m (3,940 ft) for the west-south-west portion, 2,697 m (8,850 ft) for the north-northwest portion, and 2,312 m (7,585 ft) for the north-northeast portion of the Northeast Cape Fear River.

#### 1.3.3.1.5 Nearby Industrial Facilities

The applicant discusses nearby industrial facilities in Section 1.3.2.4 of the LA (GLE, 2011b) and Section 2.4 of the ISA Summary (GLE, 2011a). The nearest facilities to the proposed facility include Global Nuclear Fuel–Americas, LLC (GNF-A) Fuel Manufacturing Operations Facility, the GE Aircraft Engines Operation, the GE Services Components Operation Facilities, the GE Fuel Components Operation Facility, and the Wilmington Field Service Center. These facilities are located on the GE site. Among these facilities, the GNF-A Fuel Manufacturing Operations Facility is the closest with a distance of more than 1,737 m (5,700 ft).

Other industrial facilities that are more than 8 kilometers (km) (5 miles (mi)) away and located on the western side of the Northeast Cape Fear River (GLE, 2011a; GLE, 2011b). These operations include the BASF Corporation, Elementis Chromium facilities, and the L.V. Sutton coal-fired power plant owned by Progress Energy.

The GE site is zoned for heavy industrial use and no agricultural activities take place on the site.

#### 1.3.3.1.6 Nearby Air Transportation

The applicant discusses nearby airports in Section 2.2.4 of the ISA Summary (GLE, 2011a). There are 13 airports in the tri-county area (New Hanover, Pender, and Brunswick): one primary commercial airport (New Hanover County Airport) and 12 small municipal airport facilities (GLE, 2011a). Brunswick County has seven small airports including heliports. Pender County has four small airports. Besides the New Hanover County Airport (Wilmington International Airport), New Hanover County also has a small airport (Pilot Ridge) located

approximately 18.5 km (11.5 mi) from the proposed facility site. Among these airports, four are publicly owned (New Hanover County Airport in New Hanover County; Odell Williamson and Brunswick County in Brunswick County; and Henderson Field Airport in Pender County) and the remaining airports are private airports for private use only (GLE, 2011a).

The airport nearest to the proposed facility site is the New Hanover County Airport, approximately 8 km (5 mi) away. The next nearest airport is the Sandy Run Acres Airport in Brunswick County, approximately 16 km (9.9 mi) away. Besides the Pilot Ridge Airport, three airports (Pettigrew Moore Aerodome and Stag Air Park in Pender County and Winnabow Airport in Brunswick County) are between 16 and 24 km (10 and 15 mi) from the proposed facility site. The remaining are more than 32 km (20 mi) away from the proposed site (GLE, 2011a).

#### 1.3.3.1.7 Site Geography Evaluation

NRC staff reviewed the information provided in the LA (GLE, 2011b) and the ISA Summary (GLE, 2011a) on site geography, which included information on the site location, major nearby highways, nearby bodies of water, and other significant features that may affect the accident analysis. The site geographical information meets the regulatory acceptance criteria in Sections 1.3.4.3(1) and 1.3.4.3(5) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable because the applicant provided a summary describing the site geography, including its location relative to prominent natural and man-made features (such as rivers, airports, commercial and manufacturing facilities). The summary also described the site boundary and controlled area boundary. The applicant's descriptions are consistent with the more detailed information in the ISA Summary (GLE, 2011a), the ER (GLE, 2008), and the Radiological Contingency and Emergency Plan (GLE, 2011f). Based on review of the information provided on the site location and geography, staff concludes that the data provided are accurate and from acceptable sources.

#### 1.3.3.2 Demographics

Information about demographics is provided in Section 1.3.2 of the LA (GLE, 2011b).

##### 1.3.3.2.1 Local Population and Land Use

The proposed site is located in the northwest corner of New Hanover County, North Carolina. Approximately 3 km (2 mi) to the north is the Pender County boundary and approximately 3 km (2 mi) to the west is the Brunswick County boundary. Within 8 km (5 mi) of the proposed site, there are 12,997 residents of New Hanover County, 3,305 residents of Pender County, and 36 residents of Brunswick County based on 2000 U.S. Census Bureau data. In the local communities nearest the proposed site, Wrightsboro has 4500 residents, Skippers Corner has about 1200 residents, and Castle Hayne has about 1100 residents.

Land use within 8 km (5 mi) of the proposed site consists of farming, residential neighborhoods, and light commercial activity. The GE property is zoned for heavy industry. Immediately north of the GE property, the land is zoned as rural agricultural and has a low-density residential area, farms, a timber management area, and a private hunting area. Immediately south of the GE property is Interstate Highway I-140 and further south is a residential neighborhood. Immediately east of the GE property is North Carolina Highway 133, an agricultural research station operated by North Carolina State University, residential neighborhoods, and a recreational area for GE employees. To the west of the GE property is the Northeast Cape Fear River. Commercial and recreational fishing occur on the Northeast Cape Fear River.

However, commercial fishing is more prevalent on the Cape Fear River south of the GE property and south of the point where the Northeast Cape Fear River joins it.

#### 1.3.3.2.2 Local Public Services

Fire fighting services are provided locally by New Hanover County and the Castle Hayne Volunteer Fire and Rescue (GLE, 2011b and 2011f). Police and law enforcement services are provided by the New Hanover Sheriff's Department (GLE, 2011f).

Figure 1-6 in the LA (GLE, 2011b) depicts local schools and recreational areas in the vicinity of the GE property. Within 6.4 km (4 mi) of the proposed facility site there is one school. Two more schools are within 8 km (5 mi) of the site and there are 21 schools within 12.8 km (8 mi) of the proposed facility site. The Trask Middle School, within 8 km (5 mi) of the site, serves as a New Hanover County emergency shelter. The nearest hospital is about 10 km (6 mi) from the proposed facility site. There are four New Hanover County parks within the 8 km (5 mi) radius of the proposed site, but no Federal- or State-managed parks.

#### 1.3.3.2.3 Site Demographics Evaluation

The staff reviewed the site demographic information presented by the applicant and finds that the applicant has adequately described and summarized general site demographical information related to local population, identification of population centers, schools, commercial facilities, land use, and water use. Population information is provided based on the latest census information. The applicant's descriptions are consistent with the more detailed information in the ISA Summary (GLE, 2011a), the ER (GLE, 2008), and the Radiological Contingency and Emergency Plan (GLE, 2011f). The information is consistent with the guidance in Sections 1.3.4.3(1), 1.3.4.3(2), and 1.3.4.3(5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 1.3.3.3 Meteorology

##### 1.3.3.3.1 Tornado Hazard

Information about the tornadoes and design-basis tornado at the proposed facility is provided in Sections 1.3.3.6 of the LA (GLE, 2011b), Section 2.5.6 of the ISA Summary (GLE, 2011a), and Section 3.6.2.7.2 of the ER (GLE, 2008).

Based on 54 years of available published data, 15 tornadoes were recorded between 1950 and 2004 in New Hanover County. The strongest tornado was rated F2 on the Fujita scale and occurred in the neighboring Brunswick County. No F4 and F5 tornadoes were recorded in North Carolina and all tornadoes occurred in the Wilmington area are either F1 or F0 tornadoes (GLE, 2011a and GLE, 2011b).

Based on these historical tornado records, the applicant determined that an F2 tornado estimate with a 3-second gust speed equivalent of 179–217 kilometers per hour (km/hour) (111–135 miles per hour (mph)) based on the Enhanced Fujita scale for the site would be conservative (GLE, 2011a and GLE, 2011b). This estimate is comparable with the 225 km/hr (140 mph) tornado wind speed with an annual probability of  $10^{-5}$  provided in NUREG/CR-4461, "Tornado Climatology of the Contiguous United States, Revision 2" (NRC, 2007a), for the Wilmington area. The applicant also indicated that this wind speed is bounded by the wind speed identified for hurricanes.

The applicant further conducted an assessment of the probabilities of tornadoes affecting the proposed facility using the expected travel distance of an F5 tornado (NRC, 2007a) and the historical tornado information for the tri-county area (New Hanover, Brunswick and Pender) (NOAA, 2010). The applicant concluded that the annual probability for a tornado with the intensity greater than F1 is near or less than  $10^{-5}$ .

The applicant further defined the tornado-generated missiles based on Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," Revision 1 (NRC, 2007b). These missiles include a schedule 40 steel pipe, automobile, and a solid steel sphere with dimensions, weights, and associated impact speeds.

Based on the review of the information concerning tornados and tornado-generated missiles, the information provided by the applicant meets the regulatory acceptance criteria in Sections 1.3.4.3(3) and (5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because the applicant provided appropriate meteorological data and design basis information on tornados and tornado-generated missiles that is accurate and is from reliable sources.

#### 1.3.3.3.2 High Winds and Hurricanes

In Section 1.3.3 of the LA (GLE, 2011b), Sections 2.5.5 and 2.5.7 of the ISA Summary (GLE, 2011a), and Section 3.6 of the ER (GLE, 2008), the applicant discusses the site meteorology, high winds, and hurricanes. Prevailing winds at the proposed facility site are from north and southwest. The mean hourly wind has a mean high of 20.1 km/hr (12.5 mph) and a mean low of 9.5 km/hr (5.9 mph). The highest wind gust recorded was approximately 138 km/hr (86 mph) measured at the New Hanover County airport (Wilmington International Airport) during Hurricane Fran in 1996 and Hurricane Floyd in 1999. Based on this information, the applicant concluded that straight winds are not a controlling parameter to determine the design basis wind speed for the proposed facility. The NRC staff agrees with the applicant's conclusion because, as discussed in the following paragraphs, hurricane winds define the design basis wind speed.

In Section 2.5.5 of the ISA Summary (GLE, 2011a), the applicant indicated that the hurricane hazards could be from winds and flooding. The 50-year (1954–2004) historical data for the New Hanover County, where the proposed facility is located, three hurricanes were recorded; two of these (Hazel in 1954 and Fran in 1996) were Category 3 hurricanes and the remaining one was a Category 1 hurricane. Based on these historical data, the applicant determined that the maximum potential hurricane hazards from a Category 4 hurricane should be a bounding case. The Category 4 hurricane has a 3-sec gust wind speed of 253.5 km/hr (157.5 mph).

In Section 1.3.3.3.2 of the LA (GLE, 2011b) and Section 2.5.7 of the ISA Summary (GLE, 2011a), the applicant discussed site flooding hazards. Flooding caused by hurricane to the proposed facility may be in the form of rainfall, high tides, and storm surge. Citing Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants," Revision 2 (NRC, 1977), the applicant indicated that the maximum probable surge along the North Carolina coast can be as high as 6.7 m (21.9 ft). Because the proposed facility is located at an elevation of 7.6 m (25 ft) above sea level and is 32 km (20 mi) upstream from the ocean (GLE, 2011a and GLE, 2011b), the storm surge from a hurricane is highly unlikely to reach the facility horizon. Therefore, the applicant concluded that the storm surge from a hurricane is not a safety concern.

Based on the review of the information concerning high winds and hurricanes, the information provided by the applicant meets the regulatory acceptance criteria in Section 1.3.4.3(3) and (5)

of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; and (2) the applicant provides design-basis information for severe high wind and hurricane conditions applicable to the site.

#### 1.3.3.3.3 Temperature Extremes

In Section 1.3.3.3.1 of the LA (GLE, 2011b), Section 2.5.7.2 of the ISA Summary (GLE, 2011a), and Section 3.6.2.6.1 of the ER (GLE, 2008), the applicant discussed temperature extremes applicable to the GE site. Based on National Weather Service temperature measurements at the Wilmington International Airport, the mean annual maximum and minimum temperatures are 23.3°C (74.0°F) and 11.9°C (53.5°F), respectively. The maximum temperature recorded is 40°C (104.0°F), and the minimum temperature recorded is -18°C (0.0°F). The applicant stated that the proposed facility would be located in a moderate climatologic environment due to its proximity to the Atlantic Ocean, and it will select construction materials appropriate for this moderate climatologic environment. Consequently, the applicant concluded that extreme temperatures of -18°C (0.0°F) and 40°C (104.0°F) are not safety concerns for the facility.

Based on the review of the information concerning extreme temperatures, the information provided by the applicant meets the regulatory acceptance criteria in Sections 1.3.4.3(3) and (5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; and (2) the applicant provides design-basis information for severe temperature conditions applicable to the site. Based on the temperature data the applicant presented, the NRC staff agrees with the applicant assessment that the facility site is in a moderate climatologic environment and temperature extremes are not a concern to the proposed facility performance.

#### 1.3.3.3.4 Extreme Precipitation

In Section 1.3.3.3.2 of the LA (GLE, 2011b), Section 2.5.7 of the ISA Summary (GLE, 2011a), and Section 3.6.2.6.2 of the ER (GLE, 2008), the applicant discussed extreme precipitation. Based on the National Oceanic and Atmospheric Administration (NOAA) record from 1971 to 2000 (NOAA, 2004), the applicant indicated that the highest 24-hour rainfall amount recorded at Wilmington International Airport was 34.0 cm (13.4 in) that was caused by Hurricane Floyd (GLE, 2011b). The extreme environmental rainfall is equivalent to the 24-hour all-season extreme local precipitation of 109 mm (4.3 in) estimated by NOAA. The applicant further indicated that Wilmington International Airport has a  $1.0 \times 10^{-3}$  annual exceedance probability of receiving precipitation at a rate of 40.77 centimeters per hour (cm/hr) (16.05 inches per hours (in/hr)) for a duration of 5 minutes.

The applicant estimated the probable maximum precipitation (PMP) for the site for 1, 6, 12, 24, 48, and 72 hour duration (GLE, 2011b) using the guidelines in NOAA Hydrometeorological Reports 51 and 52 (NOAA, 1978 and NOAA, 1982).

Based on the review of the information concerning extreme precipitation, the information provided by the applicant meets the regulatory acceptance criteria in Sections 1.3.4.3(3) and (5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; and (2) the applicant provides design-basis information for extreme precipitation conditions applicable to the site.



#### 1.3.3.3.5 Snow

Section 1.3.3.3.2 of the LA (GLE, 2011b) and Section 2.5.7.1 of the ISA Summary (GLE, 2011a) discuss regional snowfall. The largest snow accumulation recorded in the Wilmington, North Carolina, area was 38.9 cm (15.3 in) on December 22–24, 1989. The maximum amount of snowfall recorded in a 24-hour period was 33 cm (13 in). This amount of snowfall is equivalent to a ground snow load of approximately 0.8–1.1 kilopascals (kPa) (17–22 pounds per square foot (psf)). The applicant used the approach in American Society of Civil Engineers (ASCE) 7–05, “Minimum Design Loads for Buildings and Other Structures” (ASCE, 2006), to estimate the snowfall with an annual probability of  $1.0 \times 10^{-5}$ . The estimated ground snow load for an event with an annual probability of  $1 \times 10^{-5}$  is approximately 0.8–1.2 kPa (17–25 psf). The applicant defined the design basis snow load to be 1.2 kPa (25 psf).

The applicant recognized that snow drift could occur where the roof elevations change. Using the guideline in ASCE 7–05 (ASCE, 2006), the applicant determined that the highest snow load caused by snow drift from roof at high elevation to some portions of the roofs at low elevation could add additional 4.1 kPa (85 psf). The applicant pointed out the snow drift load could cause roof decking to sag or fail. However, the applicant analyzed the potential effect of roof decking failure and determined that such failure would only occur at locations where licensed material or hazardous chemicals produced from licensed material were not present. Therefore, the applicant concluded that the roof decking failure would not cause any high or intermediate consequences.

Based on the review of the information concerning snowfalls, the information provided by the applicant meets the regulatory acceptance criteria in Sections 1.3.4.3(3) and (5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; and (2) the applicant provides design-basis information for severe snow conditions applicable to the site.

#### 1.3.3.3.6 Lightning and Thunderstorms

In Section 1.3.3.3.4 of the LA (GLE, 2011b), Section 2.5.7 of the ISA Summary (GLE, 2011a), and Section 3.6.2.7 of the ER (GLE, 2008), the applicant discusses thunderstorms. In Section 1.3.3.3.5 in the LA (GLE, 2011b) and Section 3.6.2.7.1 of the ER (GLE, 2008), the applicant discusses the lightning hazard at the proposed facility site. The applicant indicated that thunderstorms occur about 33 percent of days during the June to August period and that rainfall during the summer months occurs primarily during these thunderstorms. The applicant also stated that thunderstorms can produce damaging straight-line winds with wind speeds greater than 91 km/hr (57 mph).

The lightning strike frequency in the region surrounding the facility site ranges from 4 to 8 flashes/square kilometer/year (flashes/km<sup>2</sup>/yr) (1.5 to 3.1 flashes/square mile/year (flashes/mi<sup>2</sup>/year)) and approximately 0.2 to 0.4 flashes/km<sup>2</sup>/yr (0.08 to 0.15 flashes/mi<sup>2</sup>/yr) for the proposed facility site. The facility site area is approximately 0.5 km<sup>2</sup> (0.02 mi<sup>2</sup>).

Based on the review of the information concerning lightning and thunderstorms, the information provided by the applicant meets the regulatory acceptance criteria in Sections 1.3.4.3(3) and (5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; and (2) the applicant provides design-basis information for severe lightning and thunderstorm conditions applicable to the site.

#### 1.3.3.3.7 Floods

Section 1.3.3.3.8 of the LA (GLE, 2011b), Section 2.5.3 of the ISA Summary (GLE, 2011a), and Sections 3.4.3 and 3.6.2.7.4 of the ER (GLE, 2008) discuss potential flooding to the proposed facility site. The site is located more than 16 km (10 mi) inland from the Atlantic Ocean and its closest bodies of water include the Northeast Cape Fear River and its associated tributaries. The applicant indicated that the proposed facility is located above the 100-year and 500-year flood plains for the region.

The potential floods that could affect the proposed facility include flood from rainfall in the Northeast Cape Fear River and Cape Fear River (probable maximum flood (PMF)), flood from local PMP, seismically induced upstream dam failure, hurricane surge, and tsunamis. Flood hazards resulting from hurricane surge and tsunamis are evaluated in Sections 1.3.3.3.2 and 1.3.3.3.8, respectively, of this SER.

The nearest river to the proposed facility site is the Northeast Cape Fear River. This river joins the Cape Fear River 9.7 km (6 mi) south of the site. The applicant calculated the PMF for the Northeast Cape Fear River using the method in American National Standards Institute/American Nuclear Society (ANSI/ANS) 2.8, "Determining Design Basis Flooding at Power Reactor Sites," (ANSI/ANS, 1992) to determine the PMF still water level from the discharge flows and determined that flooding of either river could potentially affect the proposed facility site. The applicant determined that the Northeast Cape Fear River has a discharge capability of 2,549–14,442 cubic meters per second ( $\text{m}^3/\text{sec}$ ) (90,000–510,000 cubic feet per second (cfs)) and a PMF discharge of 8,778  $\text{m}^3/\text{sec}$  (310,000 cfs). However, the applicant indicated that the proposed facility site and the surrounding area is relatively flat with gently sloping surfaces at gradients less than 2 percent and with little relief. The applicant further stated that the proposed facility is located 7.6 m (25 ft) above sea level. This elevation is, in general, the highest level east of the Northeast Cape Fear River. The east side of the Northeast Cape Fear River extends all the way to the coast. The elevation west of the river is also at 7.6 m (25 ft) above sea level for some distance before the elevation gets higher further west. Because of this generally level terrain around the Northeast Cape Fear River, the rise of flood water above the 7.6 m (25 ft) above sea level will be limited and will be a slow process due to the availability of large flat region to accommodate the flood water. The applicant indicated that it is difficult to determine the discharge when the water level reaches 7.6 m (25 ft) above sea level due to the wide variability of the cross sections of the Northeast Cape Fear River above that level. Nevertheless, the applicant estimated that, including coincident wind-wave effects, the design basis water level for the PMF is 8.5 m (28 ft) above sea level for the proposed facility site, which is 0.9 m (3 ft) above the proposed facility floor level. Because the water level rising due to a PMF will be a slow process, the applicant indicated that ample time is available to warn operations personnel and to execute a safe shutdown.

The applicant stated that the PMF from the Cape Fear River with a discharge of twice that from the Northeast Cape Fear River could also flood the site. However, the applicant concluded that the PMF level from the Cape Fear River would not be likely to be more than 7.6 m (25 ft) above sea level based on the same justification used for the Northeast Cape Fear River.

No upstream dams exist on the Northeast Cape Fear River. Several dams exist upstream on the Cape Fear River. These dams are 48 km (30 mi) or more from where the Northeast Cape Fear River joins the Cape Fear River. The applicant indicated that seismically induced dam failure could cause flooding of the proposed facility site; however, the applicant did not expect that such floods could result in a flooding level more than from PMF because of the general

level terrain of the proposed facility site and the general area being an estuary. Also, based on the same reason, the applicant concluded that the local PMP-induced flooding should not be more severe than the PMF.

In Section 1.3.1.2 of the LA (GLE, 2011b), the applicant provided a commitment for safe shutdown of the facilities that handle licensed material before a flood event that could challenge these facilities. This commitment is appropriate for the protection of workers and public safety. This action would be implemented by procedure.

Based on the review of the information concerning site flooding, the information provided by the applicant meets the regulatory acceptance criteria in Sections 1.3.4.3(3) and (5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; and (2) the applicant provides design-basis information for severe flood conditions applicable to the site. In addition, the applicant provided a commitment for safe shutdown of the facilities that handle licensed material before a hurricane event that could challenge these facilities is appropriate for the protection of workers and public safety.

#### 1.3.3.3.8 Tsunami

Section 2.5.4 of the ISA Summary (GLE, 2011a) discusses the probable maximum tsunami at the proposed facility site. The applicant stated that the facility site is more than 16 km (10 mi) away from the coastline and at a high elevation (7.6 m (25 ft) above sea level) compared to the surrounding level terrain. The applicant further indicated that, using NUREG/CR-6966, "Tsunami Hazard Assessment at Nuclear Power Plant Sites in the United States of America - Final Report" (NRC, 2009) as guidance, the proposed facility site can be considered "inland." Thus, the applicant determined that the tsunami hazard to the facility is a highly unlikely event. Additionally, the applicant concluded that tidal bores are also highly unlikely given the distance from the coastline, the quick dissipation as bores travel upstream, and the elevation of the proposed facility that is 7.6 m (25 ft) above mean sea level.

The NRC staff reviewed the applicant's consideration of the tsunami hazard and finds acceptable the applicant's justification and determination that tsunamis are unlikely events. Based on the review of the information concerning tsunamis, the information provided by the applicant meets the regulatory acceptance criteria in Section 1.3.4.3(3) and (5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; and (2) the applicant provides design-basis information for tsunami conditions applicable to the site.

#### 1.3.3.4 Geology

##### 1.3.3.4.1 Seismic Hazard

Seismic hazards are discussed in Section 1.3.5 of the LA (GLE, 2011b); Section 2.5.1 of the ISA Summary (GLE, 2011a); and Section 3.3 of the ER (GLE, 2008).

The staff's review of the seismic hazard applicable to the safety and design of the proposed facility includes:

1. Tectonic Setting;
2. Historic Seismicity; and
3. Seismic Hazard Assessment

The following areas concerning the seismic hazard applicable to the safety analysis and design of the proposed facility were reviewed:

1. Seismic source characterization;
2. Ground motion attenuation;
3. Seismic hazard calculation;
4. Development of site-specific spectra; and
5. Surface faulting.

### Geological and Tectonic Settings

Geologic and tectonic settings are discussed in Section 1.3.5 of the LA (GLE, 2011b), Section 2.5.1 of the ISA Summary (GLE, 2011a), and Section 3.3 of the ER (GLE, 2008). The proposed facility is located on the Atlantic Coastal Plain physiographic province. This province is a broad, low-relief terrace that stretches from along the Atlantic seaboard from New England to the Gulf of Mexico. The site geology is comprised of a wedge of unconsolidated sands, silt, marl, and other clays interbedded with occasional limestone strata which rests atop crystalline basement rocks. As noted in the ISA Summary (GLE, 2011a), the Atlantic Coastal Plain is not tectonically active. Small to moderate magnitude earthquakes occur throughout the region with concentrations in the Appalachian Mountains west of the site and near Charleston, South Carolina. These clusters of earthquakes are considered by the applicant to be associated with relic structures from Appalachian tectonics dating back more than 250 million years ago and from aftershocks related to the 1886 Charleston, South Carolina Earthquake. There are no geologic features in the Wilmington, North Carolina, region that have been identified as being capable of producing significant earthquakes. The U.S. Geological Survey (USGS), "Documentation for the 2008 Update of the United States National Seismic Hazard Maps" (USGS, 2008), has identified this area as Zone 1, with moment magnitudes ( $M_w$ ) less than 6.0 and Modified Mercalli Intensity (MMI) values of VI or less. In the USGS document "Earthquakes in Virginia and Vicinity 1774-2004" (USGS, 2006), USGS describes MMI values of VI as moderate shaking that produces only slight damage to buildings and structures.

### Historic Seismicity

The area around Wilmington, North Carolina, is not seismically active (Powell, 1991). There are no known active fault zones or concentrations of significant historic seismicity in North Carolina. The nearest major seismic event was located approximately 240 km (150 mi) southwest of the proposed facility site, near Charleston, South Carolina. Charleston experienced a large earthquake in 1886, with maximum MMI value of X and an estimated magnitude of 7.3 (USGS, 2008). Paleoseismic information indicates similar earthquakes shook the Charleston, South Carolina, region several times over the past several thousand years (USGS, 2008). A repeat of the Charleston earthquake is considered the most significant source of the seismic hazards for the southeast coast of the United States, including Wilmington, North Carolina (USGS, 2008). Estimates of repeat times for a Charleston earthquake range between 250 and 1,000 years (Talwani, 2001).

Based on an evaluation of several regional earthquake catalogs (USGS, 2006), the applicant identified nearly 900 earthquakes within a 322 km (200 mi) of the site since 1698. Most of these are small with estimated moment magnitudes less than 2.0. The two largest recorded earthquakes in the region occurred on January 18, 1884, and on March 5, 1958. No substantial damage was reported from either earthquake. As described in "Seismic Hazard in North

Carolina” (Powell, 1991), press reports indicate that houses shook and some people were rolled out of bed, suggesting that these two earthquakes had maximum MMI values of V.

### Seismic Hazard Evaluation

In addition to the lack of significant historical earthquakes near the site, the applicant cites the 2008 USGS National Seismic Hazard Maps (USGS, 2008) to conclude that the seismic hazards at the site are not significant to safety. Based on the USGS maps, the proposed facility site has a 2 percent probability in a 50-year period of exceeding a peak-ground acceleration of 0.11 g (g is the acceleration due to gravity). The 2 percent probability in a 50-year period is approximately equal to a return period of 2,500 years or an annual probability of  $4 \times 10^{-4}$ . There is also a 2 percent probability in a 50-year period of exceeding a 1-second spectral acceleration of 0.08 g and a 2 percent probability in a 50-year period of exceeding a 0.2-second spectral acceleration of 0.24 g. The USGS map results are based on an assumed “firm rock” site conditions (Site Class B) with a shear wave velocity of 760 m/s (2,500 ft/s).

The applicant developed seismic design criteria based on a deterministic analysis in accordance with guidance in NUREG-1520, Appendix D, (NRC, 2010) and the 2006 International Building Code (IBC) (ICC, 2006a), following the method for development of the safe shutdown earthquake described in 10 CFR Part 100, Appendix A. In particular, the applicant used two earthquakes to develop the design basis ground motions; a repeat of the 1886 Charleston earthquake located 114 km (71 mi) from the site and a local magnitude 5.0 earthquake 20 km (12.5 mi) from the site. Based on this analysis, the applicant derived ground motions of 0.24 g for the 0.2-second spectral acceleration and 0.09 g for the 1-second spectral acceleration, assuming 5 percent damping. The applicant used the suite of ground motion attenuation models and the weighting scheme for those models as developed in the 2008 update of the United States National Seismic Hazard Maps (USGS, 2008). Because the USGS models assume Site Class B conditions, but soils at the site are Site Class C, the applicant used site amplification coefficients from the IBC (ICC, 2006) to derive design basis ground motions (5 percent damping) of 0.29 g for the 0.2-second spectral acceleration and 0.15 g for the 1-second spectral acceleration.

The NRC staff reviewed the information provided in the LA (GLE, 2011b), including the ISA Summary (GLE, 2011a), and the ER (GLE, 2008). Based on the review of the information concerning site seismicity, the information provided by the applicant meets the regulatory acceptance criteria in Sections 1.3.4.3(4) and (5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; and (2) the applicant provides design-basis information for seismic conditions applicable to the site. While the applicant did not provide 250-year and 500-year earthquakes, it did provide information from the most recent USGS earthquake hazard data (USGS, 2008) and evaluate the most significant historical earthquake in accordance with recent NRC guidance in NUREG-1520, Revision 1, Appendix D (NRC, 2010).

#### 1.3.3.4.2 Slope Stability

Section 1.3.5.3 of the LA (GLE, 2011b) discusses other geologic information for the proposed facility site. The applicant indicated that the proposed facility site is relatively flat with gently sloping surfaces at gradients less than 2 percent and with little relief. The applicant concluded that landslides resulting from slope instability are not a safety concern to the proposed facility. The NRC staff visited the site and concur with the applicant that the proposed facility site does

not have a slope instability concern and hazards associated with slope instability are not credible.

The NRC staff reviewed the information provided in the LA (GLE, 2011b), including the ISA Summary (GLE, 2011a), and the ER (GLE, 2008). Based on the review of the information concerning site slope stability, the information provided by the applicant meets the regulatory acceptance criteria in Sections 1.3.4.3(4) and (5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; and (2) the applicant provides design-basis information for slope stability conditions applicable to the site.

#### 1.3.3.4.3 Liquefaction

In Section 1.3.5.3 of the LA (GLE, 2011b) and Section G.5 of Appendix G of the ER (GLE, 2008), the applicant discussed soil liquefaction potential at the proposed site. The applicant assessed liquefaction potential at the proposed facility site through geotechnical investigations using soil data from two borings (GLE, 2011b and GLE, 2008). The applicant indicated that the soils in the two borings represent the highest and lowest potential for liquefaction (GLE, 2008). The assessment compared the calculated cyclic stress ratio to the calculated cyclic resistance ratio. In general, when a cyclic stress ratio is greater than the cyclic resistance ratio, liquefaction is likely. The applicant determined the cyclic stress ratio using the peak horizontal ground acceleration of 0.139 g (corresponding to the design earthquake with a return period of 2,500 year) based on the USGS maps included in the 2006 North Carolina Building Code (ICC, 2006b). The assessment results suggest marginal risk of localized liquefactions at depths of 8 and 12 m (25 and 40 ft) for soils in one boring, whereas the soils in the other boring do not have a liquefaction risk. The cyclic stress ratio for the soil at the depth of 8 m (25 ft) is approximately 20 percent larger than the cyclic resistance ratio, and it is nearly the same for the soil at the depth of 12 m (40 ft). Based on this assessment, the applicant concluded that soil liquefaction potential is small at the proposed site for a peak horizontal ground acceleration of 0.139 g.

The applicant committed to conduct a more detailed evaluation during the final subsurface investigation using the guidance in Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants," Revision 2 (NRC, 2003a), to more accurately estimate the cyclic stress ratios and cyclic resistance ratios for the soils at the final structure location. This supports design consideration on liquefaction potential using the guidance in Regulatory Guide 1.198, "Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites" (NRC, 2003b). The applicant further committed to assess liquefaction potential and its effects on operational safety using a horizontal ground acceleration consistent with the ground motion with an annual probability of  $1.0 \times 10^{-5}$ .

The NRC staff evaluated the liquefaction potential results the applicant presented in Tables G-7 and G-8 in Appendix G of the ER (GLE, 2008) using the cyclic resistance ratio curves for various fines contents in the cyclic stress ratio-blow count diagram recommended by the National Center for Earthquake Engineering Research, "Proceedings of the National Center for Earthquake Engineering Research Workshop on Evaluation of Liquefaction Resistance of Soils" (NCEER, 1997), and find the applicant's assessment results are reasonable and acceptable.

The staff reviewed the liquefaction and geotechnical investigation information presented in the LA (GLE, 2011b) and the ER (GLE, 2008) and concurs with the applicant that the potential for liquefaction of soils at the site is unlikely to be a safety concern for the proposed facility. The applicant committed in Section 1.3.5.3 of the LA (GLE, 2011b) to perform additional

geotechnical investigations at the site to confirm that liquefaction is not a safety concern for the proposed facility. Additional site testing will be evaluated in accordance with NRC Regulatory Guide 1.198, (NRC, 2003b).

The NRC staff reviewed the information provided in the LA (GLE, 2011b) and the ER (GLE, 2008). Based on the review of the information concerning site liquefaction potential, the information provided by the applicant meets the regulatory acceptance criteria in Sections 1.3.4.3(4) and (5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; (2) the approach the applicant plans to use to confirm its conclusion that liquefaction of the soils at the final structure location is not a safety concern is consistent with NRC guidance; and (3) the applicant provides design-basis information for site liquefaction potential conditions applicable to the site. Because the applicant committed to follow accepted guidelines for conducting more detailed liquefaction and geotechnical investigations, the staff considers this acceptable as results of these future investigations will be evaluated in the NRC's inspections prior to the issuance of the approval for operations required under 10 CFR 40.41(g) and 70.32(k).

#### 1.3.3.4.4 Settlement and Soil-Bearing Capacity

In Sections 1.3.5.1 and 1.3.5.3 of the LA (GLE, 2011b), the applicant discussed potential for differential settlement. The applicant indicated that it will consider the potential for differential settlement across a foundation when preparing facility and roadway engineering designs. In addition, in Sections 3.3.4.3 and 3.3.5 of the ER (GLE, 2008), the applicant provided soil information and discussed the preliminary geophysical and geotechnical investigation results it used to assess feasibility of this proposed site for construction of the proposed facility. To support structural design, the applicant further committed to conduct a geotechnical investigation (GLE, 2011b). This investigation will be performed in accordance with established geotechnical methods.

To assess total and differential settlements for structural foundations, the applicant plans to use methods provided in U.S. Naval Facilities Engineering Command (NAVFAC) Design Manual 7 (NAVFAC, 1986), "Foundation Engineering Handbook" (Fang, 1990), and "Foundation Analysis Design" (Bowles, 1995).

For determining the allowable bearing pressure for shallow and deep foundations, the applicant will use the methods in NAVFAC Design Manual 7 (NAVFAC, 1986); "Foundation Engineering Handbook" (Fang, 1990); Foundation Analysis Design (Bowles, 1995); and Federal Highway Administration (FHWA) FHWA-IF-99-025, "Drilled Shafts: Construction Procedures and Design Methods" (FHWA, 1999). Using the methods in NAVFAC Design Manual 7 (NAVFAC, 1986), "Foundation Engineering Handbook" (Fang, 1990), and Foundation Analysis Design (Bowles, 1995) to determine the allowable bearing pressure for shallow and deep foundations is acceptable because the NRC staff used these methods for licensing activities related to fuel cycle facilities. The NRC staff also finds that the method in FHWA-IF-99-025 (FHWA, 1999) for estimating the allowable bearing pressure is acceptable because it is recommended by a FHWA and the suggested approach is consistent with that in NAVFAC Design Manual 7 (NAVFAC, 1986).

The NRC staff reviewed the settlement and soil bearing capacity information provided in the LA (GLE, 2011b) and the ER (GLE, 2008). Based on the review of the information concerning settlement and soil bearing capacity, the information provided by the applicant meets the regulatory acceptance criteria in Sections 1.3.4.3(4) and (5) of NUREG-1520 (NRC, 2002) and

is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; (2) the applicant provides design-basis information for site settlement and soil bearing capacity conditions applicable to the site; and (3) the approaches the applicant plans to use to obtain design-basis information for site settlement and soil-bearing capacity to support final facility design are consistent with industry-accepted methods. Because the applicant committed to follow accepted guidelines for conducting more detailed settlement and soil bearing capacity investigations, the staff considers this acceptable as results of these future investigations will be evaluated in the NRC's inspections prior to the issuance of the approval for operations required under 10 CFR 40.41(g) and 70.32(k).

#### 1.3.3.5 Hydrology

Site surface water and groundwater hydrology is discussed in Sections 1.3.4 of the LA (GLE, 2011b) and 3.4 of the ER (GLE, 2008).

Surface water in the vicinity of the proposed site includes the Northeast Cape Fear River and several tributaries and creeks that flow into the Northeast Cape Fear River. The Northeast Cape Fear River is characterized as a blackwater river with relatively low-levels of dissolved oxygen and higher turbidity than the Cape Fear River. It is also characterized as swamp water due to its naturally low pH. The Northeast Cape Fear River is influenced by tidal action, but its salinity depends on local freshwater flow conditions that can vary with time and tidal exchange.

There are three freshwater streams on the site. Unnamed Tributaries No. 1 and No. 2 drain through the Swamp Forest community in the western part of the site to the Northeast Cape Fear River and one that drains into Prince George Creek on the north side of the GE site property. All three streams are capable of supporting wildlife from the Northeast Cape Fear River, however, the salinity and dissolved oxygen content may limit the suitability of the habitat for some species.

There are also three small ephemeral ponds. These ponds are located in the western part of the site and in the north-central sector. These ponds are capable of providing a water source to wildlife.

Groundwater systems in the vicinity of the Wilmington site consist of six regional aquifers. These systems include the Surficial Aquifer, the Castle Hayne Aquifer, the Peedee Aquifer, the Black Creek Aquifer, and the Upper and Lower Cape Fear Aquifers. All these aquifers are permeable water-yielding formations. Less permeable confining units separate the aquifers.

The Surficial Aquifer consists of stratified sedimentary deposits and is recharged directly by rainfall. The water table is located an average of 2.7 m (9 ft) below ground surface (bgs) with a range of 0 m (0 ft) to 6.1 m (20 ft) bgs. The hydraulic conductivity has been estimated to be 39.5 meters per day (m/day) (130 feet per day (ft/day)). The Surficial Aquifer discharges into streams, drainage ditches, and swampy areas and it recharges the Peedee Aquifer, which is referred to as the principal aquifer. Due to yield limits, it is used primarily for domestic use only.

Industrial process and drinking water wells used for the Wilmington site operations are drilled into the Peedee Aquifer. The average withdrawal rate is about 3.8 million liters per day (1.0 million gallons per day). Historical data do not exhibit a long-term downward trend in aquifer levels from this withdrawal rate and future uses are not expected to adversely affect the sustainable yield. The hydraulic conductivity for the Peedee Aquifer has been estimated to be 11.5 m/day (38 ft/day).



The NRC staff reviewed the information provided in the LA (GLE, 2011b) and the ER (GLE, 2008). Based on the review of the information concerning site hydrology, the information provided by the applicant meets the regulatory acceptance criteria in Sections 1.3.4.3(4) and (5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable because: (1) the information is accurate and is from reliable sources; and (2) the applicant provides design-basis information for hydrological conditions applicable to the site. In addition, the staff reviewed the applicant's hydrological data in the LA (GLE, 2011b) and finds that it provides sufficient information to assess site flooding hazards and ground- and surface-water impacts, and is consistent with information in the ER (GLE, 2008).

#### 1.3.4 EVALUATION FINDINGS

The staff has reviewed the site description for the proposed uranium enrichment facility according to Section 1.3 of the Standard Review Plan. The applicant has adequately described and summarized general information pertaining to: (1) the site geography, including its location relative to prominent natural and man-made features such as mountains, rivers, airports, population centers, schools, and commercial and manufacturing facilities; (2) population information on the basis of the most current available census data to show population distribution as a function of distance from the facility; (3) meteorology, hydrology, and geology for the site; and (4) applicable design basis events. The reviewer verified that the site description is consistent with the information used as a basis for the ER, emergency management plan, and ISA Summary; and that it demonstrates compliance with regulatory requirements in 10 CFR 30.33, 10 CFR 40.32, 10 CFR 70.22, and 10 CFR 70.65(b)(1).

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## **2.0 ORGANIZATION AND ADMINISTRATION**

The purpose of the U.S. Nuclear Regulatory Commission's (NRC's) review of the applicant's organization and administration is to evaluate whether the application describes proposed management policies that provide reasonable assurance that the licensee plans, implements, and controls site activities in a manner that ensures the safety of workers, the public, and the environment. The review also ensures that the applicant has identified and provided adequate qualification descriptions for key management positions.

### **2.1 REGULATORY REQUIREMENTS**

Title 10 of the *Code of Federal Regulations* (10 CFR) 70.22(a)(6) requires that the applicant provide the technical qualifications, including the training and the experience of the applicant and members of the staff. In addition, the regulations in 10 CFR 30.33(a)(3), 10 CFR 40.32(b), and 10 CFR 70.23(a)(2) require that an applicant be qualified by reason of training and experience to use the licensed material for the purpose requested. Also, the regulations in 10 CFR 30.33(a)(2), 10 CFR 40.32(c), and 10 CFR 70.23(a)(4) require that the applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property. In addition, the regulations in 10 CFR 70.62(d) require a management system and administrative procedures for Items Relied on for Safety (IROFS) to ensure their availability and reliability.

### **2.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA**

The guidance applicable to NRC's review of the organization and administration section of the license application (LA) (GLE, 2011a) is contained in Chapter 2 of the "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," NUREG-1520 (NRC, 2002). Section 2.3 of NUREG-1520 (NRC, 2002), "Areas of Review," includes areas of review for both new facility applications and applications for modifications to existing facilities. Similarly, Section 2.4.3 of NUREG-1520 (NRC, 2002), "Regulatory Acceptance Criteria," lists acceptance criteria for both new facilities and existing facilities. The regulatory acceptance criteria for both new and existing facilities are applicable to the review of the LA (GLE, 2011a).

### **2.3 STAFF REVIEW AND ANALYSIS**

#### **2.3.1 ORGANIZATION**

The regulations in 10 CFR 30.33(a)(3), 10 CFR 40.32(b), and 70.23(a)(2) require that an applicant be qualified by reason of training and experience to use the licensed material for the purpose requested. In addition, the regulations in 10 CFR 30.33(a)(2), 10 CFR 40.32(c), and 10 CFR 70.23(a)(4) require that the applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property. Thus, the applicant must implement an organization and appropriate administrative elements to support these regulatory requirements. The acceptance criteria in Section 2.4.3 of NUREG-1520 (NRC, 2002) address the need to: (1) identify and functionally describe the specific organizational groups that are responsible for

managing the design, construction, and operation of the facility; (2) organization charts; and (3) plans to commission the facility's startup and operation, including the transition from the startup phase to operations, under the direct supervision of the applicant's personnel responsible for safe operations.

In Section 2.1 of the applicant's LA (GLE, 2011a), the applicant describes the organizational commitments, relationships, responsibilities, and authorities for the overall management system to assure the protection of the health and safety of the workers and the public, protection of the environment, and to provide for the common defense and security. This section includes qualifications, functions, responsibilities, and authorities of the positions in the organizations assigned functions related to environmental protection, health, safety, safeguards, security, and quality assurance during all stages of the project from design through construction, start-up, and operation. In Section 2.1.2 of the LA (GLE, 2011a), the applicant states that the qualifications, responsibilities, and authorities are defined in position descriptions that will be accessible to affected personnel and NRC.

Figures 2-1 and 2-2 of the LA (GLE, 2011a) depict the applicant's organization from design and construction through start-up and operations.

As described in Section 2.1 of the LA (GLE, 2011a), the GLE President and Chief Executive Officer (CEO) provides the overall direction and management for facility design, construction, operations, and decommissioning. During the design and construction phases, the GLE President and CEO is responsible for ensuring that the facility meets the applicable regulatory requirements and for implementation of a quality assurance program (GLE, 2011a). During these phases, the Quality Assurance (QA) and Infrastructure Program Manager, the Operations Manager, the Engineering Manager, the Projects Manager, the Security Manager, and the Environmental Health and Safety (EHS) Manager report to the GLE President and CEO (GLE, 2011a). Figure 2-1 in the LA (GLE, 2011a) shows these relationships.

During the operations phase, the Facility Manager has overall responsibility for facility operations and directs activities involving quality assurance; operations; engineering; projects; security; emergency preparedness; infrastructure programs; environmental, health, and safety; and the Facility Safety Review Committee (GLE, 2011a). The Facility Manager reports to the GLE President and CEO (GLE, 2011a). The organization structure for operations is shown in Figure 2-2 in the LA (GLE, 2011a).

The applicant plans to construct and operate the proposed facility in 1 million Separative Work Unit phases (GLE, 2011a). As the construction of the first phase is completed, the applicant will begin staffing its operations organization and transition to the operations team (GLE, 2011a). During the transition, the EHS Manager and the QA Manager will report directly to the GLE President and CEO for design and construction matters and to the Facility Manager for operations matters (GLE, 2011a). As construction is completed, systems will undergo acceptance testing and turnover to the operations organization in accordance with written policies and procedures (GLE, 2011a).

As stated above, the applicant identified and provided a description of the proposed project organization that would be responsible for managing the design, construction, and operation of the proposed facility. The applicant also provided organization charts. The proposed organization provides for essential functions, qualified managers with appropriate experience, and defined responsibilities and authorities for the organizations assigned to environmental protection, health, safety, safeguards, security, and quality assurance during all stages of the



project from design through construction, start-up, and operation. The proposed organization, therefore, provides an acceptable management system for ensuring that the design, construction, and operation of the facility with effective lines of communication will meet NRC regulatory requirements. The information provided by the applicant meets the guidance in Section 2.4.3(1) of NUREG-1520 (NRC, 2002) for new facilities as the applicant has identified and functionally described the specific organizational groups responsible for operating the facility and managing the design, construction, and operation of the facility, and has provided organization charts. The information provided by the applicant also meets the guidance in Sections 2.4.3(1) and (7) of NUREG-1520 (NRC, 2002) for existing facilities as the applicant has identified and functionally described the specific organizational groups responsible for operating the facility and managing the development of design changes to the facility, and has provided organization charts. In addition, effective lines of communication and authority among the organizational units involved in the engineering, health, safety, environment, and operations functions of the facility are clearly defined in the applicant's organization. The applicant's organization structure is, therefore, acceptable.

### 2.3.2 ORGANIZATIONAL RESPONSIBILITIES AND QUALIFICATIONS

The regulations in 10 CFR 70.22(a)(6) require that the applicant provide the technical qualifications, including the training and the experience of the applicant and members of the staff. The regulations in 10 CFR 30.33(a)(3), 10 CFR 40.32(b), and 70.23(a)(2) require that an applicant be qualified by reason of training and experience to use the licensed material for the purpose requested. Thus, the applicant must implement an organization and appropriate administrative elements to support these regulatory requirements. The acceptance criteria in Section 2.4.3 of NUREG-1520 (NRC, 2002) address the need to identify the responsibilities, qualifications, and authorities of the key personnel responsible for managing the design, construction, and operations of the proposed facility and for health, safety, and engineering responsibilities. In addition, these responsibilities need to be clearly defined in position descriptions that are accessible to affected staff and the NRC, upon request. Also, the EHS and QA organizations need to be independent of the operations organization allowing it to provide objective EHS audit, review, or control of facility activities. Lines of authority, communications, and authority need to be clearly drawn. The EHS Manager also needs to have stop work authority if operations appear unsafe and must approve the restart of shutdown operations.

In Section 2.2 of the applicant's LA (GLE. 2011a), the applicant provided information concerning the minimum qualifications, function, and responsibilities for key staff positions and are summarized in the following paragraphs. Personnel responsible for managing the design, construction, and operation of the plant will be required to have the substantive breadth and level of experience to successfully execute their responsibilities (GLE. 2011a). Responsibilities, authorities, and group inter-relationships will be documented in approved, written position descriptions (GLE. 2011a). Individuals who do not meet the specified qualification requirements may not be eliminated from consideration if other work experience and abilities demonstrate competence to fulfill the position requirements (GLE. 2011a). Such situations will be considered on a case-by-case basis and will be approved and documented by the Facility Manager (GLE. 2011a).

The responsibilities and minimum qualifications for key positions, as described in Section 2.2 of the LA (GLE. 2011a), are summarized in the following paragraphs:

The President and CEO is responsible for overall policy direction and management of project activities. This individual takes direction from General Electric-Hitachi Nuclear Energy Americas

Fuel Cycle Senior Vice President. The qualifications for this position are, as a minimum, a bachelor's degree (or equivalent) and five years of related experience.

The Facility Manager reports to the President and CEO and has overall responsibility for the safety and activities conducted at the proposed facility. The Facility Manager must have, as a minimum, a bachelor's degree in an engineering or scientific area and four years of experience in nuclear facility operations. The Facility Manager must be knowledgeable of the safety program and has the authority to shutdown the facility or unsafe processes and must approve restart of any operation that this individual shuts down.

The QA Manager reports to the Facility Manager and is responsible for establishing, implementing, and maintaining the facility QA program. This position is independent from other management positions and has stop-work authority and the ability to contact the President and CEO on any QA matter. The QA Manager must have, as a minimum, a bachelor's degree in an engineering or scientific area and four years of supervisory experience in implementing QA programs. The QA Manager must also have at least two years experience in a nuclear facility QA organization.

The Operations Manager reports to the Facility Manager and has the responsibility of directing the day-to-day operation of the facility. This includes such activities as ensuring the correct and safe operation of uranium hexafluoride (UF<sub>6</sub>) processes, proper handling of UF<sub>6</sub>, and the identification and mitigation of any off-normal operating conditions. The Operations Manager will have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and 4 years of responsible nuclear experience.

The Engineering Manager reports to the Facility Manager and has the responsibility of providing engineering support to the facility. This includes technical support for facility modifications; engineering support for operations and maintenance; safe performance; and support for the preparation of operating and maintenance procedures. The Engineering Manager will have, as a minimum, a bachelor's degree or equivalent in an engineering or scientific field and 5 years of responsible nuclear experience.

The Projects Manager reports to the GLE President and CEO and has the responsibility for implementing facility modifications and for providing engineering support to operations, maintenance, and equipment testing personnel. The Projects Manager also manages design and construction activities. The Projects Manager will have, as a minimum, a bachelor's degree or equivalent in engineering or a scientific field, 5 years of nuclear experience, and 3 years of supervisory or management experience.

The Infrastructure Programs Manager reports to the Facility Manager and has the responsibility for business and administrative support, including document control, records management, training, and administrative functions. The Business Manager must have, as a minimum, a bachelor's degree or equivalent in personnel management, business administration, or a related field, and three years of related experience at a nuclear facility.

The EHS Manager reports to the Facility Manager and has the overall responsibility for establishing and managing the material control and accounting, nuclear criticality safety, industrial safety, environmental protection, fire safety, and radiation protection programs. The EHS Manager is administratively independent of operations activities and other management positions at the facility, but has the authority to stop work on any process or facility in the event

that safety controls are not assured. The EHS Manager must be consulted on the restart of any plant function shutdown due to EHS issues. Changes to the facility or to activities of personnel that require prior NRC approval are reviewed and approved by the EHS Manager or designee. The EHS Manager will have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and at least 5 years of management experience in regulated activities. The EHS Manager will also have experience in the administration of nuclear criticality safety, environmental, and industrial programs.

The Security and Emergency Preparedness Manager reports to the GLE President and CEO and has the responsibility for physical security of the facility site and ensuring that the facility remains prepared to react and respond to any emergency situation that may arise. This includes protection of classified information, maintaining and implementing the Emergency Preparedness Program, training of personnel to implement the program, evaluating program effectiveness, and coordinating and maintaining agreements with offsite emergency response organizations. The Security and Emergency Preparedness Manager is administratively independent of operations activities. The Emergency Preparedness Manager will have, as a minimum, a bachelor's degree (or equivalent) in a related field and at least 5 years of experience in related activities, or equivalent; or a high school diploma and 8 years of experience in related activities.

The Licensing Manager reports operationally to the Facility Manager and functionally to the General Electric-Hitachi Nuclear Energy Americas (GEHNEA) Regulatory Affairs General Manager. GEHNEA is the immediate parent of GLE. The GEHNEA Regulatory Affairs General Manager has the responsibility for providing leadership and strategic guidance to the GEHNEA subsidiaries, which include GLE. The Licensing Manager is responsible for coordinating facility activities to ensure that compliance is maintained with applicable NRC requirements and for ensuring abnormal events are reported to NRC in accordance with NRC regulations. The Licensing Manager will have a minimum of a bachelor's degree and 5 years of related experience in implementing and supervising a nuclear licensing program.

The Environmental Protection Manager reports to the EHS Manager and has the responsibility for coordinating facility activities to ensure all local, State, and Federal environmental regulations are met. The Environmental Protection Manager is administratively independent of operations activities, but has the authority to stop work on any process or facility related to environmental protection. The Environmental Protection Manager must approve the restart of any plant function shutdown due to environmental protection issues. The Environmental Protection Manager will have, as a minimum, a bachelor's degree (or equivalent) in engineering or in a scientific field and at least two years of experience in regulatory activities, or equivalent; or a high school diploma and 8 years of experience in regulatory activities.

The Radiation Protection Manager reports to the EHS Manager and has the responsibility for maintaining and implementing the Radiation Protection Program. These duties include: 1) the training of personnel in radiation protection; 2) evaluation and documentation of radiation exposures of personnel; 3) evaluation of the integrity and reliability of radiological instrumentation; 4) support emergency planning activities; and 5) assessing the effectiveness of the Radiation Protection Program through audits. The Radiation Protection Manager is administratively independent of operations activities, but has the authority to stop work on any process or facility related to radiation protection. The Radiation Protection Manager must approve the restart of any plant function shutdown due to radiation protection issues.

The Radiation Protection Manager will have, as a minimum, a bachelor's degree in an engineering or scientific field, and 3 years of responsible experience that includes assignments of responsibility in a radiation protection program, and experience in the understanding, application, and direction of radiation protection programs.

The Nuclear Criticality Safety (NCS) Manager reports to the EHS Manager and is responsible for establishing and maintaining the NCS Program. The NCS Manager supports operations by: 1) providing assessments for the Integrated Safety Analysis and for configuration control; 2) assessing normal and credible abnormal conditions; 3) determining NCS limits for controlled parameters; 4) performing nuclear criticality analyses; 5) supporting emergency response activities; and 6) assessing the effectiveness of the NCS program. The NCS Manager is administratively independent of operations activities, but has the authority to stop work on any process or facility related to nuclear criticality. The NCS Manager must approve the restart of any plant function shutdown due to nuclear criticality issues. The NCS Manager will have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field with at least 4 years in assignments involving regulatory activities, and experience in the understanding, application, and direction of NCS programs.

The Fire Safety Manager reports to the EHS Manager and has the responsibility for implementing the facility fire safety program. The Fire Safety Manager is administratively independent of operations activities, but has the authority to stop work on any process or facility related to fire safety concerns. The Fire Safety Manager must approve the restart of any plant function shutdown due to fire safety issues. The duties of the Fire Safety Manager include complying with fire safety regulatory requirements, managing the facility fire brigade, fire safety training, performing fire safety inspections, and supporting the ISA and configuration management activities. The Fire Safety Manager must have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and 4 years of experience in fire safety assignments.

The Material Control and Accounting (MC&A) Manager reports to the EHS Manager and has the responsibility for implementation and control of the Fundamental Nuclear Material Control Plan. The MC&A Manager is administratively independent of operations activities, but has the authority to stop work on any process or facility related to MC&A activities. The MC&A Manager must approve the restart of any plant function shutdown due to MC&A issues. The MC&A Manager must have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and 5 years of experience in the management of a safeguards program for special nuclear material to include responsibilities for MC&A. No credit for academic training may be taken toward fulfilling this experience requirement.

The Industrial Safety Manager reports to the EHS Manager and has the responsibility for the implementation of facility industrial safety programs and procedures. This will include programs and procedures for training individuals in non-radiological safety, laser safety, non-radiological chemical safety, and facility fire protection. The Industrial Safety Manager is administratively independent of operations activities, but has the authority to stop work on any process or facility related to industrial safety issues. The Industrial Safety Manager must approve the restart of any plant function shutdown due to industrial safety issues. The Industrial Safety Manager will have, as a minimum, a bachelor's degree (or equivalent) in engineering or in a scientific field and two years in related assignments; or a high school diploma and 8 years of related experience.

In Section 2.2.11 of the LA (GLE. 2011a), the applicant discusses the Facility Safety Review Committee, the Radiation Safety Committee, and the Chemical Review Committee functions. The Facility Safety Review Committee provides independent input to the Facility Manager on safety considerations related to environmental protection, NCS, radiation protection, and industrial safety (GLE. 2011a). This committee performs an annual assessment of the As Low As Reasonably Achievable (ALARA) program (GLE. 2011a). The Radiation Safety Committee reviews matters associated with occupational exposures and the ALARA program and makes recommendations to the Facility Manager on radiological safety trends and projects (GLE. 2011a). The Radiation Safety Committee is further discussed in Section 4.2.4 of the LA (GLE. 2011a) and Section 4.3.2 of this Safety Evaluation Report (SER). The Chemical Review Committee reviews requests for new chemicals and the health and safety risks of the chemical, including information on handling, storage, and disposal (GLE. 2011a). Section 6.2.1.1.1 of the LA (GLE. 2011a) and Section 6.3.1.3 of this SER provides additional information on the Chemical Review Committee.

The information provided above meets the acceptance criteria in Section 2.4.3(3) of NUREG-1520 (NRC, 2002) for new facilities and the acceptance criteria in Sections 2.4.3(2), (3), and (4) of NUREG-1520 (NRC, 2002) for existing facilities. In the LA (GLE. 2011a), the applicant identified the responsibilities, qualifications, and authorities of the personnel responsible for managing the design, construction, and operations of the proposed facility. These personnel have substantive breadth and experience and will be in place and be appropriately available. In addition, the responsibilities, qualifications, and authorities for key supervisory and management positions with health, safety, and environmental responsibilities are clearly defined in written position descriptions that will be available to all affected personnel and to the NRC, upon request. Also, the EHS and QA organizations are independent of the operations organization allowing them to provide objective EHS audit, review, or control of facility activities. Lines of authority, communications, and authority are clearly drawn. The EHS Manager also has stop work authority if operations appear unsafe and must approve the restart of shutdown operations. As described above, the applicant provided an organization having the essential management functions needed to ensure safe operation of the proposed facility and having the appropriate breadth, independence, and level of experience necessary to effectively manage the facility design, construction, and operations. The organizational responsibilities and qualifications are, therefore, acceptable.

### 2.3.3 MANAGEMENT CONTROL

The regulations in 10 CFR 70.22(a)(6) require that the applicant provide the technical qualifications, including the training and the experience of the applicant and members of the staff. The regulations in 10 CFR 30.33(a)(3), 10 CFR 40.32(b), and 70.23(a)(2) require that an applicant be qualified by reason of training and experience to use the licensed material for the purpose requested. Thus, the applicant must implement an organization and appropriate administrative elements to support these regulatory requirements. The acceptance criteria in Section 2.4.3 of NUREG-1520 (NRC, 2002) address the need to provide clear, unambiguous management controls and lines of communication and authority within the organization for managing the design, construction, and operation of the facility. The proposed management controls also need to provide an acceptable management system for ensuring that the design, construction, and operation of the facility will meet NRC requirements. In addition, the applicant needs to perform EHS functions using approved, written procedures prepared in accordance with a formal document control program. The applicant also needs a corrective action program for staff to report unsafe conditions in the EHS area and needs to ensure that reported concerns will be promptly investigated, assessed, and resolved. The applicant also needs effective and

clearly defined lines of communications and authority among its organizational units involved in engineering, EHS, and operations. In addition, the applicant needs formal management measures to ensure the availability and reliability of IROFS and needs to have written agreements in-place with local agencies for responding to fires and site emergencies. The above management controls need to provide for configuration management, facility maintenance, training and job qualifications, development of formal procedures for facility activities, internal audits and assessments, incident investigations, an employee corrective action program, and a formal records management program.

In Sections 2.1.2 and 2.3 of the LA (GLE. 2011a), the applicant describes the management measures and associated policies, administrative procedures, and management controls to ensure that the facility equipment, facilities and procedures, staff (including training and qualifications), and programs provide for the protection of the health and safety of workers and the public, protection of the environment, and for common defense and security.

Organizations having responsibility for environmental, health and safety, safeguards, security, and QA functions are independent from the operations organization providing separate and independent lines of communication (GLE. 2011a). Organizations having engineering, safety and health, environmental, security, safeguards, and operations responsibilities have clear and well-defined lines of communication and authority (GLE. 2011a). For example, the QA Manager, the Security Manager, and EHS Manager are independent from the Operations Manager and other organizations enabling them to provide independent input to the GLE President and CEO during design and construction and to the Facility Manager during operations (GLE. 2011a).

Activities that are essential for effective implementation of the environmental, safety, and health functions are documented in approved, written procedures, prepared in compliance with a document control program (GLE. 2011a). Facility staff receives training in these control functions, which are monitored through internal and independent audits and assessments (GLE. 2011a).

The applicant implemented an employee concerns program to provide a mechanism for employees to raise issues or concerns related to the design, construction, or operation of the facility (GLE. 2011a). Employees have the right and obligation to initiate the stop-work process if they consider that safety or quality is being compromised (GLE. 2011a). The applicant committed to investigating and resolving employee concerns in an effective and timely manner (GLE. 2011a). For the construction and operating phases of the project, the applicant will implement a corrective action program as described in Section 17 in the applicant's Quality Assurance Program Description (GLE, 2010b) and evaluated in Sections 11.3.5 and 11.A.3.17 of this SER.

The applicant has a Configuration Management Program to define and maintain a technical baseline for facility Items Relied on for Safety (IROFS) and provide a formal process for making changes to that baseline (GLE. 2011a). All changes made to facility IROFS are made in accordance with the Configuration Management Program (GLE. 2011a). Section 11.3.1 of this SER evaluates the Configuration Management Program.

A maintenance program will be implemented during operations. This program will include planned and scheduled preventive maintenance, surveillance, and performance trending, to ensure that IROFS are available and reliable to perform their intended functions (GLE. 2011a).

The applicant will implement a formal, planned training program that will include indoctrination training for all employees, addressing criticality, radiological, emergency response, and industrial safety (GLE. 2011a). The level of indoctrination training will depend on the specific jobs to be performed (GLE. 2011a). Continued or periodic retraining will be established, when applicable, to ensure employee proficiency (GLE. 2011a). Operator training will be conducted as part of the qualification requirements prior to performing safety-related activities and before startup following significant changes in safety controls (GLE. 2011a). Additional information on the applicant's training program is provided in Section 11.3 of the LA (GLE. 2011a) and is evaluated in Section 11.3.3 of this SER.

The applicant will implement a QA Program that requires periodic audits of activities affecting quality, to ensure that these activities are being conducted in accordance with procedures and the QA Program requirements (GLE. 2011a). The audits will be identified, scheduled, and performed in accordance with a written plan (GLE. 2011a). The frequency of audits will depend on the safety significance, status, and work history of the activity (GLE. 2011a). The Facility Safety Review Committee and the QA organization will conduct operational reviews and program audits (GLE. 2011a). Further information on audits is provided in Section 11.5 of the LA (GLE. 2011a) and is evaluated in Section 11.3.5 of this SER. Incident investigations will be conducted following upset conditions to ensure that these conditions are understood, that proper corrective actions are taken, and that appropriate offsite agencies, including NRC are properly notified (GLE. 2011a). Incident investigations are also described in Section 11.6 of the LA (GLE. 2011a) and evaluated in Section 11.3.6 of the SER.

The applicant will implement a records management program to control the preparation and issuance of applicant documents (GLE. 2011a). This document control program will include a formal process for preparing, reviewing, approving, and issuing revisions to documents (GLE. 2011a). Further evaluation of the records management program is provided in Section 11.3.7 of this SER.

The applicant will coordinate emergency actions with appropriate State and local offsite emergency agencies through written agreements (GLE, 2010c). Coordination with offsite emergency agencies is discussed in Sections 4.3 and 4.4 of the Radiological Contingency and Emergency Plan (GLE, 2010c). Further evaluation of emergency management is provided in Section 8.3.2 of this SER.

The information the applicant provided above meets the guidance in Section 2.4.3(2) of NUREG-1520 (NRC, 2002) for new facilities as the applicant has provided clear, unambiguous management controls and lines of communication and authority within the organization for managing the design and construction of the facility. The proposed management controls provide an acceptable management system for ensuring that the design, construction, and operation of the facility will meet NRC requirements. In addition, the information the applicant provided above meets the guidance in Sections 2.4.3(5), (6), (7), (8), and (9) of NUREG-1520 (NRC, 2002) for existing facilities as the EHS functions are performed using approved, written procedures prepared in accordance with a formal document control program. The applicant also has an employee concerns program for staff to report unsafe conditions in the EHS area and reported concerns will be promptly investigated, assessed, and resolved. The applicant also has effective and clearly defined lines of communications and authority among its organizational units involved in engineering, EHS, and operations. In addition, the applicant will establish formal management measures to ensure the availability and reliability of IROFS. The applicant has written agreements in-place with local agencies for responding to fires and site emergencies. The above management controls provide for configuration management, facility

maintenance, training and job qualifications, development of formal procedures for facility activities, internal audits and assessments, incident investigations, an employee corrective action program, and a formal records management program. These programs will provide the needed scope of control over facility activities to ensure that worker and public health and safety will be protected in accordance with the regulations cited in Section 2.1 of this SER. Therefore, the applicant's management controls are acceptable.

#### 2.3.4 TRANSITION FROM DESIGN AND CONSTRUCTION TO OPERATIONS

The regulations in 10 CFR 30.33(a)(3), 10 CFR 40.32(b), and 10 CFR 70.23(a)(2) require that an applicant be qualified by reason of training and experience to use the licensed material for the purpose requested. Also, the regulations in 10 CFR 30.33(a)(2), 10 CFR 40.32(c), and 10 CFR 70.23(a)(4) require that the applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property. In addition, the regulations in 10 CFR 70.62(d) require a management system and administrative procedures for IROFS to ensure their availability and reliability. Acceptance criteria on the transition from construction to operations are addressed in Section 2.4.3(4) of NUREG-1520 (NRC, 2002). Under these criteria, an applicant for a new facility needs to describe specific plans to commission the facility's startup and operation, including the transition from the startup phase to operations under the supervision of the applicant's personnel responsible for safe operations. This information needs to be of sufficient detail for the staff to understand the applicant's planned transitions and to ensure that the transitions will be orderly and effective without introducing unnecessary health and safety issues for the initial operation of the proposed facility.

The applicant is responsible for the design, QA, construction, testing, initial start-up, operation, and decommissioning of the facility (GLE. 2011a).

Toward the end of construction, the focus of the organization will shift from design and construction to initial start-up and operation of the facility (GLE. 2011a). As the facility nears completion, the applicant will staff its operations organization to ensure a smooth transition from construction activities to operation activities (GLE. 2011a).

As the construction of systems is completed, the systems will undergo acceptance testing as required by procedure, followed by turnover from the construction organization to the operations organization by means of a detailed transition plan (GLE. 2011a). The turnover will include the physical systems and corresponding design information and records (GLE. 2011a). After turnover, the operating organization will be responsible for system maintenance and configuration management (GLE. 2011a). The design basis for the facility is maintained during the transition from construction to operations through the configuration management system described in Section 11.1 of the LA (GLE. 2011a) and evaluated in Section 11.3.1 of this SER.

The information the applicant provided on the transition from construction to operations meets the guidance in Section 2.4.3(4) of NUREG-1520 (NRC, 2002) for new facilities as the applicant has described specific plans to commission the facility's startup and operation, including the transition from the startup phase to operations under the supervision of the applicant's personnel responsible for safe operations. This information is of sufficient detail for the staff to understand the applicant's planned transitions and to ensure that the transitions will be orderly and effective without introducing unnecessary health and safety issues for the initial operation of the proposed facility. Therefore, the applicant's transition plans are acceptable.



## **2.4 EVALUATION FINDINGS**

The staff reviewed the organization and administration for the proposed facility in accordance with the acceptance criteria in Chapter 2 of NUREG-1520 (NRC, 2002). The staff reviewed the applicant's organization, management position summaries and qualifications, and management controls. These organizational and administrative elements describe: (1) clear responsibilities and associated resources for the design, construction, and operation of the facility; and (2) its plans for managing and operating the project. The staff reviewed these plans and the management and organizational commitments and concludes that they provide reasonable assurance that an acceptable organization, administrative policies, and sufficient competent resources have been established or are committed, to satisfy the applicant's commitments for the design, construction, and operation of the facility.

## **2.5 REFERENCES**

(GLE, 2011a) General Electric-Hitachi Global Laser Enrichment (GLE). "GE-Hitachi Global Laser Enrichment LLC Commercial Facility License Application," Revision 6. 2011.

(GLE, 2011b) General Electric-Hitachi Global Laser Enrichment LLC (GLE). "Quality Assurance Program Description for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility," Revision 7, 2011.

(GLE, 2011c) General Electric-Hitachi Global Laser Enrichment LLC (GLE). "Radiological Contingency and Emergency Plan (RC&EP) for Global Nuclear Fuel – Americas, LLC and GE-Hitachi Global Laser Enrichment, LLC at Wilmington, NC," Revision 3, 2011.

(NRC, 2002) U.S. Nuclear Regulatory Commission (NRC). NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility." 2002.



### **3.0 INTEGRATED SAFETY ANALYSIS AND INTEGRATED SAFETY ANALYSIS SUMMARY**

The purpose of the U.S. Nuclear Regulatory Commission's (NRC's) review of the applicant's Integrated Safety Analysis (ISA) and ISA Summary (GLE, 2011a) is to evaluate whether the applicant meets the regulatory requirement specified in 10 CFR 70, Subpart H, "Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material." The review determined whether appropriate hazards and baseline design criteria (BDC) have been addressed. The review also determined whether acceptable Items Relied on for Safety (IROFS) including initial conditions (ICs), management measures, and likelihoods and consequences have been designated for high-risk accident sequences and whether, with IROFS, the performance requirement of 10 CFR 70.61 have been met. The review also determined whether programmatic commitments to maintain the ISA and ISA Summary (GLE, 2011a) are acceptable.

In particular, the review as described in this chapter considered information provided by the applicant that is related to:

- Commitments regarding the applicant's safety program, including the ISA, pursuant to the requirements of 10 CFR 70.62; and
- The ISA Summary (GLE, 2011a) submitted in accordance with 10 CFR 70.62(c)(3)(ii) and 70.65.

#### **3.1 REGULATORY REQUIREMENTS**

The following regulatory requirements are applicable to the ISA and ISA Summary (GLE, 2011a) content:

- The regulations in 10 CFR 70.62 specify the requirements to establish and maintain a safety program, including performance of an ISA that demonstrates compliance with the performance requirements of 10 CFR 70.61;
- The regulations in 10 CFR 70.62(c) specify requirements for conducting an ISA, including a demonstration that credible high-consequence and intermediate-consequence events meet the safety performance requirements of 10 CFR 70.61;
- The regulations in 10 CFR 70.64 specify requirements for baseline design criteria and facility and system design and facility layout; and
- The regulations in 10 CFR 70.65(b) describe the contents of an ISA Summary.

The regulations in 10 CFR 70.62 require an applicant to establish and maintain a safety program that demonstrates compliance with the performance requirements of 10 CFR 70.61. The safety program is required to contain: (1) process safety information; (2) an ISA; and (3)

management measures. The ISA must be conducted and maintained by the applicant and must identify the following, in accordance with 10 CFR 70.62(c):

- Radiological hazards related to possessing or processing licensed material at the facility;
- Chemical hazards of licensed material and hazardous chemicals produced from licensed material;
- Facility hazards that could affect the safety of licensed material and, thus, present an increased radiological risk;
- Potential accident sequences caused by process deviations or other events internal to the facility and credible external events, including natural phenomena;
- Consequence and likelihood of concurrence of each potential accident sequence identified and the methods used to determine the consequences and likelihoods; and
- Each IROFS identified pursuant to 10 CFR 70.61(e), the characteristics of its preventative, mitigative, or other safety function, and the assumptions and conditions under which the item is relied upon to support compliance with the performance requirements of 10 CFR 70.61.

The regulations in 10 CFR 70.61 provide that the ISA must evaluate compliance with the performance requirements. The requirements in 10 CFR 70.61(b) specify that the risk of each credible, high-consequence event must be limited such that the likelihood of occurrence is highly unlikely; and the requirements in 10 CFR 70.61(c) specify that the risk of each credible, intermediate-consequence event must be limited such that the likelihood of occurrence is unlikely.

The license application must include a description of the safety program under 10 CFR 70.65(a). In addition, the applicant is required to submit to the NRC an ISA Summary. As outlined in 10 CFR 70.65(b), the ISA Summary is required to contain:

- A general description of the site with emphasis on those factors that could affect safety;
- A general description of the facility with emphasis on those areas that could affect safety, including an identification of the controlled area boundaries;
- A description of each process analyzed in the ISA in sufficient detail to understand the theory of operation; and, for each process, the hazards that were identified in the ISA pursuant to 10 CFR 70.62(c)(1)(i)-(iii) and a general description of the types of accident sequences;
- Information that demonstrates the licensee's compliance with the performance requirements in 10 CFR 70.61, including a description of the management measures; the requirements for criticality monitoring and alarms in 10 CFR 70.24; and, if applicable, the requirements of 10 CFR 70.64;
- A description of the team, qualifications, and the methods used to perform the ISA;

- A list briefly describing each IROFS identified pursuant to 10 CFR 70.61(e) in sufficient detail to understand their functions in relation to the performance requirements of 10 CFR 70.61;
- A description of the proposed quantitative standards used to assess the consequences to an individual from acute chemical exposure to licensed material or chemicals produced from licensed materials that are onsite, or expected to be onsite, as described in 10 CFR 70.61(b)(4) and (c)(4);
- A description list that identifies all IROFS that are the sole item preventing or mitigating an accident sequence that exceeds the performance requirement of 10 CFR 70.61; and
- A description of the definitions of unlikely, highly unlikely, and credible, as used in the evaluations in the ISA.

### **3.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA**

The guidance applicable to the NRC's review of the applicant's ISA and ISA Summary (GLE, 2011a) is contained in Chapter 3 of NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (NRC, 2002). Chapter 3 of NUREG-1520 (NRC, 2002) addresses the review of the ISA and the ISA Summary (GLE, 2011a). Sections 3.4.3.1 and 3.4.3.2 of NUREG-1520 (NRC, 2002) address the acceptance criteria for this review and are applicable in their entirety.

Chapter 11, "Management Measures," of NUREG-1520 (NRC, 2002) was used in the staff's review of the management measures applied for the IROFS evaluated in the ISA Summary (GLE, 2011a).

### **3.3 STAFF REVIEW AND ANALYSIS**

#### **3.3.1 SAFETY PROGRAM AND ISA COMMITMENTS**

This section contains the staff's programmatic review of the applicant's proposed safety program, the proposed ISA commitments, proposed ISA method, proposed BDC considerations, and proposed defense-in-depth items. The staff's review of the sensitive information, including proprietary, export control, and security-related ISA information provided in the ISA Summary (GLE, 2011a) and License Application (LA) (GLE, 2011b) is found in the non-public version of this Safety Evaluation Report (SER). The staff's review of other information in the ISA, as determined from onsite reviews, is provided in Section 3.3.17 of this SER.

The staff reviewed the applicant's proposed safety program commitments identified in Section 3.1 of the LA (GLE, 2011b) to determine whether the three elements of process safety information, the ISA, and management measures demonstrate compliance with the requirements of 10 CFR 70.62; and that records will be established and maintained for documenting each discovery that an IROFS or management measure has failed or degraded such that it cannot perform its intended safety function. The applicant's commitments regarding process safety information is discussed in Section 3.3.1.1 of this SER. The applicant's ISA

commitments are discussed in Section 3.3.1.2 of this SER, and the applicant's commitments regarding management measures are discussed in Section 3.3.12 of this SER.

### 3.3.1.1 Process Safety information

The acceptance criteria in Section 3.4.3.1(1)(a), (b), and (c) of NUREG-1520 (NRC, 2002) state that the applicant needs to commit to compiling process safety information to be used to identify and understand that hazards associated with the processes.

In Section 3.1.1 of the LA (GLE, 2011b), the applicant stated that it compiled and maintains process information addressing:

- The hazards of materials used or produced in the process — including information on chemical and physical properties (e.g., toxicity, acute exposure limits, reactivity, and chemical and thermal stability) such as are included in Materials Safety Data Sheets meeting the requirements of 29 CFR 1910.1200(g);
- The description of the technology of the process — including block flow diagrams or simplified process flow diagrams, a brief outline of process chemistry, safe upper and lower limits for controlled parameters (e.g., temperature, pressure, flow, and concentration), and evaluation of the health and safety consequences of process deviations; and
- Equipment used in the process, which includes general information on topics such as the materials of construction, piping and instrumentation diagrams, ventilation, design codes and standards employed, material and energy balances, IROFS, electrical classification, and relief system design.

The process-safety information described above will be maintained up-to-date by the configuration management program described in Section 11.1 of the LA (GLE, 2011b). As discussed in Section 11.3.1 of this SER, the applicant uses its configuration management system to control documentation and review design changes.

The applicant also developed procedures and criteria for changing the ISA. These include implementation of a facility change mechanism that meets the requirements of 10 CFR 70.72. The development and implementation of procedures is described in Section 11.4 of the LA (GLE, 2011b) and is evaluated in Section 11.3.4 of this SER.

As described in Section 3.1.1 of the LA (GLE, 2011b), the applicant uses personnel with expertise in engineering, safety analysis, and enrichment process operations and experience (individually or collectively) in nuclear criticality safety, radiological safety, fire safety, chemical safety, operations and maintenance, and ISA methods to maintain the ISA. The ISA Team for the various processes consists of individuals who are knowledgeable in the ISA method(s) and the operation, hazards, and safety design criteria of the particular process. Training and qualifications of individuals responsible for maintaining the ISA are described in Chapter 1 of the ISA Summary (GLE, 2011a).

Therefore, the staff concludes that the above-mentioned program elements:

1. Meet the acceptance criteria in Section 3.4.3.1(1)(a) of NUREG-1520 (NRC, 2002) because the applicant's safety program contains commitments to compile and maintain an up-to-date database of process safety information and is, therefore, acceptable.
2. Meet the acceptance criteria in Section 3.4.3.1(1)(b) of NUREG-1520 (NRC, 2002) because the applicant's safety program includes procedures and criteria for changing the ISA, along with a commitment to design and implement a facility change mechanism, and is, therefore, acceptable.
3. Meet the acceptance criteria in Section 3.4.3.1(1)(c) of NUREG-1520 (NRC, 2002) because the applicant's safety program contains a commitment to engage personnel with appropriate experience and expertise in engineering and process operations to maintain the ISA, and is, therefore, acceptable.

### 3.3.1.2 ISA Commitments

The acceptance criteria in Section 3.4.3.1(2)(a) of NUREG-1520 (NRC, 2002) state that the applicant needs to commit to conducting an ISA of appropriate complexity for each process, including radiological, chemical, facility hazards, potential accident sequences, consequences and likelihood for each sequence, and IROFS. The acceptance criteria in Section 3.4.3.1(2)(b) of NUREG-1520 (NRC, 2002) state that the applicant needs to commit to maintain the ISA and its supporting documentation so that it is accurate and up-to-date. The acceptance criteria in Section 3.4.3.1(2)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to commit to train personnel in ISA methods. The acceptance criteria in Section 3.4.3.1(2)(d) of NUREG-1520 (NRC, 2002) state that the applicant needs to commit to evaluate proposed changes to the facility and its operations using ISA methods and to designate new or additional IROFS and appropriate management measures as required. The acceptance criteria in Section 3.4.3.1(2)(e) of NUREG-1520 (NRC, 2002) state that the applicant needs to commit to any IROFS unacceptable performance deficiencies identified through updates of the ISA. The acceptance criteria in Section 3.4.3.1(2)(f) of NUREG-1520 (NRC, 2002) state that the applicant needs to commit to maintain written procedures onsite. The acceptance criteria in Section 3.4.3.1(2)(g) of NUREG-1520 (NRC, 2002) state that the applicant needs to commit to establish all IROFS and to maintain them so that they are available and reliable when needed.

In Section 3.1.2 of the LA (GLE, 2011b), the applicant identifies ISA program elements that were used to establish the ISA process and contains the applicant's commitments to conduct an ISA of appropriate complexity for each process. Those elements include the performance of an ISA for each process that identifies the radiological hazards, chemical hazards that could increase radiological risk, chemical hazards from materials involved in processing licensed material, facility hazards that could increase radiological risk, potential accident sequences, consequences and likelihood of each accident sequence, and IROFS including the assumptions and conditions under which the program elements support compliance with the performance requirements of 10 CFR 70.61 (GLE, 2011b). The staff's evaluation of the applicant's methods and criteria for implementing the ISA method is contained in Sections 3.3.5.2 and 3.3.6 of this SER.

Section 3.1.2 of the LA (GLE, 2011b) contains a commitment to maintain the ISA and its supporting documentation so that it is accurate and up-to-date. Changes to the ISA Summary

will be submitted to the NRC, in accordance with 10 CFR 70.72 (GLE, 2011b). The ISA update process accounts for any changes made to the facility or its processes (GLE, 2011b). Changes will be made in accordance with approved site procedures, and will be reviewed to ensure that the technical basis for the change and impacts to the ISA or other safety programs are examined by the applicant's engineering, safety, and operations staff prior to implementation (GLE, 2011b). This commitment meets the acceptance criteria in Section 3.4.3.1(2)(b) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

Sections 3.1.1 and 3.1.2 of the LA (GLE, 2011b) contain commitments to train personnel in the facility's ISA methods and use suitably qualified personnel to update and maintain the ISA and ISA Summary (GLE, 2011a). This commitment meets the acceptance criteria in Section 3.4.3.1(2)(c) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

Section 3.1.2 of the LA (GLE, 2011b) contains a commitment to evaluate proposed changes to the facility or its operations by means of the ISA method and to designate new or additional IROFS and appropriate management measures. Proposed changes that result in a new type of accident sequence or increased risk (likelihood or consequence) as well as the adequacy of IROFS and their corresponding management measures are evaluated and revised promptly (GLE, 2011b). This commitment meets the acceptance criteria in Section 3.4.3.1(2)(d) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

Section 3.1.2 of the LA (GLE, 2011b) contains a commitment to address the unacceptable performance deficiencies of IROFS that are identified through updates to the ISA. This commitment meets the acceptance criteria in Section 3.4.3.1(2)(e) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

In Section 11.4 of the LA (GLE, 2011b), the applicant commits to maintain written procedures onsite. This commitment meets the acceptance criteria in Section 3.4.3.1(2)(f) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

In Section 3.1.3 of the LA (GLE, 2011b), the applicant commits to establish all IROFS (if not already established) and to maintain them so that they are available and reliable when needed. This commitment meets the acceptance criteria in Section 3.4.3.1(2)(g) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

### 3.3.2 DESCRIPTION OF THE SITE AND FACILITY

#### 3.3.2.1 Description of the Site

The regulations in 10 CFR 70.65(b)(1) require that the applicant describe the site with emphasis on those factors that could affect safety. In Chapter 2 of the ISA Summary (GLE, 2011a), the applicant described and summarized general information pertaining to: (1) the site location and geography, including its location relative to prominent natural and man-made features such as rivers, airports, highways, and population centers; (2) population data; (3) climate; (4) motor vehicle and air traffic; and (5) topography. In Chapter 2 of the ISA Summary (GLE, 2011a), the applicant included a discussion of external hazards, including both natural phenomena such as earthquakes, landslides, volcanoes, flooding, as well as man-made phenomena such as aircraft crashes. The reviewers verified that the site description was consistent with the information used as a basis for the ISA.



The population in New Hanover County is in excess of 182,000 (GLE, 2011a). The three neighboring counties (Brunswick, New Hanover, and Pender) have a total population of approximately 326,000 (GLE, 2011a). The nearest residential areas are located a distance of approximately 1280 meters (m) (4,200 feet (ft)) from the proposed facility (GLE, 2011a). These figures are provided in the ISA Summary (GLE, 2011a) based on available census data, as stated in the criteria in Section 3.4.3.2(2)(a) of NUREG-1520 (NRC, 2002) and therefore meet the acceptance criteria. During the ISA process, the applicant assessed worker doses within the restricted area (GLE, 2011a). The consequences to the public and the environment were assessed at the outer perimeter of the Wilmington site boundary nearest to the process of interest (GLE, 2011a). Figure 3-1 of the ISA Summary (GLE, 2011a) provides a map of the facility with each major process and support building identified and meets the acceptance criteria in Section 3.4.3.2(2)(a) of NUREG-1520 (NRC, 2002).

The primary production activities are supported by a large number of support activities, including, but not limited to, materials storage, waste processing, analytical/physical testing, and facilities and equipment maintenance (GLE, 2011a). Chapter 4 of the ISA Summary (GLE, 2011a) contains 17 subsections, which provide details of the evaluated hazards for each primary activity.

The staff finds the information provided in Chapter 2 of the ISA Summary (GLE, 2011a) to be adequate for meeting the requirements of 10 CFR 70.65(b)(1) and the acceptance criteria in Sections 3.4.3.2(1)(a) and (b) in NUREG-1520 (NRC, 2002), which states that the applicant needs to provide a description of the site geography, population, and characterization of natural phenomena, as they affect facility safety and the consequence or likelihood of accidents caused by external factors.

### 3.3.2.2 Description of the Facility

The regulations in 10 CFR 70.65(b)(2) require that the applicant submit a general description of the facility with emphasis on areas that could affect safety, including an identification of the controlled area boundary. To meet the acceptance criteria in Section 3.4.3.2(2) of NUREG-1520 (NRC, 2002), the applicant needs to identify and describe the facility location and distance from the site boundary, restricted area and controlled area boundaries, design information regarding the resistance of the facility to credible external events, and the location of site buildings.

The proposed facility and site are described in Sections 2.2.1 and 2.1.2 of the ISA Summary (GLE, 2011a). The controlled area boundary (CAB) and the restricted area are described in Section 3.1 of the ISA Summary (GLE, 2011a). The commercial facility site lies within the 657 hectare (1,621-acre) Wilmington Site located in New Hanover County approximately 9.7 kilometers (km) (6 miles (mi)) from Wilmington, NC (GLE, 2011a). The proposed facility is located on approximately 40.5 hectares (100 acres) within the Wilmington Site (GLE, 2011a). The facility consists of operations and administrative buildings including cylinder storage pads (GLE, 2011a). These buildings and facilities are located within the 40.5 hectare (100-acre) fenced area (GLE, 2011a). Figure 3-1 in Chapter 3 of the ISA Summary (GLE, 2011a) shows the layout of the facility.

In Section 2.1.2 of the ISA Summary (GLE, 2011a), the applicant stated that the CAB is the area between the restricted area and the Wilmington site boundary, and is otherwise known as the Owner Controlled Area.

The staff finds the descriptions of the facility, controlled area boundary, restricted area, and distances used in the consequence modeling adequate for meeting the requirements of 10 CFR 70.65(b)(2) and the acceptance criteria in Sections 3.4.3.2(1)(b) and 3.4.3.2(2) of NUREG-1520 (NRC, 2002).

### 3.3.3 PROCESS DESCRIPTIONS

The regulations in 10 CFR 70.62(b) require the applicant to maintain process safety information to enable the performance and maintenance of an ISA. This process safety information must include information pertaining to the hazards of the materials used or produced in the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process. The regulations in 10 CFR 70.62(c)(1)(iv) require that the ISA identify potential accident sequences caused by process deviations or other events internal to the facility and credible external events, including natural phenomena.

The regulations in 10 CFR 70.65(b)(3) require the ISA Summary to include a description of each process (defined as a single reasonably simple integrated unit operation within an overall production line) analyzed in the ISA in sufficient detail to understand the theory of operation, and, for each process, the hazards that were identified in the ISA and a general description of the types of accident sequences. The acceptance criteria in Section 3.4.3.2(3) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a description of the analyzed processes, including basic process function, major components, and a discussion of operating ranges and variables.

Chapter 4 of the ISA Summary (GLE, 2011a) provided a description of the activities and hazards for each key process system in the facility, including a general description of the building, the equipment function, overview of the operations, and hazards of each process step. Each process system within the facility is analyzed in a "node" or subsection of Chapter 4 of the ISA Summary (GLE, 2011a). A list of these chapters and process systems is included in Chapter 4 of the ISA Summary (GLE, 2011a). Each node includes the following information:

1. System description;
2. Hazard identification discussion;
3. Summary of accident sequences that resulted in a Risk Index (consequence x likelihood) greater than 4;
4. Summary of IROFS implemented to protect against the accident sequences;
5. Quantification of accident sequence; and
6. Likelihood calculation (event tree) for each scenario.

Each chapter (node) in the ISA Summary (GLE, 2011a) contains a description of the process, basic theory of operation, a discussion of the unit processes broken down to a level necessary to understand the hazards and initiating conditions, major components, and system interfaces. Included in the process information is a description of the temperatures, pressures, state (solid, liquid, or gas) of the licensed material. This information meets the acceptance criteria in Section 3.4.3.2(3) in NUREG-1520 (NRC, 2002).

### 3.3.4 EXTERNAL HAZARDS

Section 2.5 of the ISA Summary (GLE, 2011a) presents a discussion of external hazards, including natural phenomena such as earthquakes, landslides, volcanoes, flooding, and intense

precipitation, as well as man-made phenomena such as aircraft crashes. The acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of natural phenomena and other external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination.

#### 3.3.4.1 High Wind and Tornado Hazards

The applicant provided historical data on tornadoes in the area near the site in Section 2.5.6 of the ISA Summary (GLE, 2011a).

Fifteen tornadoes were recorded between 1950 and 2004 (54 years of data) in New Hanover County (GLE, 2008; GLE 2010; GLE, 2011b). Six of them occurred in 1998 and 1999 with an intensity of F1 or less on the Fujita scale. The strongest tornado (June 13, 1962) was rated F2 and occurred in the western part of New Hanover County. No F4 and F5 tornadoes were recorded in North Carolina and all tornadoes occurred in the Wilmington area are either F1 or F0 tornadoes.

Based on these historical tornado records, the applicant determined that an F2 tornado estimate with a 3-second gust speed equivalent of 179 – 217 kilometers/hour (km/hr) (111 – 135 miles per hour (mph)) in the Enhanced Fujita scale for the site would be conservative. This estimate is comparable with the 225 km/hr (140 mph) tornado wind speed with an annual probability of  $10^{-5}$  provided in NUREG/CR-4461, “Tornado Climatology of the Contiguous United States” (NRC, 2007a), for the Wilmington area. The applicant also indicated that this wind speed is bounded by the wind speed identified for hurricanes. The applicant further defined the tornado-generated missiles based on Regulatory Guide 1.76, “Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants” (NRC, 2007b). These missiles include a schedule 40 steel pipe, automobile, and a solid steel sphere with dimensions, weights, and associated impact speeds.

The applicant further conducted an assessment of the probabilities of tornadoes impacting the proposed facility using the expected travel distance of an F5 tornado (NRC, 2007a) and the historical tornado information from the National Oceanic and Atmospheric Administration (NOAA), “Severe Weather Database Files (1950-2010)” (NOAA, 2011), for the tri-county area (New Handover, Brunswick and Pender). The applicant concluded that the annual probability for a tornado with the intensity greater than F1 is near or less than  $10^{-5}$ .

The NRC staff reviewed the tornado hazard information the applicant provided and finds the tornado hazard probability the applicant estimated for the facility site to be acceptable because the applicant appropriately used the historical data from a reliable source (NOAA) to estimate tornado hazards for the proposed facility and the approach it used is consistent with the guidance in NUREG/CR-4461 (NRC, 2007a), which is guidance widely used in the nuclear industry for tornado estimation. The NRC staff further finds that the applicant appropriately defined the tornado-generated missiles using Regulatory Guide 1.76 (NRC, 2007b). Consequently, the NRC staff concludes, with reasonable assurance, that the regulatory requirements in 10 CFR 70.65(b)(1) regarding tornado hazards have been met. The acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of natural phenomena and other external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant’s

analysis of hazards from tornadoes met these acceptance criteria and was found to be acceptable.

#### 3.3.4.2 Hurricane and Tsunami

In Section 2.5.5 of the ISA Summary (GLE, 2011a) and in Section 1.3.3.3.7 of the LA (GLE, 2011b), the applicant indicated that the hurricane hazards could be from winds and flooding. The 50-year (1954–2004) historical data for the New Hanover County, where the proposed facility is located, three hurricanes were recorded; two of these (Hazel in 1954 and Fran in 1996) were Category 3 hurricanes and the remaining one was a Category 1 hurricane (Diane in 1955) (GLE, 2011a).

The applicant stated that no hurricanes made landfall in the area of the proposed site with a wind speed in the Category 4 range. Based on these historical data, the applicant determined that the maximum potential hurricane hazards from a Category 4 hurricane should be a bounding case. This Category 4 hurricane has a 3-second gust wind speed of 253.5 km/hr (157.5 mph). By definition, the wind speed associated with a Category 4 hurricane is 210–249 km/hr (131–155 mph) in Saffir-Simpson hurricane wind scale. The applicant stated that historically only six Category 4 and six Category 5 hurricanes were recorded with wind speeds greater than 253.5 km/hr (157.5 mph) at landfall. Landfall of these hurricanes took place either on the coast of the Gulf of Mexico or in southern Florida which are at least 805 km (500 mi) from the coast of North Carolina. Hurricane Hugo in 1989 made landfall north of Charleston, South Carolina with a 3-second gust wind speed of approximately 245 km/hr (152 mph) which is less than the 253.5 km/hr (157.5 mph) design basis wind speed the applicant defined. Category 4 Hurricane Hazel in 1954 made landfall just south of the North/South Carolina border approximately 64 km (40 mi) from the proposed site with an estimated 3-second gust wind speed of 225 km/hr (140 mph). The applicant further indicated that, the wind speed of a hurricane will decrease once it makes landfall and is expected to continue to decrease as it travels further inland. Because the proposed site is 16 km (10 mi) inland, the expected wind speed at the proposed site will be smaller than that at the landfall area. Therefore, the applicant concludes that its selection of the design basis wind speed of 253.5 km/hr (157.5 mph) is justifiable.

Flooding caused by hurricane to the proposed facility may be in the form of rainfall, high tides, and storm surge. Citing Regulatory Guide 1.59, “Design Basis Floods for Nuclear Power Plants” (NRC, 1977), the applicant indicated that the maximum probable surge along the North Carolina coast can be as high as 6.7 m (21.9 ft). Because the proposed facility is located at an elevation of 7.6 m (25 ft) above sea level and is 32 km (20 mi) upstream from the ocean, the storm surge from a hurricane is highly unlikely to reach the facility horizon. Therefore, the applicant concluded that the storm surge from a hurricane is not a safety concern.

The NRC staff reviewed the applicant’s consideration of hurricane hazard and finds that the applicant’s selection of a Category 4 hurricane as the bounding case for the proposed facility site is acceptable because the applicant appropriately used the historical data to assess the hurricane hazard and the selection approach is meets the acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002). The NRC staff concludes, with reasonable assurance, that the regulatory requirements in 10 CFR 70.65(b)(1) regarding high wind and hurricane hazards have been met. The acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of natural phenomena and other external events sufficient to assess their impact on facility safety,

including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant's analysis of hazards from hurricanes met these criteria and was found to be acceptable.

In Section 2.5.4 of the ISA Summary (GLE, 2011a), the applicant discussed the probable maximum tsunami at the proposed facility site. The applicant pointed out that the facility site is of sufficient distance (more than 16 km (10 mi)) away from the coastline and at a high elevation (7.6 m (25 ft) above sea level) compared to the surrounding level terrain. The applicant further indicated that, using NUREG/CR-6966, "Tsunami Hazard Assessment at Nuclear Power Plant Sites in the United States of America" (NRC, 2009), as guidance, the proposed facility site can be considered "inland." Thus, the applicant determined that the tsunami hazard to the facility is a highly unlikely event. Additionally, the applicant concluded that tidal bores are also highly unlikely given the distance from the coastline, the quick dissipation as bores travel upstream, and the elevation of the proposed facility site that is 7.6 m (25 ft) above mean sea level. The NRC staff agree with the applicant that it is highly unlikely that a tsunami would affect the proposed facility resulting in consequences exceeding the performance criteria in 10 CFR 70.61 and conclude, with reasonable assurance, that the regulatory requirements in 10 CFR 70.65(b)(1) regarding tsunami have been met. The acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) states that the applicant needs to provide a characterization of natural phenomena and other external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant's analysis of hazards from tsunamis met these criteria and was found to be acceptable.

### 3.3.4.3 Extreme Rainfall

Extreme precipitation is discussed in Section 1.3.3.3.2 of the LA (GLE, 2011b), in Section 2.5.7 of the ISA Summary (GLE, 2011a), and in Section 3.6.2.6.2 of the Environmental Report (ER) (GLE, 2008). Based on the NOAA record (1871-2009), the applicant indicated that the highest 24-hour rainfall amount recorded at Wilmington International Airport was 34.0 centimeters (cm) (13.4 inches (in)) that was caused by Hurricane Floyd in September 1999 (NOAA, 2004a). According to the applicant, the extreme environmental rainfall is equivalent to the 24-hour all-season extreme local precipitation of 10.9 cm (4.3 in) estimated by NOAA (NOAA, 2006). The applicant further indicated that Wilmington International Airport has a  $1.0 \times 10^{-3}$  annual exceedance probability of receiving precipitation at a rate of 40.77 centimeters per hour (cm/hr) (16.05 inches per hour (in/hr)) for a duration of 5 minutes (NOAA, 2004b).

In Section 2.5.7 of the ISA Summary (GLE, 2011a), the applicant estimated the probable maximum precipitations (PMPs) for the site for 1, 6, 12, 24, 48, and 72 hour duration using the guidelines in NOAA Hydrometeorological Report Nos. 51 and 52 (NOAA, 1978; NOAA 1982). The applicant stated that to avoid ponding potential from the PMPs, the roofs of the facility structures will not have parapets. The potential effects of PMPs on flooding of the site are evaluated in Section 3.3.4.4 of this SER.

The NRC staff reviewed the applicant's extreme precipitation information and finds that the structural roof design criterion the applicant proposed should be able to prevent roof ponding related hazards. Based on this finding, the NRC staff conclude that the applicant's ISA adequately considered the extreme precipitation risk and the regulatory requirements in 10 CFR 70.65(b)(1) have been met. The acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of natural

phenomena and other external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant's analysis of hazards from extreme rainfall met these criteria and was found to be acceptable.

#### 3.3.4.4 Flooding

In Section 2.5.3 of the ISA Summary (GLE, 2011a) and in Sections 1.3.1.2 and 1.3.3.3.8 of the LA (GLE, 2011b), the applicant discussed flooding events. In Table 4.16-1 of the ISA Summary (GLE, 2011a), the applicant indicated that potential accident sequences induced by flooding hazards may have low consequences as defined in 10 CFR 70.61(c).

The proposed Wilmington, North Carolina, site is located more than 16 km (10 mi) inland from the Atlantic Ocean and its closest bodies of water include the Northeast Cape Fear River and its associated tributaries (GLE, 2011a). The applicant indicated that the proposed facility is located above the 100-year and 500-year flood plains for the region (GLE, 2011a). The potential floods that could affect the proposed facility include flood from rainfall in the Northeast Cape Fear River and Cape Fear River (probable maximum flood (PMF)), flood from local PMP, seismically induced upstream dam failure, hurricane surge, and tsunamis (GLE, 2011a). Flood hazards resulting from hurricane surge and tsunamis are evaluated in Section 3.3.4.2 of this SER (GLE, 2011a).

The applicant indicated that nearest river to the proposed Wilmington, North Carolina, facility site is the Northeast Cape Fear River (GLE, 2011a). This river joins the Cape Fear River 9.7 km (6 mi) south of the site (GLE, 2011a). The applicant calculated the PMF for the Northeast Cape Fear River using the method in American National Standards Institute/American Nuclear Society (ANSI/ANS) ANSI/ANS-2.8, "Determining Design Basis Flooding at Power Reactor Sites" (ANSI/ANS, 1992), to determine the PMF still water level from the discharge flows and determined that flooding of either river could potentially affect the proposed facility site (GLE, 2011a). The applicant determined that the Northeast Cape Fear River has a discharge capability of 2,549–14,442 cubic meters per second ( $\text{m}^3/\text{sec}$ ) (90,000–510,000 cubic feet per second (cfs)) and a PMF discharge of 8,778  $\text{m}^3/\text{sec}$  (310,000 cfs) (GLE, 2011a).

The applicant indicated that the proposed Wilmington, North Carolina, site and the surrounding area are relatively flat with gently sloping surfaces at gradients less than 2 percent and with little relief (GLE, 2011a). The applicant further stated that the proposed facility is located 7.6 m (25 ft) above sea level. This elevation is, in general, the highest level east of the Northeast Cape Fear River (GLE, 2011a). The east side of the Northeast Cape Fear River extends all the way to the coast (GLE, 2011a). The elevation west of the river is also at 7.6 m (25 ft) above sea level for some distance before the elevation gets higher further west (GLE, 2011a). Because of this general level terrain around the Northeast Cape Fear River, the rise of flood level above the 7.6 m (25 ft) above sea level for the main processing facility (MPF) of this river will be limited and will be a slow process due to the availability of large flat region to accommodate the flood water (GLE, 2011a). The applicant indicated that it is difficult to determine the discharge when the water level reaches 7.6 m (25 ft) above sea level due to the wide variability of the cross sections of the Northeast Cape Fear River above that level (GLE, 2011a). Nevertheless, the applicant estimated that, including coincident wind-wave effects, the design basis water level for the MPF is 8.5 m (28 ft) above sea level for the proposed facility site, which is 0.9 m (3 ft) above the proposed facility floor level (GLE, 2011a). Because the water level rising due to a PMF will

be a slow process, the applicant indicated that ample time is available to warn operations personnel and to execute a safe shutdown (GLE, 2011a).

The applicant stated that the PMF from the Cape Fear River with a discharge of twice of that from the Northeast Cape Fear River could also flood the site (GLE, 2011a). However, the applicant concluded that the PMF level from the Cape Fear River would not be likely to be more than 7.6 m (25 ft) above sea level based on the same justification used for the Northeast Cape Fear River (GLE, 2011a). No upstream dams exist on the Northeast Cape Fear River. Several dams exist upstream on the Cape Fear River (GLE, 2011a). These dams are 48 km (30 mi) or more from where the Northeast Cape Fear River joins the Cape Fear River (GLE, 2011a). The applicant indicated that seismically induced dam failure could cause flooding of the proposed facility site; however, the applicant did not expect that such floods could result in a flooding level more that from PMF because of the general level terrain of the proposed facility site and the general area being an estuary (GLE, 2011a). Also, based on the same reason, the applicant concluded that the local PMP-induced flooding should not be more severe than the PMF (GLE, 2011a).

The NRC staff reviewed the applicant's discussion on flood hazards and find that the maximum flood level of 8.5 m (28 ft) above sea level the applicant estimated is acceptable because: (1) the applicant used industry-accepted guidance to calculate PMF; and (2) the NRC staff agrees with the applicant's assessment that the relatively flat topography for the site at elevation greater than 7.6 m (25 ft) above sea level would limit the flood level from rising too much above 7.6 m (25 ft). In addition, because of the relatively flat topography for the site at elevation greater than 7.6 m (25 ft) above sea level, the NRC staff's analysis also concludes that the rise of flood water above 7.6 m (25 ft) will be a slow process and the applicant should have sufficient time to warn operations personnel and to execute a safe shutdown. Therefore, the NRC staff further concludes, with reasonable assurance, that the regulatory requirements in 10 CFR 70.65(b)(1) regarding flood hazards have been met. The acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of natural phenomena and other external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant's analysis of hazards from flooding met these criteria and was found to be acceptable.

#### 3.3.4.5 Snow

In Section 2.5.7.1 of the ISA Summary (GLE, 2011a) and Section 1.3.3.3.2 of the LA (GLE, 2011b), the applicant discusses extreme snowfall events. The largest snow accumulation recorded in the Wilmington, North Carolina, area was 38.9 cm (15.3 in) on December 22–24, 1989 (GLE, 2011a). The maximum amount of snowfall recorded in a 24-hour period was 33 cm (13 in) on December 23, 1989 (GLE, 2011a). This amount of snowfall is equivalent to a ground snow load of approximately 0.8–1.1 kilopascals (kPa) (17–22 pounds per square foot (psf)) (GLE, 2011a). The applicant used the method in American Society of Civil Engineers (ASCE) ASCE 7–05, "Minimum Design Loads for Buildings and Other Structures" (ASCE, 2006) to estimate the snowfall with an annual probability of  $1.0 \times 10^{-5}$  (GLE, 2011a). The estimated ground snow load for an event with an annual probability of  $1 \times 10^{-5}$  is approximately 0.8–1.2 kPa (17–25 psf) (GLE, 2011a). The applicant defined the design basis snow load to be 1.2 kPa (25 psf) (GLE, 2011a).

The applicant recognized that snow drift at the proposed Wilmington, North Carolina, facility could occur where the roof elevations change (GLE, 2011a). Using the guidelines in ASCE 7–05 (ASCE, 2006), the applicant determined that the highest snow load caused by snow drift from roof at high elevation to the same portions of the roofs at low elevation could add additional 4.1 kPa (85 psf) (GLE, 2011a). The applicant pointed out the snow drift load could cause roof decking to sag or fail (GLE, 2011a). However, the applicant analyzed the potential effect of roof decking failure and determined that such failure would only occur at locations where licensed material or hazardous chemicals produced from licensed material were not present (GLE, 2011a). Therefore, the applicant concluded that the roof decking failure would not cause any high or intermediate consequences (GLE, 2011a).

The NRC staff reviewed the information the applicant presented on snow hazards and find the applicant adequately characterize the snow hazards to the proposed facility because it: (1) adequately described the historical snow fall data; (2) estimated ground snow load use a method consistent with acceptable code; and (3) adequately assessed potential effects of roof decking failure caused by snow drift load. Consequently, the NRC staff concludes that the regulatory requirements in 10 CFR 70.65(b)(1) regarding snow hazards have been met. The acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of natural phenomena and other external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant's analysis of hazards from snow met these criteria and was found to be acceptable.

#### 3.3.4.6 Nearby Highways

In Section 2.2.1 of the ISA Summary (GLE, 2011a), Section 1.3.1.1 of the LA (GLE, 2011b), and Section 3.2.1 of the ER (GLE, 2008), the applicant discusses nearby transportation corridors. Several highways and roads are either near or at the boundary of the proposed facility site. The shortest distance from the proposed facility site is approximately 3,219 m (10,560 ft) to Interstate Highway I–40; approximately 1,372 m (4,500 ft) to Interstate Highway I–140; approximately 1,920 m (6,300 ft) to North Carolina Highway 133; and approximately 457 m (1,500 ft) to a local road north of the site (GLE, 2011a).

According to Regulatory Guide 1.91, “Evaluations of Explosions Postulated To Occur on Transportation Routes Near Nuclear Power Plants” (NRC, 1978), the distance from the transportation route to the structures, systems, and components that must be protected should be at least 505 m (1,657 ft) assuming a maximum probable hazardous solid cargo for a single highway truck to be 23,000 kilograms (kg) (50,000 pounds (lb)) of trinitrotoluene equivalent (TNT) (GLE, 2011a). Beyond this distance, the peak positive incident overpressure on the structures, systems, and components induced by the explosion of this solid cargo would be less than approximately 7 kPa (1 psi) below which no significant damage would be expected (GLE, 2011a). This distance is also called the safety distance (GLE, 2011a).

The NRC staff reviewed the road distances the applicant provided from the facility to the surrounding transportation routes and find that the only road with a distance less than the safety distance of 505 m (1,657 ft) is the local road north of the site. However, according to the applicant, this local road is not a transportation route, but a residential subdivision road, and it ends northwest of the proposed facility. Based on this understanding, the NRC staff conclude, with reasonable assurance, that the regulatory requirements in 10 CFR 70.65(b)(1) have been met. The acceptance criteria in Section 3.4.3.2(1)(a) of NUREG-1520 (NRC, 2002) state that



the applicant needs to provide a characterization of external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant's analysis of hazards from highway transportation accidents met these criteria and was found to be acceptable.

#### 3.3.4.7 Railroads

In Section 2.2.2 of the ISA Summary (GLE, 2011a) and in Section 3.2.1.3 of the ER (GLE, 2008), the applicant discusses nearby rail service. CSX Corporation provides freight service to the region.

The NRC staff concludes, with reasonable assurance, that the regulatory requirements in 10 CFR 70.65(b)(1) regarding railroad boxcar explosion hazards have been met. The acceptance criteria in Section 3.4.3.2(1)(a) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant's analysis of hazards from rail transportation accidents met these criteria and was found to be acceptable.

#### 3.3.4.8 Nearby Industrial Facilities

In Section 2.4 of the ISA Summary (GLE, 2011a); Sections 1.1.1, 1.3.2.4, and 1.3.2.5 of the LA (GLE, 2011b); and Section 3.1.6 in the ER (GLE, 2008), the applicant discusses nearby industrial facilities. The nearest facilities to the proposed facility include Global Nuclear Fuel–Americas, LLC (GNF-A) Fuel Manufacturing Operations Facility, General Electric Aircraft Engines and Services Components Operation Facilities, Fuel Components Operation Facility. Among these facilities, the GNF-A Fuel Manufacturing Operations Facility is the closest with a distance of approximately 1,737 m (5,700 ft) (GLE, 2011a). The applicant concluded that this distance provides adequate protection to the proposed facility personnel from radiological and chemical releases from the most significant, credible accident sequences resulting from GNF-A operations (GLE, 2011a). The applicant further indicated that offsite industrial facilities that exist within 8 km (5 mi) of the proposed facility site include the BASF Corporation, Elementis Chromium facilities, and the L.V. Sutton coal-fired power plant (GLE, 2011a). These facilities are located on the west side of the Northeast Cape Fear River and would not pose a safety concern to the proposed facility (GLE, 2011a). Also, these industrial facilities do not own or produce nuclear material (GLE, 2011a).

Based on this review, the NRC staff conclude, with reasonable assurance, that the regulatory requirements in 10 CFR 70.65(b)(1) have been met because the applicant adequately considered and included relevant nearby facilities-related hazards in its ISA. The acceptance criteria in Section 3.4.3.2(1)(a) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant's analysis of hazards from accidents at nearby industrial facilities met these criteria and was found to be acceptable.

#### 3.3.4.9 Air Transportation

In Section 2.2.4 of the ISA Summary (GLE, 2011a), Section 1.3.2.5 of the LA (GLE, 2011b), and Section 3.2.1.4 of the ER (GLE, 2008), the applicant discusses nearby airport facilities. There is

one primary commercial airport (New Hanover County Airport) and 12 small municipal airport facilities in the tri-county area (New Hanover, Pender, and Brunswick) (GLE, 2011a, Figure 2-3) (GLE, 2011a). Brunswick County has seven small airports including heliports. Pender County has four small airports (GLE, 2011a). Besides the New Hanover County airport (Wilmington International Airport), New Hanover County also has a small airport (Pilot Ridge) located approximately 18.5 km (11.5 mi) from the proposed facility site (GLE, 2011a). Among these airports, four are publicly owned (New Hanover County Airport in New Hanover County; Odell Williamson and Brunswick County in Brunswick County; and Henderson Field Airport in Pender County) and the remaining airports are private airports for private use only (GLE, 2011a).

The airport nearest to the proposed facility site is the New Hanover County Airport, approximately 8 km (5 mi) away (GLE, 2011a). The next nearest airport is the Sandy Run Acres Airport in Brunswick County, approximately 16 km (9.9 mi) away (GLE, 2011a). Besides the Pilot Ridge Airport, three airports (Pettigrew Moore Aerodome and Stag Air Park in Pender County and Winnabow Airport in Brunswick County) are between 16 and 24 km (10 and 15 mi) from the proposed facility site (GLE, 2011a). The remaining are more than 32 km (20 mi) away from the proposed site (GLE, 2011a).

Except for the New Hanover County Airport, all the other airports are small with limited annual number of operations (GLE, 2011a). The applicant showed that the aircraft hazards associated with these airports need not be included in the assessment of aircraft crash hazard for the proposed facility using the guidelines provided in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (NRC, 2007c). The NRC staff also finds it acceptable for the applicant to exclude these airports in the aircraft hazard analysis for the proposed site because these airports are either for private use or are small operations with the annual number of operations much less than the threshold numbers for the corresponding airports as specified in NUREG-0800 (NRC, 2007c).

The applicant indicated that the proposed facility is located just off a direct flight path 6.4–8.0 km (4–5 mi) from the runways of the New Hanover County Airport (GLE, 2011a). The applicant determined that, due to the proximity of the proposed facility to the New Hanover County Airport, the screening criteria outlined in NUREG-0800 (NRC, 2007c) are not met; therefore, estimation of aircraft crash probability was needed (GLE, 2011a). The NRC staff finds that it is appropriate for the applicant to assess aircraft crash hazard to the proposed facility. An aircraft crash hazard analysis is required because the annual number of operations (more than 83,000 from AirNav.com (2009) and more than 92,000 from Airport-Data.com (2009)) at the New Hanover County Airport greatly exceeds the operation threshold specified in NUREG-0800 (NRC, 2007c) (GLE, 2011a). The NUREG-0800-specified threshold of annual number of operations for a facility with a distance,  $D$ , approximately 8 km (5 mi) from the airport of interest is  $500 \times D^2$  (NRC, 2007c). In the case of New Hanover County Airport, the threshold for annual number of operations is approximately 12,500, which is less than the recorded operations of 83,000–92,000 (GLE, 2011a).

The applicant used the methods provided in U.S. Department of Energy (DOE) Standard DOE-STD-3014, "Accident Analysis for Aircraft into Hazardous Facilities" (DOE, 2006) to estimate aircraft crash frequency at the New Hanover County Airport and NUREG-0800 (NRC, 2007c) to gain additional insight into the aircraft potential to the proposed site (GLE, 2011a). The applicant included all aircraft types in the analyses (GLE, 2011a). For each method, the applicant considered three categories of flight operations data (GLE, 2011a). For Category 1 or Case 1, the applicant estimated the number of operations by selectively using the data from the

Federal Aviation Administration Air Traffic Activity Data System, AirNav information, and New Hanover County Airport operations records (GLE, 2011a). For Case 2, the applicant used the average of the 10-year (1999–2008) historical flight data. Case 3 included the 40-year historical flight data (GLE, 2011a). The applicant indicated that the 30-year operations data before 1999 show a steady increase in numbers of operations (GLE, 2011a). The numbers of operations show a decreasing trend since 2007 (GLE, 2011a). The applicant further indicated that the 10-year historical data (1999–2008) used for Case 2 represented the best operation estimate that bounds the current New Hanover County Airport operations and addresses potential future operation changes (GLE, 2011a). Consequently, the applicant used the probability estimates for Case 2 to assess potential aircraft crash hazards to the proposed facility (GLE, 2011a). The NRC staff finds that the applicant's decision using the probability estimates for Case 2 to assess aircraft crash hazards at the site is acceptable because the data set used in Case 2 bounds the New Hanover County Airport operations.

The applicant presented the aircraft crash frequencies obtained from these two methods for Case 2 in its ISA Summary (GLE, 2011a). The aircraft crash frequency for the proposed facility Operations Building obtained using DOE–STD–3014 (DOE, 2006) is  $3.66 \times 10^{-5}/\text{yr}$  and it is  $3.47 \times 10^{-6}/\text{yr}$  using the approach in NUREG–0800 (NRC, 2007c). The applicant further fine tuned the calculation using the effective height of the proposed facility instead of assuming that the entire Operations Building has the same height as the taller part (35-percent of the Operations Building is taller than the rest of the building) and excluding crash of single engine aircraft (GLE, 2011a). The resulting aircraft crash probability is  $1.06 \times 10^{-5}/\text{yr}$  using the DOE–STD–3014 (DOE, 2006) method and  $1.06 \times 10^{-6}/\text{yr}$  for the NUREG–0800 (NRC, 2007c) approach. The applicant contended that, with the additional inherent conservatism as discussed in ISA Summary (GLE, 2011a), it is reasonable to conclude that the potential of having an aircraft crash to affect the proposed facility is highly unlikely.

The NRC staff reviewed the aircraft crash analysis information the applicant provided. Based on this review, the NRC staff finds that the applicant's analysis results are acceptable because the applicant appropriately used: (1) the threshold guidelines specified in NUREG–0800 (NRC, 2007c) to screen small airports in the region and holding patterns associated with the New Hanover County Airport from further consideration in the analysis; (2) the commonly accepted methods to estimate aircraft crash probability; and (3) reliable flight operations data from Federal Aviation Administration Air Traffic Activity Data System. Therefore, the NRC staff further concludes, with reasonable assurance, that the regulatory requirements in 10 CFR 70.65(b)(1) regarding aircraft hazards have been met. The acceptance criteria in Section 3.4.3.2(1)(a) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant's analysis of hazards from air transportation accidents met these criteria and was found to be acceptable.

#### 3.3.4.10 Geology and Seismic Events

The applicant provides information on seismic hazards in Section 2.5.1 of the ISA Summary (GLE, 2011a), Section 1.3.5 of the LA (GLE, 2011b), and Section 3.3 of the ER (GLE, 2008).

Staff review of the seismic hazard applicable to the safety and design of the proposed facility included:

- Tectonic setting;
- Historic seismicity; and
- Seismic hazard assessment.

#### 3.3.4.10.1 Tectonic Settings

In Section 2.5 of the ISA Summary (GLE, 2011a), in Section 1.3.5 of the LA (GLE, 2011b), and Section 3.3 of the ER (GLE, 2008), the applicant discusses the tectonic setting of the proposed facility site. The proposed facility is located on the Atlantic Coastal Plain physiographic province (GLE, 2011a). This province is a broad, low-relief terrace that stretches from along the Atlantic seaboard from New England to the Gulf of Mexico (GLE, 2011a). The site geology is comprised of a wedge of unconsolidated sands, silt, marl, and other clays interbedded with occasional limestone strata, which rests atop crystalline basement rocks (GLE, 2011a). As noted in Section 2.5.1 of the ISA Summary (GLE, 2011a), the Atlantic Coastal Plain is not tectonically active. Small to moderate magnitude earthquakes occur throughout the region with concentrations in the Appalachian Mountains west of the site and near Charleston, South Carolina (GLE, 2011a). These clusters of earthquakes are considered by the applicant to be associated with relic structures from Appalachian tectonics dating back more than 250 million years ago and from aftershocks related to the 1886 Charleston, South Carolina, Earthquake (GLE, 2011a). There are no geologic features in the Wilmington, North Carolina, region that have been identified as being capable of producing significant earthquakes (GLE, 2011a). In the U.S. Geological Survey (USGS) report, "Documentation for the 2008 Update of the United States National Seismic Hazard Maps" (USGS, 2008) USGS identified this area as Zone 1, with moment magnitudes ( $M_w$ ) less than 6.0 and Modified Mercalli Intensity (MMI) values of VI or less. In the USGS report, "Earthquakes in Virginia and Vicinity 1774-2004" (USGS, 2006), USGS describes MMI values of VI as moderate shaking which produces only slight damage to buildings and structures (GLE, 2011a).

#### 3.3.4.10.2 Historic Seismicity

In the North Carolina Division of Emergency Management (NCDEM) report, "Seismic Hazard in North Carolina" (NCDEM, 1991), NCDEM states that the area around Wilmington, North Carolina is not seismically active. There are no known active fault zones or concentrations of significant historic seismicity in North Carolina (GLE, 2011a). The nearest major seismic event was located approximately 240 km (150 mi) southwest of the proposed facility site, near Charleston, South Carolina (GLE, 2011a). Charleston experienced a large earthquake in 1886, with maximum MMI value of X and an estimated magnitude of between 6.6 and 7.3 (USGS, 2008). Paleoseismic information indicates similar earthquakes shook the Charleston, South Carolina, region several times over the past several thousand years (USGS, 2008). A repeat of the Charleston earthquake is considered the most significant source to the seismic hazards for the southeast coast of the United States, including Wilmington, South Carolina (USGS, 2008). Estimates of repeat times for a Charleston Earthquake range between 250 and 1,000 years (Talwani, 2001). Based on an evaluation of several regional earthquake catalogs (USGS, 2006), the applicant identified nearly 900 earthquakes within a 322 km (200 mi) of the site between 1698 and 2007 (GLE, 2011a). Most of these were small, with estimated moment magnitudes less than 2.0. The two largest recorded earthquakes in the region occurred on January 18, 1884, and again on March 5, 1958 (GLE, 2011a). No substantial damage was reported from either earthquake (GLE, 2011a). Press reports indicate that houses shook and

some people were rolled out of bed, suggesting that these two earthquakes had maximum modified MMI values of V (NCDEM, 1991).

The recent August 23, 2011 earthquake, with a magnitude of 5.8, occurred more than 480 km (300 mi) north of the Wilmington site near the town of Mineral, Virginia (GLE, 2011a). According to the USGS shake maps for this earthquake, little or no ground shaking was felt in Wilmington from this earthquake (GLE, 2011a). In Section 2.5.1.2 of the ISA summary (GLE, 2011a), the applicant noted that this earthquake occurred in an area of the Virginia Piedmont known as the Central Virginia Seismic zone and that a similar magnitude event occurred near there in 1897. The closest distance between the Central Virginia seismic zone and the proposed site is about 130 km (80 mi) (GLE, 2011a). A repeat of the 1886 Charleston, SC earthquake, located at its closest point to the site remains as the most severe historical seismic event relative to the proposed site (GLE, 2011a).

#### 3.3.4.10.3 Seismic Hazard Evaluation

In addition to the lack of significant historical earthquakes near the site, the applicant cites the 2008 USGS National Seismic Hazard Maps (USGS, 2008) to conclude that the seismic hazards at the site are not significant to safety (GLE, 2011a). Based on the USGS maps, the facility site has a 2 percent probability in a 50-year period of exceeding a peak-ground acceleration (PGA) of 0.11 g (g is the acceleration due to gravity) (GLE, 2011a). The 2 percent probability in a 50-year period is approximately equal to a return period of 2,500 years or an annual probability of  $4 \times 10^{-4}$  (GLE, 2011a). There is also a 2 percent probability in a 50-year period of exceeding a 1-second spectral acceleration of 0.08 g and a 2 percent probability in a 50-year period of exceeding a 0.2-second spectral acceleration of 0.24 g (GLE, 2011a). The USGS map results are based on an assumed "firm rock" site conditions (Site Class B) with a shear wave velocity of 760 meters per second (m/s) (2,500 feet per second (ft/s)) (GLE, 2011a).

Based on this analysis, the applicant derived In Table 1-8 of the ISA Summary (GLE, 2011a), the applicant defined "highly unlikely" for earthquakes as natural phenomena in terms of a performance goal. According to this definition, the seismic performance goal is a failure probability equal to  $1 \times 10^{-4}$ /yr (GLE, 2011a). The applicant states that this performance goal can be achieved by applying the additional design features of the ASCE 43-05, "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities" (ASCE, 2005) to the design of the building as an IROFS (GLE, 2011a).

As noted in the ISA Summary (GLE, 2011a), the applicant originally defined the design basis earthquake (DBE) for the proposed facility in terms of a deterministic earthquake ground motion as described in Interim Staff Guidance (ISG) FCSS-ISG-08, "Natural Phenomena Hazards," (NRC, 2005). This approach follows the method for development of the safe shutdown earthquake described in 10 CFR Part 100, Appendix A (GLE, 2011a). In particular, the applicant used two earthquakes to develop the design basis ground motions; a repeat of the 1886 Charleston earthquake located 114 km [71 mi] from the site and a local magnitude 5.0 earthquake 20 km (12.5 mi) from the site (GLE, 2011a). Based on this analysis, the applicant derived ground motions of 0.06 for the PGA, 0.14 g for the 2-second spectral acceleration and 0.05 g for the 1-second spectral acceleration, assuming 5 percent damping (GLE, 2011a). The applicant used the suite of ground motion attenuation models and the weighting scheme for those modes as developed in the 2008 update of the United States National Seismic Hazard Maps (USGS, 2008). Because the USGS models assume Site Class B conditions, but soils at the site are Site Class C, the applicant used site amplification coefficients from the IBC (ICC,

2006) to derive design basis ground motions (5 percent damping) of 0.07 PGA, 0.17 g for the 2-second spectral acceleration and 0.09 g for the 1-second spectral acceleration (GLE, 2011a).

However, the applicant determined, based on a comparison of the deterministic DBE with the USGS 2008 probabilistic seismic hazard results, using USGS 2008 data, that the likelihood of the DBE is approximately  $1 \times 10^{-3}$ /year (GLE, 2011a). Thus, the applicant determined that the DBE falls short of the “Highly Unlikely” performance goal of  $1 \times 10^{-4}$ /year for seismic events (GLE, 2011a). Therefore, the applicant developed an approach that uses a combination of the  $4 \times 10^{-4}$  probabilistic ground motions and the design features of the ASCE 43–05 (ASCE, 2005) to assure that they the  $1 \times 10^{-4}$ /year performance goal is achieved (GLE, 2011a).

#### 3.3.4.10.4 Staff Evaluation of Seismic Hazard Assessment

The NRC staff reviewed the information provided in the LA (GLE, 2011b), the ISA Summary (GLE, 2011a), and the ER (GLE, 2008). Based on this review the staff conclude that the applicant met the requirements of 10 CFR 70.64(a)(2). The NRC staff conclusion is based on the following rationale:

- The description of the tectonic setting is derived from the USGS report entitled, “Quaternary Fault and Fold Database of the United States” (USGS, 1998); North Carolina Geologic Survey (NCGS) Bulletin 95, “Geology of Basement Rocks Beneath the North Carolina Coastal Plain” (NCGS, 1993); and the published geologic literature (e.g., Talwani, 2001). NRC staff evaluated this information and based on the staff’s expert judgment, the staff find that the applicant appropriately considered the tectonic setting in their evaluation of the potential seismic hazard at the site.
- The summary of historical earthquakes was derived from an examination of reliable earthquake catalog information, including data published in “The Virginia Tech Seismological Observatory Historic/Instrumental Southeaster U.S. Earthquake Catalog” (VPI, 2008) and the Advanced National Seismic System (ANSS) of the USGS (<http://earthquake.usgs.gov/monitoring/anss/>). NRC evaluated the historical earthquake information in the application and compared the information to other sources of earthquake data, including USGS ANSS catalog. Based on this evaluation, the staff found that the applicant appropriately considered the relevant historical earthquake data in their evaluation of the potential seismic hazard at the site.
- The design basis ground motions were derived from the 2,500-year return period ground motions from the USGS 2008 National Seismic Hazard map (USGS, 2008) and adjusted for site soil conditions using the site amplification coefficients from the IBC (ICC, 2006). Staff review finds that a design basis earthquake using the 2,500-year return period ground motions based on a probabilistic seismic hazard assessment is consistent with guidance in DOE-STD-1020, “Natural Phenomena Hazards Design And Evaluation Criteria For Department of Energy Facilities,” (DOE, 2002a) and ASCE 43–05 (ASCE, 2005) and is, therefore, appropriate as the seismic design basis for the proposed facility.
- Current nuclear-grade design codes and standards (such as ASCE, 2005; DOE, 2002a; and DOE-STD-1023, “Natural Phenomena Hazard Assessment Criteria” (DOE 2002b)) suggest that structures, systems, and components (SSCs) designed and constructed following these codes and standards will maintain their safety functions well beyond their design level. For example, in Table C-3 of DOE-STD-1023 (DOE, 2002b), DOE

concludes that SSCs appropriately designed to  $4 \times 10^{-4}$  ground motions have sufficient design margins so that they will maintain their safety functions for seismic demands four times less likely, or the  $1 \times 10^{-4}$  probability of exceedence ground motions. This would suggest that the SSCs at the proposed facility that are designed using the  $4 \times 10^{-4}$  design basis ground motions would maintain their safety functions even under seismic demands from the  $1 \times 10^{-4}$  ground motions.

- The use of the guidance in FCSS-ISG-08 (NRC, 2005) is not appropriate in this case because the deterministic safe shutdown earthquake does not represent a level of hazard sufficient to address safety of the facility, given the potentially high consequence of radiological risks from the facility. The deterministic DBE is roughly equal to  $1 \times 10^{-3}$  probabilistic ground motions, and, thus, it is not sufficient to allow the target  $1 \times 10^{-4}$  performance goal to be achieved.

Therefore, based on these aforementioned reasons, the seismic hazard assessment conducted by the applicant coupled with the proposed seismic design method will, with reasonable assurance, meet the  $1 \times 10^{-4}$  definition of “highly unlikely.” The acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of natural phenomena and other external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff found that the information provided by the applicant meets the criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 3.3.4.11 Slope Stability

Slope stability of the site is discussed in Section 1.3.5.1 of the LA (GLE, 2011b) and Section 3.3.5 and 4.3.2 of the ER (GLE, 2008). The applicant indicated that the proposed facility site is relatively flat with gently sloping surfaces at gradients less than 2 percent and with little relief (GLE, 2011a). The applicant concluded that landslides resulting from slope instability are not a safety concern to the proposed facility (GLE, 2011a). The NRC staff visited the site previously on May 18–20, 2004, for an onsite review of the GNF-A Fuel Fabrication Facility and, based on this onsite observation, the NRC staff concur with the applicant that the proposed facility site is relatively flat with gently sloping surfaces and, therefore, does not have a slope instability concern and hazards associated with slope instability are not credible. Therefore, the NRC staff conclude, with reasonable assurance, that the regulatory requirements in 10 CFR 70.65(b)(1) have been met regarding to this topic. The acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of natural phenomena and other external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant’s analysis of hazards from seismic events met these criteria and was found to be acceptable.

#### 3.3.4.12 Liquefaction

In Section 2.5.1.3 of the ISA Summary (GLE, 2011a), Section 1.3.5.3 of the LA (GLE, 2011b), and Sections 3.3.5 and 4.3.2 of the ER (GLE, 2008), the applicant discusses the potential for liquefaction. The applicant assessed liquefaction potential at the proposed facility site through geotechnical investigations using soil data from two borings (GLE, 2011a). The applicant indicated that the soils in the two borings represent the highest and lowest potential for liquefaction (GLE, 2011a). The assessment compared the calculated cyclic stress ratio to the

calculated cyclic resistance ratio (GLE, 2011a). In general, when a cyclic stress ratio is greater than the cyclic resistance ratio, liquefaction is likely (GLE, 2011a). The applicant determined the cyclic stress ratio using the peak horizontal ground acceleration of 0.139 g (corresponding to the design earthquake with a return period of 2,500 years) based on the USGS maps included in the 2006 North Carolina Building code (ICC, 2006). The assessment results suggest marginal risk of localized liquefactions at depths of 8 and 12 m (25 and 40 ft) for soils in one boring, whereas the soils in the other boring do not have a liquefaction risk (GLE, 2011a). The cyclic stress ratio for the soil at the depth of 8 m (25 ft) is approximately 20 percent larger than the cyclic resistance ratio, and it is nearly the same for the soil at the depth of 12 m (40 ft) (GLE, 2011a). Based on this assessment, the applicant concluded that soil liquefaction potential is small at the proposed site for a peak horizontal ground acceleration of 0.139 g (GLE, 2011a). The applicant committed to conduct a more detailed evaluation during the final subsurface investigation using the guidance in Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants" (NRC, 2003a) to more accurately estimate the cyclic stress ratios and cyclic resistance ratios for the soils at the final structure location (GLE, 2011a). This supports design consideration on liquefaction potential using the guidance in Regulatory Guide 1.198, "Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites" (NRC, 2003b). In Section 1.5.3 of the LA (GLE, 2011b), the applicant further committed to assess liquefaction potential and its effects on operational safety using a horizontal ground acceleration consistent with the ground motion guidance in the IBC (ICC, 2006).

The NRC staff evaluated the liquefaction potential results the applicant presented in Tables G-7 and G-8 of the ER (GLE, 2008) using the cyclic resistance ratio curves for various fines contents in the cyclic stress ratio-blow count diagram recommend in the National Center for Earthquake Engineering Research (NCEER) report, "Earthquake-Induced Liquefaction Features in the Coastal South Carolina Region" (NCEER, 1987), and find the applicant's assessment results are reasonable and acceptable. The NRC staff also conclude, with reasonable assurance, that the regulatory requirements in 10 CFR 70.65(b)(1) have been met regarding this topic because the applicant's commitment to conduct a more detailed evaluation of liquefaction potential for the soils at the final structure location using NRC guidance to support design is appropriate and acceptable. The acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a characterization of natural phenomena and other external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant's analysis of hazards from seismic events met these criteria and was found to be acceptable.

#### 3.3.4.13 Settlement and Soil-Bearing Capacity

In Sections 1.3.5.1 and 1.3.5.3 of the LA (GLE, 2011b) and Sections 3.3.5 and 4.3.2 of the ER (GLE, 2008), the applicant discusses the potential for soil settlement. The applicant indicated that it would consider the potential for differential settlement across a foundation when preparing facility and roadway engineering designs (GLE, 2011a). In addition, the applicant provided soil information and discussed the geophysical and geotechnical investigation results it used to assess feasibility of this proposed site for construction of the proposed facility (GLE, 2011a). To support structural design, the applicant further committed to conduct a geotechnical investigation (GLE, 2011a). This investigation will be performed in accordance with Regulatory Guide 1.132 (NRC, 2003a). To assess total and differential settlements for structural foundations, the applicant plans to use methods provided in Naval Facilities Engineering Command (NAVFAC) Design Manual (DM) 7, "Naval Facilities Engineering Command Design



Manual” (NAVFAC, 1986), “Foundation Engineering Handbook” (Fang, 1990), and Foundation Analysis Design (Bowles, 1995).

For determining the allowable bearing pressure for shallow and deep foundations, the applicant will use the methods in NAVFAC DM 7 (NAVFAC, 1986), Foundation Engineering Handbook (Fang, 1990), Foundation Analysis Design (Bowles, 1995), and Federal Highway Administration, (FHWA), FHWA-IF-99-025, “Drilled Shafts: Construction Procedures and Design Methods” (FHWA, 1999).

The NRC staff found that the applicant’s commitment of conducting a geotechnical investigation to support facility structural design is acceptable. The NRC staff conclude, with reasonable assurance, that the regulatory requirements in 10 CFR 70.65(b)(1) have been met because the guidelines the applicant proposes to use for the geotechnical investigation are acceptable NRC guidance and the methods the applicant proposes to use for settlement and allowable soil-bearing pressure determinations are industry-accepted methods as recommended in Regulatory Guide 1.132 (NRC, 2003a). The acceptance criteria in Section 3.4.3.2(1)(c) of NUREG-1520 (NRC, 2002) states that the applicant needs to provide a characterization of natural phenomena and other external events sufficient to assess their impact on facility safety, including a discussion of which events are incredible and the basis for that determination. The NRC staff concluded that the applicant’s analysis of hazards from seismic events met these criteria and was found to be acceptable.

### 3.3.5 DESCRIPTION OF ISA TEAM QUALIFICATIONS AND ISA METHODS

#### 3.3.5.1 ISA Team Qualification

The regulations in 10 CFR 70.62(c)(2) require that, to assure the adequacy of the ISA, the analysis must be performed by a team with expertise in engineering and process operations. The team must include at least one person who has experience and knowledge specific to each process being evaluated, and persons who have experience in nuclear criticality safety, radiation safety, fire safety, and chemical process safety. One member of the team must be knowledgeable in the specific ISA method being used. In addition, the regulations in 10 CFR 70.65(b)(5) require a description of the expertise of the ISA team members and their qualifications. The acceptance criteria in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002) state that the applicant’s ISA team leader needs to have formal training in the chosen method(s), at least one member needs to have specific operating experience in the process under review, and the team needs to have representatives from a variety of design and safety disciplines.

In Section 1.3 of the ISA Summary (GLE, 2011a), the applicant stated that separate ISA Teams applied the ISA approach to the unclassified as well as the classified portions of the design under the direction of the ISA Team Leader. Each team included members with experience in:

1. Nuclear criticality;
2. Radiological safety;
3. Fire protection;
4. Laser enrichment technology;
5. Chemical safety; and
6. Process/operations.

The team leader is formally trained in ISA methods and may be an outside consultant. Table 1-11 of the ISA Summary (GLE, 2011a) provides a list of key ISA team members along with their experience and qualifications.

The information provided by the applicant in Chapter 1 of the ISA Summary addresses the criteria in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002), for identification of a team leader trained in the chosen ISA methodologies, and the team of individuals with the range of experience and disciplines required for a thorough understanding of the processes which were evaluated. Based on the above information, the staff finds that the ISA team and their qualifications are acceptable for meeting the requirements of 10 CFR 70.62(c)(2) and 10 CFR 70.65(b)(5) and the acceptance criteria in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002) because the applicant's ISA team leaders have formal training in the chosen method(s), at least one member has specific operating experience in the process under review, and the ISA team includes representatives from a variety of design and safety disciplines.

### 3.3.5.2 ISA Methods

The regulations in 10 CFR 70.65(b)(5) require a description of the methods used to perform the ISA. The acceptance criteria in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002) state that the applicant's ISA method needs to provide a list of hazards and potential interactions, needs to select one of the methods described in NUREG-1513, "Integrated Safety Analysis Guidance Document" (NRC, 2001), needs to evaluate consequences in a manner consistent with the approaches described in NUREG/CR-6410, "Nuclear Fuel Cycle Facility Accident Analysis Handbook" (NRC, 1998), and needs to evaluate likelihood in an acceptable manner, such as the one described in Appendix A of NUREG-1520 (NRC, 2002). The applicant's conformance with those criteria is described below.

In Section 1.2.1 of the ISA Summary (GLE, 2011a), the applicant stated that each facility/process is divided down to "nodes," which established the boundaries for the review that the ISA team could efficiently and accurately analyze using an appropriate hazard identification method such as those described in the American Institute of Chemical Engineers (AIChE), "Guidelines for Hazard Evaluation Procedures" (AIChE 1992) including "What-if"/checklist analyses. The method uses an interdisciplinary team to identify hazards, construct accident scenarios, assess consequences, and select IROFS. The applicant considered all modes of operations, including startup, normal operation, shutdown and maintenance in addition to common cause incidents, common mode failures, system interactions, and process conditions that could lead to undesirable consequences which do not meet the 10 CFR 70.61 performance requirements.

The applicant used Process Hazards Analyses (PHAs), Fire Hazards Analyses (FHAs), or similar analyses to identify facility hazards and incorporate the results into the ISA. A PHA is a set of systematic assessments of the potential hazards associated with an industrial process, and provides information useful in analyzing potential causes and consequences of fires and releases of toxic or flammable chemicals. The methods for conducting a PHA include, but are not limited to "Layer Of Protection Analysis", and "What-if/ Checklist" techniques. An FHA is a comprehensive evaluation of the causes of, impacts from, and consequences of a fire scenario. The staff finds that the hazard analysis methods meet the acceptance criteria in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002) and are, therefore, acceptable.

The acceptance criteria in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002) state that the applicant's ISA method should be one of the methods described in NUREG-1513 (NRC, 2001). The applicant utilized a combination of "What-If"/checklist analyses followed by event tree analysis techniques in the development of event summary tables, and to identify the IROFS (GLE, 2011a).

NUREG-1513, Appendix A, "Flowchart for Selecting a Hazards Analysis Technique" (NRC, 2001), identifies the "What-If"/checklist technique as an acceptable approach. Therefore, the staff concludes that the process hazard analysis method used by the applicant is acceptable for the identification of potential radiological, chemical and facility hazards, and potential accident sequences caused by process deviations; or other events internal to the facility and credible external events, including natural phenomena that could lead to a loss of UF<sub>6</sub> confinement or a criticality. Based on the above information, the staff finds that the methods used to perform the ISA meet the acceptance criteria in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002) and are, therefore, acceptable.

### 3.3.6 ISA REGULATORY REQUIREMENTS

The regulations in 10 CFR 70.65(b)(4) require that the ISA Summary contain information that demonstrates the applicant's compliance with the performance requirements of 10 CFR 70.61, including a description of the management measures, the requirements for criticality monitoring and alarms in 10 CFR 70.24, and the requirements of 10 CFR 70.64. The regulations in 10 CFR 70.61(b) require that the risk of each credible high consequence event be limited. Engineered controls, administrative controls, or both, shall be applied to the extent needed to reduce the likelihood of the event so that, upon implementation of such controls, the event is highly unlikely or its consequences are less severe than those in paragraphs (b)(1)-(4) of 10 CFR 70.61. The regulations in 10 CFR 70.61(c) require that the risk of each credible intermediate consequence event be limited. Engineered controls, administrative controls, or both, shall be applied to the extent needed to reduce the likelihood of the event so that, upon implementation of such controls, the event is unlikely or its consequences are less severe than those in paragraphs (c)(1)-(4) of 10 CFR 70.61. The regulations in 10 CFR 70.61(d) require that the risk of nuclear criticality accidents be limited by assuring that under normal and credible abnormal conditions, all nuclear processes are subcritical including an approved margin of subcriticality for safety. Preventive controls (as opposed to mitigative controls) must be the primary means of protection against nuclear criticality accidents.

Section 3.4.3.2(4) of NUREG-1520 (NRC, 2002) recommends that the performance requirements of 10 CFR 70.61 have three elements: (1) completeness, (2) consequences, and (3) likelihood. Completeness refers to the fact that the ISA must address each credible event. Consequences refer to the magnitude of the chemical and radiological doses of the accident and are the basis upon which an accident is classified in 10 CFR 70.61 to be a high or intermediate consequence event. Likelihood refers to the fact that 10 CFR 70.61 requires that intermediate consequence events be unlikely and high consequence events be highly unlikely. The applicant's approach to each of these elements is discussed below.

#### 3.3.6.1 Completeness

In Chapter 4 of the ISA Summary (GLE, 2011a), the applicant evaluated materials that are radioactive, fissile, flammable, explosive, toxic, and reactive; and identified potentially hazardous conditions. Hazards were assessed individually for the potential impact on the

process systems (e.g., UF<sub>6</sub> feed system) (GLE, 2011a). The FHA was consulted in order to place reasonable and conservative bounds on the fire scenarios (GLE, 2011a). External events evaluated included seismic, tornado, tornado missile and high wind, snow and ice, flooding, local precipitation, transportation and nearby facility accidents, aircraft, pipelines, highway, railroad, and flooding (GLE, 2011a). The facility assessment resulted in natural phenomena events being assessed against all structures without regard to location or design differences, and fires were assessed by process nodes and included all possible fire hazards within the area (GLE, 2011a). These assessments by the applicant are evaluated by the applicant's ISA Team in the discipline-related chapters of the ISA Summary (GLE, 2011a). At the end of the discussion for each node, the applicant listed each accident sequence, likelihood and consequence category, applicable IROFS, and overall risk (GLE, 2011a).

The staff reviewed the accident sequences and determined that the ISA addressed the criteria in Section 3.4.3.2(4) of NUREG-1520 (NRC, 2002) because the applicant correctly applied an appropriate accident identification method, the "What-If" method, as described in NUREG-1513 (NRC, 2001) and effectively presented the information for each node using an appropriate description of the identified accidents. In addition, the information meets the acceptance criteria in 3.4.3.2(3) as discussed in Section 3.3.3 of this SER. The staff, therefore, has reasonable assurance that the ISA is complete.

#### 3.3.6.2 Consequences

In Section 1.2.4 of the ISA Summary (GLE, 2011a), the applicant listed three different consequence severity rankings (low, intermediate, and high) based on the consequences resulting from exposure to chemical, fire, criticality, or radiological hazards. The applicant's program estimates the possible "worst case" consequences using acceptable methods including the guidance in NUREG/CR-6410 (NRC, 1998).

The high and intermediate rankings correspond to those listed in 10 CFR 70.61(b) and (c) for high and intermediate consequence events, respectively. NRC staff reviewed the applicant's criteria for determining whether an accident is classified in 10 CFR 70.61 to be a high or intermediate consequence event and has determined that the criteria are in conformance with 10 CFR 70.61(b)(1)-(4) and (c)(1)-(4) and are acceptable. The staff considers the consequence determinations to be acceptable and in accordance with the guidance in NUREG/CR-6410 (NRC, 1998). The staff finds that the methods used to evaluate consequences meet the acceptance criteria in Sections 3.4.3.2(4) and 3.4.3.2(5) of NUREG-1520 (NRC, 2002) and are, therefore, acceptable.

#### 3.3.6.3 Enabling Conditions

In Section 1.2.3 of the ISA Summary (GLE, 2011a), the applicant introduces a new term, "enabling events," which do not cause the sequence, but must be present for the initiating event to proceed.

Staff examined the contribution of the enabling events, and determined that for each sequence, the identified IROFS were sufficient to make the overall likelihood unlikely or highly unlikely, as appropriate, and, therefore, no enabling events were necessary to meet the performance requirements. The staff considers the likelihoods to have been derived using acceptable methods and to comply with acceptable definitions of "not unlikely," "unlikely," and "highly

unlikely". The staff concludes that these descriptions meet the acceptance criteria provided in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002) and are, therefore, acceptable.

#### 3.3.6.4 Conditional Events

In Section 1.2.3 of the ISA Summary (GLE, 2011a), the applicant introduces a new term, "conditional events," which are not considered IROFS, but affect the overall likelihood of the accident sequence.

Staff examined the contribution of the conditional events, and determined that for each sequence, the identified IROFS were sufficient to make the overall likelihood unlikely or highly unlikely, as appropriate, and therefore no conditional events were necessary to meet the performance requirements. The staff considers the likelihoods to have been derived using acceptable methods and to comply with acceptable definitions of "not unlikely," "unlikely," and "highly unlikely". The staff concludes that these descriptions meet the acceptance criteria in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002) and are, therefore, acceptable.

#### 3.3.6.5 Safety Controls

In evaluating accident sequences, the applicant introduces a new term, "safety control," which are not considered IROFS, but provide defense-in-depth, for additional safety margin in the preliminary design, and to reduce the reliance on certain IROFS (GLE, 2011a). In Section 1.2.8 of the ISA Summary (GLE, 2011a), the applicant stated that they define and clearly identify items that provide defense-in-depth.

Staff examined the safety controls, and determined that for each sequence, the identified IROFS were sufficient to make the overall likelihood unlikely or highly unlikely, as appropriate, and, therefore, no safeguards features were necessary to meet the performance requirements, which would otherwise require them to be designated as IROFS. The staff concludes that these descriptions meet the acceptance criteria provided in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002) and are, therefore, acceptable.

#### 3.3.6.6 Overall Risk

The overall risk category of each accident sequence is determined using the consequence category and likelihood (as determined above) for the sequence in the Risk Matrix (Table 1-9 in the ISA Summary (GLE, 2011a)).

In the applicant's Risk Matrix, an accident sequence with an overall risk index (likelihood x consequence) greater than 4 does not meet the Part 70 performance requirements and the application of IROFS to mitigate the consequence or reduce the likelihood is required (GLE, 2011a).

The NRC staff has reviewed the applicant's approach for assuring that intermediate consequence events are unlikely and high consequence events are highly unlikely and has determined that it is acceptable. The staff considers the ISA method to be complete by its use of the appropriate accident identification methodology from NUREG-1513 (NRC, 2001) and considers the consequence determinations to be acceptable and in accordance with the guidance in NUREG/CR-6410 (NRC, 1998). The staff considers the likelihoods to have been derived using acceptable methods and to comply with acceptable definitions of "not unlikely,"

“unlikely,” and “highly unlikely.” The criteria in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002) state that the applicant’s ISA method needs to provide a list of hazards and potential interactions, needs to select one of the methods described in NUREG-1513 (NRC, 2001), and needs to evaluate consequences in a manner consistent with the approaches described in NUREG/CR-6410 (NRC, 1998). The staff concludes that the applicant’s ISA method conforms with the acceptance criteria and meets the requirements of 10 CFR 70.65(b)(4).

The acceptance criteria in Section 3.4.3.2(4) of NUREG-1520 (NRC, 2002) state that the applicant’s ISA Summary needs to contain information that demonstrates compliance with the performance requirements in 10 CFR 70.61 for completeness, consequence, and likelihood. In addition, likelihood should be determined using an acceptable method, using acceptable definitions of “unlikely” and “highly unlikely.” The staff concludes that the applicant’s ISA method meets the acceptance criteria and is, therefore, acceptable.

### 3.3.7 ISA APPROACH

The regulations in 10 CFR 70.65(b)(4) require that the applicant demonstrate compliance with the performance requirements of 10 CFR 70.61 and the requirements of 10 CFR 70.64. The following is a description of the approach selected by the applicant. A discussion of compliance with the acceptance criteria in Section 3.4.3.2(5) of NUREG-1520 (NRC, 2002) follows.

In Section 3.2.5 of the LA (GLE, 2011b), the applicant commits to a semi-quantitative risk-index approach identical to the example in Appendix A of NUREG-1520 (NRC, 2002).

#### 3.3.7.1 Define Nodes to be Evaluated

In Table 1-2 of the ISA Summary (GLE, 2011a), the applicant divided the process systems, subsystems, facilities, and operations into nodes to establish the boundaries of the process systems and subsystems which enter or exit the node. Chapter 4 of the ISA Summary (GLE, 2011a) provided a description of the activities and hazards for each key process system in the facility, including a general description of the building, the equipment function, overview of the operations, and hazards of each process step.

#### 3.3.7.2 Identify Hazards

The applicant used What-if analysis and checklist methodology to identify the facility process areas which represent significant hazards to workers, members of the public, or the environment due to radiological or chemical characteristics of licensed materials (GLE, 2011a). The types of materials identified include those which are radioactive, fissile, flammable, explosive, toxic or reactive, consistent with the guidance provided in NUREG-1513 (NRC, 2001). The staff found that the applicant’s hazard identification meets the acceptance criteria in Sections 3.4.3.2(4) and 3.4.3.2(5) of NUREG-1520 (NRC, 2002) to provide a list of hazards and for use of methods listed in NUREG-1513 (NRC, 2001), and is, therefore, acceptable.

#### 3.3.7.3 Identify Scenarios

As stated in Chapter 1 of the ISA Summary (GLE, 2011a), the hazard identification process used by the applicant documented credible accident scenarios or sequences, usually with single initiating events consisting of process deviations, human errors, internal facility events, and

credible external events (such as aircraft crashes). Hazards were assessed individually for the potential impact on the process systems (e.g., UF<sub>6</sub> feed system (GLE, 2011a).

External events described in Section 2.5 of the ISA Summary (GLE, 2011a) included seismic, tornado, tornado missile and high wind, snow and ice, flooding, local precipitation, transportation and nearby facility accidents, aircraft, pipelines, and highways. Hazardous scenarios initiated by natural phenomena events were assessed for each process unit and described in Chapter 4 of the ISA Summary (GLE, 2011a). The staff found that the applicant's scenario identification meets the acceptance criteria in Sections 3.4.3.2(4) and 3.4.3.2(5) of NUREG-1520 (NRC, 2002) to provide a list of hazards and for use of methods listed in NUREG-1513 (NRC, 2001), and is, therefore, acceptable.

#### 3.3.7.4 Determine Consequence Category

Each node described in chapter 4 of the ISA Summary (GLE, 2011a) lists the potential accident sequences that were identified that could have consequences that exceed the performance requirements of 10 CFR 70.61. Such sequences could be caused by external events, facility events external to the process being analyzed, deviations from normal operations, and other failures (GLE, 2011a).

The following unmitigated consequence categories for workers, members of the public, as well as the environment are presented in Tables 1-3 and 1-4 of the ISA Summary (GLE, 2011a) and include the consequence definitions from 10 CFR 70.61 as well as Acute Exposure Guideline Level (AEGL) thresholds for chemical releases of uranium hexafluoride (UF<sub>6</sub>), soluble uranium, and hydrogen fluoride (HF):

**Table 3.3-1  
Unmitigated Consequence Categories**

| Unmitigated Consequence Categories |   |
|------------------------------------|---|
| High                               | 3 |
| Intermediate                       | 2 |
| Low – no further action required   | 1 |

The staff found that the applicant's quantitative standards meets the acceptance criteria in Sections 3.4.3.2(4) and 3.4.3.2(7) of NUREG-1520 (NRC, 2002) to provide a list of hazards and for use of methods listed in NUREG-1513 (NRC, 2001), and is, therefore, acceptable.

#### 3.3.7.5 Determine Unmitigated Likelihood

The unmitigated likelihood for each accident sequence is calculated by using the Initiating Event frequency and assumes that none of the identified IROFS are available to perform their intended function (GLE, 2011a).

Table 1-6 in the ISA Summary (GLE, 2011a) presents the categories of "Not Unlikely," "Unlikely," and "Highly Unlikely," and Table 1-7 of the ISA Summary (GLE, 2011a) cross references the three likelihood categories with a probability of occurrence based on approximate order of magnitude ranges.

The following unmitigated likelihood categories are presented in Tables 1-6 and 1-7 of the ISA Summary (GLE, 2011a):

**Table 3.3-2  
Unmitigated Likelihood Categories**

| Unmitigated Likelihood Categories |   |  |
|-----------------------------------|---|--|
| Not unlikely                      | 3 | more than $10^{-4}$ per event per year             |
| Unlikely                          | 2 | between $10^{-4}$ and $10^{-5}$ per event per year |
| Highly unlikely                   | 1 | less than $10^{-5}$ per event per year             |

The staff found that the applicant's likelihood definitions meets the acceptance criteria in Sections 3.4.3.2(4) and 3.4.3.2(9) of NUREG-1520 (NRC, 2002) to provide a list of hazards and for use of methods listed in NUREG-1513 (NRC, 2001), and is, therefore, acceptable.

### 3.3.7.6 Determine Unmitigated Risk

In Chapter 1 of the ISA Summary (GLE, 2011a), the applicant describes the unmitigated risk assignment matrix, which presents the risk category as the product of unmitigated likelihood and consequence categories. The risk matrix and computed index values are shown in Table 1-9 of the ISA Summary (GLE, 2011a) with the likelihood categories across the top and the consequence categories along the left side. The risk matrix shows the combinations of likelihood and consequence that are unacceptable (GLE, 2011a). Sequences that fall into these combinations will be mitigated or prevented with IROFS (GLE, 2011a).

The staff found that the applicant's determination of unmitigated risk meets the acceptance criteria in Sections 3.4.3.2(4) and 3.4.3.2(5) of NUREG-1520 (NRC, 2002) to provide a list of hazards and for use of methods listed in NUREG-1513 (NRC, 2001), and is, therefore, acceptable.

**Table 3.3-3  
Unmitigated Risk Matrix**

| Unmitigated Risk Matrix                |  |                                   |                                       |
|--|--|-----------------------------------|---------------------------------------|
| Severity                               | Likelihood Category 1<br>Highly Unlikely | Likelihood Category 2<br>Unlikely | Likelihood Category 3<br>Not Unlikely |
| Consequence Category 3<br>High         | Acceptable Risk<br>3                     | Unacceptable Risk<br>6            | Unacceptable Risk<br>9                |
| Consequence Category 2<br>Intermediate | Acceptable Risk<br>2                     | Acceptable Risk<br>4              | Unacceptable Risk<br>6                |
| Consequence Category 1<br>Low          | Acceptable Risk<br>1                     | Acceptable Risk<br>2              | Acceptable Risk<br>3                  |

### 3.3.7.7 Perform Quantitative Risk Analysis

The analysis of each process in the ISA Summary (GLE, 2011a) documents the evaluation of each node being analyzed. The entire quantitative analysis includes a description of the accident sequence, initiating and contributing conditions, preventive and mitigating controls, as well as an event tree showing a detailed likelihood determination (GLE, 2011a).



The staff found that the applicant's quantitative risk analysis meets the acceptance criteria in Sections 3.4.3.2(4) and 3.4.3.2(5) of NUREG-1520 (NRC, 2002) to provide a list of hazards and for use of methods listed in NUREG-1513 (NRC, 2001), and is, therefore, acceptable.

#### 3.3.7.8 Develop IROFS and Likelihoods

For each scenario, the applicant determines and documents the *mitigated* likelihood in a Quantitative Risk Assessment (QRA) report, which provides sufficient information about the process, accident, and undesirable consequences (GLE, 2011a). The mitigated likelihood (or mitigated consequence) with the IROFS, including sole IROFS, applied must meet the performance requirements in 10 CFR 70.61 that high-consequence accident sequences are highly unlikely and intermediate-consequence accident sequences are unlikely (GLE, 2011a).

The staff found that the applicant's IROFS development meets the acceptance criteria in Sections 3.4.3.2(4), 3.4.3.2(5), 3.4.3.2(6), and 3.4.3.2(8) of NUREG-1520 (NRC, 2002) to provide a list of hazards and for use of methods listed in NUREG-1513 (NRC, 2001), and is, therefore, acceptable.

#### 3.3.7.9 Management Measures

The evaluation in each node analysis includes a description of the management measures which are applied to each IROFS for each scenario (GLE, 2011a). Additional information on management measures is contained in Chapter 11 of the ISA Summary (GLE, 2011a). The staff found that the applicant's IROFS development meets the acceptance criteria in Section 3.4.3.2(4) of NUREG-1520 (NRC, 2002) to provide a list of hazards and for use of methods listed in NUREG-1513 (NRC, 2001), and is, therefore, acceptable.

#### 3.3.7.10 Update Lists and Risk Indices

Following evaluation of the entire scenario, including identification of IROFS and determination of the mitigated likelihood and consequence, a table summarizing the scenario is updated to include: a unique accident identification number, initiating event, initiating event frequency, IROFS and reliability, likelihood index, likelihood category, a link to the consequence determination, consequence category, overall risk index, and comments or recommendations (GLE, 2011a). An example table 1-10 is provided in the methodology described in Chapter 1 of the ISA Summary (GLE, 2011a). Completed tables are furnished at the end of each process node evaluation in Chapter 4 of the ISA Summary (GLE, 2011a). The staff found that the applicant's IROFS development meets the acceptance criteria in Sections 3.4.3.2(4), 3.4.3.2(5), 3.4.3.2(6), and 3.4.3.2(8) of NUREG-1520 (NRC, 2002) to provide a list of hazards and for use of methods listed in NUREG-1513 (NRC, 2001), and is, therefore, acceptable.

#### 3.3.7.11 Defense-In-Depth

In Appendix D of the ISA Summary (GLE, 2011a), the applicant describes the use of defense-in-depth principles, beginning with the preference for engineered controls instead of administrative controls described in 10 CFR 70.64. The applicant describes the use of safety controls in addition to IROFS and recognizes that they are not IROFS and are not credited barriers that prevent or mitigate the consequence described in the scenario (GLE, 2011a). Based on the above, the staff found that the applicant's hazard identification meets the acceptance criteria in

Section 3.4.3.2(4) of NUREG-1520 (NRC, 2002) to utilize defense-in-depth principles and engineered over administrative controls where practical, and is, therefore, acceptable.

#### 3.3.7.12 ISA Approach Summary Evaluation

Based on the above, the staff found that the applicant's ISA approach meets the criteria in Sections 3.4.3.2(4) through 3.4.3.2(9) of NUREG-1520 (NRC, 2002) to evaluate accident sequences, identify IROFS and applicable management measures, and is, therefore, acceptable.

### 3.3.8 NUCLEAR CRITICALITY REVIEW

The requirements in 10 CFR 70.65(b)(3) specify that the ISA Summary must contain process information sufficient to understand the theory of operation, a detailed description of the hazards, and a description of the general types of accident sequences. The applicant's ISA Summary (GLE, 2011a) contains information on process-dependent criticality controls and their safety function. The ISA Summary (GLE, 2011a) also contains a criticality safety section for each process or facility analyzed, with supporting discussions, describing the criticality safety control parameters and associated parameter limits. With regard to criticality safety, compliance with the double-contingency principle and defense-in-depth principles are adhered to in supporting the evaluation of criticality-related events. The NRC staff reviewed the information in the ISA Summary (GLE, 2011a), regarding the applicant's description of process information, hazards, and accident sequences. Based on its review, the NRC staff determined, with reasonable assurance, that the facility meets the requirements of 10 CFR 70.65(b)(3). Further information on the application of the ISA process to the evaluation of criticality hazards is provided in Section 5.3.8 of this SER. Further discussion on other aspects of the NCS program is provided in Chapter 5 of this SER.

The review criteria in Sections 3.4.3.2(4) and 5.4.3.4.6 of NUREG-1520 (NRC, 2002) state that the applicant needs to identify criticality accident sequences, their consequences and likelihood.

#### 3.3.8.1 Criticality Safety IROFS

Discussion of the nuclear criticality safety IROFS is found in the non-public version of this SER.

##### 3.3.8.1.1 Criticality Safety IROFS Evaluation

The criteria in Section 5.4.3.4.6 of NUREG-1520 (NRC, 2002) require the applicant to meet the performance requirements in 10 CFR 70.61(d) to limit the risk of criticality accidents during normal and credible abnormal conditions. In addition, 10 CFR 70.61(d) states that preventive controls (compared to mitigating controls) must be the primary means of protection against criticality accidents. This is to be accomplished by identification of criticality sequences, determination of the likelihood of criticality sequences, and descriptions of IROFS for criticality sequences. The staff concludes that the licensee's ISA and IROFS described above meet the acceptance criteria provided in Section 5.4.3.4.6 of NUREG-1520 (NRC, 2002) and are therefore acceptable.

### 3.3.8.2 Nuclear Criticality ISA Evaluation

The staff reviewed the list of IROFS and their safety functions for criticality safety accident sequences, the management measures supporting the IROFS, and the accident sequences presented in Chapter 4 of the ISA Summary (GLE, 2011a) that provide the basis for the determination of the IROFS. For each IROFS, a description of the control is provided.

Based on the review of ISA documentation, the staff's evaluation found that the list of IROFS for process-specific operations of the facility, provided in the ISA Summary (GLE, 2011a), are consistent with the controls identified by the applicant in its ISA process, and supports the assurance that the hazards described in the general types of accident sequences for criticality safety has been determined to be "highly unlikely." This meets the acceptance criteria listed in Section 3.4.3.2(3) of NUREG-1520 (NRC, 2002) for criticality accident sequences.

The staff also reviewed information contained in the detailed ISA documentation, maintained onsite, for selected processes having criticality safety accident sequences. As part of this review, the staff reviewed criticality safety analyses (CSAs), as appropriate. The CSAs reviewed were complete and had a number of parametric studies to support the conclusions made and the listing of IROFS required.

The requirement in 10 CFR 70.65(b)(4) specifies that the ISA Summary must contain information that demonstrates the applicant's compliance with the requirements for criticality monitoring and alarms described in 10 CFR 70.24. In Section 5.3.5 of the LA (GLE, 2011b), the applicant stated that it will maintain a nuclear criticality accident alarm system (CAAS) in each area that exceeds the limits specified in 10 CFR 70.24. Therefore, the facility is required to have a CAAS with two detectors in each area, to detect an inadvertent criticality and to alert facility personnel that it occurred. Placement of the detectors is determined by applying the detection criteria in 10 CFR 70.24(a)(1). The NRC staff reviewed the information in the LA (GLE, 2011b) and the ISA Summary (GLE, 2011a) regarding the applicant's commitment to the CAAS. As stated in Section 5.3.5.2 of this SER, the applicant has not yet incorporated a sufficient level of detail in the ISA Summary, because the design of the CAAS system is not complete. To satisfy the requirements in 10 CFR 70.65(b)(4), an applicant must provide information in the ISA Summary demonstrating compliance with 10 CFR 70.24. Because a criticality cannot occur if there is no fissionable material onsite, an operating CAAS is not needed until the applicant obtains licensed material. Therefore, the staff is granting an exemption to the requirements in 10 CFR 70.65(b)(4) and is imposing the following license condition to ensure that the regulatory requirement is met before the licensee obtains licensed material:

*The Licensee is granted an exemption to the requirements in 10 CFR 70.65(b)(4) to require that the ISA Summary contain information that demonstrates compliance with the criticality monitoring and alarm requirements of 10 CFR 70.24. At least 90 days prior to obtaining licensed material, the Licensee shall submit to the NRC for approval Criticality Accident Alarm System design information to demonstrate compliance with 10 CFR 70.65(b)(4) for all areas in which NRC has not granted an exemption to 10 CFR 70.24, and in which special nuclear material is handled, used, stored, or transported (including outdoor transport routes), and include this information in the ISA Summary.*

The staff reviewed the nuclear criticality safety information contained in the ISA Summary (GLE, 2011a) and other supporting documentation using the acceptance criteria in Sections 3.4.3.2(4)(c) and 5.4.3.4.6(1) of NUREG-1520 (NRC, 2002). The staff concludes that the ISA Summary (GLE, 2011a) provides reasonable assurance that:

1. The applicant adequately documented the ISA results in the ISA Summary (GLE, 2011a) for nuclear criticality safety (NCS);
2. The applicant adequately identified credible accident sequences for NCS;
3. The applicant adequately identified engineered and administrative controls, IROFS, and management measures for NCS;
4. The applicant adequately applied engineered and administrative controls, IROFS, and management measures to ensure that credible criticality accident sequences are prevented and made highly unlikely; and
5. The applicant maintains a criticality accident alarm system in accordance with the requirements in 10 CFR 70.24 and, when incorporated into the ISA Summary (GLE, 2011a), will be in compliance with 10 CFR 70.65(b)(4).

In accordance with the acceptance criteria in Section 3.4.3.2(6) of NUREG-1520 (NRC, 2002) the applicant provided a complete list of all IROFS, as well as a description of their essential details, expected function, conditions needed to reliably perform the function, and the effects of the failure of the IROFS. The staff concludes that these actions meet the acceptance criteria provided in Section 3.4.3.2(6) of NUREG-1520 (NRC, 2002) and are, therefore, acceptable.

The criteria in Section 5.4.3.4.6 of NUREG-1520 (NRC, 2002) state that the applicant needs to meet the performance requirements in 10 CFR 70.61(d) to limit the risk of criticality accidents during normal and credible abnormal conditions. In addition, 10 CFR 70.61(d) states that preventive controls (compared to mitigating controls) must be the primary means of protection against criticality accidents. This is to be accomplished by identification of criticality sequences, determination of the likelihood of criticality sequences, and descriptions of IROFS for criticality sequences. The staff concludes that the licensee's ISA and IROFS described above meet the acceptance criteria provided in Section 5.4.3.4.6 of NUREG-1520 (NRC, 2002) and are, therefore, acceptable.

### 3.3.9 CHEMICAL PROCESS REVIEW

The regulations in 10 CFR 70.65(b)(7) require that the ISA Summary include a description of the proposed quantitative standards used to assess the consequences to an individual from acute chemical exposure to licensed material or chemicals produced from licensed materials which are onsite, or expected to be onsite, as described in 10 CFR 70.61(b)(4) and (c)(4). The acceptance criteria are listed in Section 6.4.3.1 of NUREG-1520 (NRC, 2002) and are described below and in additional discussion in Chapter 6 of this SER.

The NRC's regulatory authority over chemicals hazards is explained in the NRC memorandum, "Regulatory Authority Over Chemical Hazards at Fuel Cycle Facilities," dated March 10, 2003 (NRC, 2003c). In the ISA, the applicant identified and evaluated all chemical hazards and accident sequences that could result in consequences exceeding the 10 CFR 70.61

performance requirements in accordance with this NRC memorandum. Chemical hazards that do not affect the radiological material are covered by the Occupational Safety and Health Administration Process Safety Management regulation 29 CFR 1910.119, and the Environmental Protection Agency (EPA) Risk Management Program (RMP) regulations in 40 CFR 68.

The applicant discusses the chemical and radiological hazards resulting from a release of licensed material in Section 4 of the ISA Summary (GLE, 2011a). Detailed analyses are evaluated at each node of the process.

The NRC staff chemical safety review of the ISA Summary (GLE, 2011a) consisted of the evaluation of a selected sample of accidents sequences in the dry conversion process and the cylinder wash area. The chemical safety review included the evaluation of the following areas:

- Chemical processes;
- Chemical hazards;
- Chemical accident sequences;
- IROFS' preventive and mitigative functions; and
- Chemical consequences and standards.

#### 3.3.9.1 Chemical Process Descriptions

During the site visit and vertical slice review discussed in Section 3.3.17 of this SER, NRC staff examined a number of supporting documents, including QRAs for liquid and vapor HF scenarios and Technical Reports in addition to the LA (GLE, 2011b) and the ISA Summary (GLE, 2011a). In addition to the supporting documents, the NRC staff examined the applicant's descriptions of the approach employed for adequately maintaining safety in normal operations, including the hierarchy of policies, procedures, and screening criteria the applicant employed to identify chemicals for further analysis in the hazard evaluation and to allow an understanding of the development of potential accident scenarios. Safety significant scenarios for loss of confinement and plug removal were examined, as well as the methods for determination and identification of conditional events, management measures, administrative, and defense-in-depth controls.

#### 3.3.9.2 Chemical Hazards, Accident Sequences, and IROFS

For each of the process systems (nodes) in Chapter 4 of the ISA Summary (GLE, 2011a), the staff concludes that the applicant has adequately identified credible chemical accident sequences, including appropriate accident likelihoods, based on the applicant's use of a combination of approved hazards analysis methods (What-If/Checklist or QRA) to identify those sequences and the staff's review of selected chemical accident sequences. For each process node in Chapter 4 of the ISA Summary (GLE, 2011b), the applicant provides a description of potential interactions of chemicals and an evaluation of the risks (both consequence and likelihood) as well as a description of controls to minimize the risks. The acceptance criteria in Section 6.4.3.1(1) and 6.4.3.1(2) of NUREG-1520 (NRC, 2002) state that the applicant needs to submit process descriptions of sufficient detail to allow an understanding of the chemical process hazards, and an adequate list of the consequences and likelihoods of identified accident sequences. The information provided by the applicant meets the accident sequence and likelihood acceptance criteria in Sections 6.4.3.1(1) and 6.4.3.1(2) of NUREG-1520 (NRC,

2002) and is, therefore, acceptable. Additional discussion of the staff evaluation of chemical safety is provided in Chapter 6 of this SER.

### 3.3.9.3 Chemical Consequence Analysis Approach

For each node evaluated in Chapter 4 of the ISA Summary (GLE, 2011a), the applicant estimated chemical consequences for the bounding accident scenarios based on potential exposure concentrations. These estimated chemical exposures were then compared to the chemical quantitative standards the applicant identified in accordance with 10 CFR 70.65(b)(7). Chemical exposure calculations considered variables such as quantity, location, physical properties of the hazardous chemical, atmospheric conditions, and time of exposure. In addition, different assessment models were used to estimate the exposure of a hazardous chemical after a release.

The acceptance criteria in Sections 6.4.3.1(3), 6.4.3.1(4), and 6.4.3.1(5) of NUREG-1520 (NRC, 2002) state that an applicant needs to use appropriate techniques and valid assumptions as well as approved source term and vapor dispersion models, in evaluation of identified accident sequences. The staff finds that the applicant has identified and used appropriate methods and valid assumptions in estimating the consequences from identified chemical accident sequences, and that the consequences have been conservatively estimated. The information provided by the applicant meets the guidance in Sections 6.4.3.1(3), 6.4.3.1(4), and 6.4.3.1(5) of NUREG-1520 (NRC, 2002) and is therefore acceptable. Additional discussion of the staff evaluation of chemical safety is provided in chapter 6 of this SER.

### 3.3.9.4 Chemical Consequence Limits

This section evaluates the proposed chemical quantitative standards used to assess the consequences to the worker, public, and environment from acute chemical exposure to licensed material or chemicals incident to the processing of licensed material. In accordance with 10 CFR 70.65(b)(7), the applicant is required to propose chemical quantitative standards as a part of the ISA Summary.

In Section 4.1 of the ISA Summary (GLE, 2011a), the applicant described exposures to the reaction products from a UF<sub>6</sub> leak: UO<sub>2</sub>F<sub>2</sub>, and HF.

In Tables 1-3 and 1-4 of the ISA Summary (GLE, 2011a), the applicant committed to AEGL-3 and AEGL-2 exposures as chemical consequence standards for high and intermediate consequence events, respectively, to a worker. In addition, the applicant defined dermal exposure consequences for both workers and members of the public. The applicant defined contact with HF solution as an intermediate consequence for a worker.

In Table 1-3 of the ISA Summary (GLE, 2011a), the applicant committed to a soluble uranium intake limit of 75 milligrams (mg) (0.165 lb) for a high consequence to a worker, and 30 mg (0.066 lb) for a high consequence to a member of the public.

The NRC staff, based on the information in NUREG-1391, "Chemical Toxicity of Uranium Hexafluoride Compared to Acute Effects of Radiation" (NRC, 1991), determined that 30 mg (0.066 lb) of soluble uranium is in agreement with the definition of a high consequence event as defined in 10 CFR 70.61(b)(4)(i) that states: "an acute chemical exposure to an individual from

licensed material or hazardous chemicals produced from licensed material that: (i) could endanger the life of the worker...”

The threshold for permanent kidney damage is the derived limit based on a systemic burden per 0.3 milligram uranium per kilogram (mg/kg) (0.0003 lb uranium/lb) body weight, which totals 21 mg (0.046 lb) for a 70 kg (154 lb) standard man, as referenced in Table 2 in NUREG-1391 (NRC, 1991). Using the improved model in International Commission for Radiological Protection (ICRP) Publication 66 (ICRP-66), “Human Respiratory Tract Model for Radiological Protection, (ICRP, 1995), the systemic burden of 21 mg (0.046 lb) would require an intake of 75 mg (0.165 lb) of soluble uranium. The NRC-industry soluble uranium working group has agreed that an intake of 75 mg (0.165 lb) is a suitable limit for a worker.

NRC staff reviewed the applicant’s chemical consequence standards and determined that they are in conformance with 10 CFR 70.61(b)(4) and (c)(4), as required by 10 CFR 70.65(b)(7), and meet the acceptance criteria in Sections 3.4.3.2(7) and 6.4.3.1 of NUREG-1520 (NRC, 2002) and are, therefore, acceptable.

### 3.3.10 FIRE PROTECTION REVIEW

FHAs are used in the ISA to evaluate credible fire scenarios as to their potential to result in high- or intermediate-consequence events from the release of licensed materials, release of Part 70-regulated chemicals, or initiation of a criticality event (GLE, 2011a).

Areas of the facility for which fire events were documented in the ISA Summary (GLE, 2011a) are the following:

- Cylinder Storage and Handling
- Feed and Vaporization
- Product Withdrawal
- Tails Withdrawal
- Blending System
- Sampling System
- Decontamination/Maintenance
- Laboratory Operations

Discussion of the fire protection IROFS is found in the non-public version of this SER.

The staff finds that the fire safety analysis is adequate to ensure the requirements of 10 CFR 70.61(b)(1)-(b)(4) and 10 CFR 70.61(c)(1)-(c)(4) will not be exceeded. The acceptance criteria in Sections 7.4.3.3 and 7.4.3.4 of NUREG 1520 (NRC, 2002) state that an applicant needs to apply fire safety considerations in the design of the facility, including process fire safety by utilizing National Fire Protection Association (NFPA) NFPA 801, “Standard for Fire Protection for Facilities Handling Radioactive Materials” (NFPA, 2008), as a standard. The applicant’s commitment to NFPA 801 (NFPA, 2008) is in Sections 7.1, 7.2, and 7.3 of the LA (GLE, 2011b). The acceptance criteria in Section 7.4.3.5 of NUREG 1520 (NRC, 2002) state that an applicant needs to identify the fire emergency response organizations and IROFS. The applicant’s commitments for emergency response organizations for fire protection are described in Sections 7.6.1 and 7.6.2 of the LA (GLE, 2011b). The applicant’s commitment for identification of fire safety IROFS is described in Section 7.4 of the LA (GLE, 2011b). The staff found that the applicant’s commitments meet the acceptance criteria in Section 7.4.3 of NUREG-1520 (NRC,

2002), and is, therefore, acceptable. Additional discussion of the staff evaluation of fire safety is provided in Chapter 7 of this SER.

### 3.3.11 RADIATION PROTECTION REVIEW

The staff reviewed the applicant's treatment of onsite radiological hazards with respect to their potential to create intermediate or high consequence events relative to workers or the general public. At the applicant facility, the radiological hazards are associated with low-enriched uranium with a maximum of 8 wt percent <sup>235</sup>U, which is greater than the enrichment of traditional commercial feed material for low-enriched nuclear fuel fabrication plants, but is intended to provide flexibility for blending of product cylinders (GLE, 2011b).

The applicant performed a radiological safety analysis for each credible accident scenario (GLE, 2011b). Credible radiological accidents that were of intermediate or high consequences were identified (GLE, 2011b).

All credible radiological accidents were made unlikely or highly unlikely (GLE, 2011b). The staff reviewed a sample of the credible accident sequences and the associated IROFS for those sequences (GLE, 2011b).

Radiological consequences limits are presented along with chemical consequences in Table 1-3 of the ISA Summary (GLE, 2011a). The applicant's radiological limits are the same as those specified in 10 CFR 70.61(b)(3). The staff finds that the radiological safety analysis is adequate to ensure the requirements of 10 CFR 70.61(b)(1)-(b)(3) and 10 CFR 70.61(c)(1)-(c)(3) will not be exceeded. The acceptance criteria in Section 4.4.6.3 of NUREG 1520 (NRC, 2002) state that an applicant needs to install ventilation and containment systems in the facility, when designated as IROFS. The applicant's commitments regarding bi-weekly verification of flows and direction, as well as filtration of air from ventilation and containment systems, including the commitment for verification following modifications to systems are in Sections 4.6.1 of the LA (GLE, 2011b). The staff found that the applicant's commitments meet the acceptance criteria in Section 4.4.6.3 of NUREG-1520 (NRC, 2002), and are, therefore, acceptable. Additional discussion of the staff evaluation of radiation protection is provided in Chapter 4 of this SER.

### 3.3.12 IROFS STRUCTURES REVIEW

The NRC staff reviewed the applicant's proposed design for structures containing licensed material processes to ensure compliance with the performance requirements in 10 CFR 70.61 and 10 CFR 70.64(a)(2), and 64(a)(4). Acceptance criteria in Sections 3.4.3.2(2)(c), 3.4.3.2(3), and 3.4.3.2(4) are applicable to this review. The acceptance criteria on Section 3.4.3.2(2)(c) of NUREG-1520 (NRC, 2002) states that the applicant should provide design information regarding the resistance of the facility to failures caused by credible external events, when those failures may produce consequences exceeding those identified in 10 CFR 70.61. The acceptance criteria in Sections 3.4.3.2(3) and 3.4.3.2(4) of NUREG-1520 (NRC, 2002) state that the applicant should address hazards and accident sequences and information demonstrating compliance with the performance requirements in 10 CR 70.61.

Discussion of the IROFS structures is found in the non-public version of this SER.



The NRC staff organized the review and evaluation of the applicant's LA (GLE, 2011b), and ISA Summary (GLE, 2011a) on structural, foundation, and equipment support designs of IROFS structures in Figure 4.16-1 of the ISA Summary (GLE, 2011a) into the following four sections.

#### 3.3.12.1 Structural Design Loads

The structural design load criteria are based on the environmental and geologic features of the proposed site as identified in Sections 1.3.3, 1.3.4, and 1.3.5 of the LA (GLE, 2011b), in Section 2 of the ISA Summary (GLE, 2011a), and the data presented in the accepted consensus industry codes and standards. In accordance with 10 CFR 70.64(a), the IROFS structures, foundations, and equipment supports are required to comply with a baseline design criterion for natural phenomena and external hazards. This baseline design criterion in 10 CFR 70.64(a) requires that the design adequately protects against natural phenomena of the most severe documented historical events for the site. These design basis loads from natural phenomena and external hazards, among others, include seismic, winds, snow, and local intense precipitation defined in Section 2.5 of the ISA Summary (GLE, 2011a) and Merrick & Company calculation, "Design Analysis Calculation for Natural Phenomena Analysis of the GLE Commercial Facility" (Merrick, 2010).

The NRC staff reviewed the loads the applicant proposed for the preliminary design of the proposed IROFS buildings as provided in applicant's LA (GLE, 2011b), ISA Summary (GLE, 2011a), and the Merrick & Company calculation (Merrick, 2010). The NRC staff find that the applicant's design bases for natural phenomena and external hazards are acceptable because these design bases were determined based on the environmental and geologic features of the site using industry accepted codes, standards, and methods. The applicant proposed to convert the design bases to applied loads to the IROFS structures in accordance with procedures outlined in an industry-accepted standard such as ASCE 7-05 (ASCE, 2006). Based on this evaluation, the NRC staff concludes, with reasonable assurance, that the regulatory requirements in 10 CFR 70.64(a)(2) and 64(a)(4) have been met because the structural design loads the applicant considered are consistent with those characterized for the proposed site. The acceptance criterion in Section 3.4.3.2(2)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide design information regarding the resistance of the facility to failures caused by credible external events, when those failures may produce consequences exceeding those identified in 10 CFR 70.61. The acceptance criteria in Sections 3.4.3.2(3) and 3.4.3.2(4) of NUREG-1520 (NRC, 2002) address the evaluation of hazards and accident sequences to demonstrate compliance with 10 CFR 70.61. The NRC staff concluded that the applicant's information on IROFS structural design loads met these criteria and is, therefore, acceptable.

#### 3.3.12.2 Load Combinations

All major loads encountered or postulated for the IROFS buildings are listed in Sections 2.5 and 3.3.2 of the ISA Summary (GLE, 2011a) and evaluated as design loads in Section 3.3.12.1 of this SER. Design loads are considered by the applicant to act in various load combinations according to industry accepted codes and standards (e.g., Section B.2 of American Institute of Steel Construction (AISC) AISC N690, "Specification for Safety-Related Steel Structures for Nuclear Facilities," (AISC, 2007) and ASCE 7-05 (ASCE, 2006)) as stated in ISA Summary (GLE, 2011a).

Based on this evaluation, the NRC staff finds, with reasonable assurance, that the regulatory requirements in 10 CFR 70.64(a)(2) and 64(a)(4) have been met because the load

combinations the applicant proposed for the IROFS buildings are consistent with industry accepted codes, standards, and methods for steel structures and components. The acceptance criterion in Section 3.4.3.2(2)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide design information regarding the resistance of the facility to failures caused by credible external events, when those failures may produce consequences exceeding those identified in 10 CFR 70.61. The acceptance criteria in Sections 3.4.3.2(3) and 3.4.3.2(4) of NUREG-1520 (NRC, 2002) address the evaluation of hazards and accident sequences to demonstrate compliance with 10 CFR 70.61. The NRC staff concluded that the applicant's information on load combinations met these criteria and is, therefore, acceptable.

### 3.3.12.3 Structural Analysis Method

The applicant performed preliminary design analysis of selected IROFS building structures under selected design loads as described in the Merrick and Company calculation (Merrick, 2010). The directions of application of seismic forces for the final design will be those which will produce the most critical load effects as delineated in Section 12.5 of ASCE 7-05 (ASCE, 2006). The final seismic analysis will consist of one of the types permitted by Table 12.6-1 in ASCE 7-05 (ASCE, 2006), based on the structure's seismic design category, structural system, dynamic properties, and regularity. The applicant proposed to use two out of three methods permitted by Table 12.6-1 in ASCE 7-05 (ASCE, 2006): (i) equivalent lateral force method and (ii) modal response spectrum analysis. In the preliminary seismic analysis (Merrick, 2010), the applicant used the equivalent lateral force method. The preliminary analysis revealed that the wind load instead of seismic load governs the design of IROFS buildings. In the final analysis, resulting element and member moments and forces from the load combinations accepted in the Load Combinations subsection above will be checked for whatever combination produces the most unfavorable effects for IROFS buildings, foundations, and other structural components.

The NRC staff reviewed the structural analysis method the applicant proposed and the preliminary analysis the applicant conducted for the IROFS structures and foundations as provided in the LA (GLE, 2011b), the ISA Summary (GLE, 2011a), and the Merrick and Company calculation (Merrick, 2010). The NRC staff finds that the analysis method the applicant proposed and used in preliminary analysis is acceptable because this method is based on standard industry accepted procedures. The NRC staff also finds that the preliminary analysis is acceptable because the proposed analysis method is appropriately used. Therefore, the NRC staff finds, with reasonable assurance, that the regulatory requirements in 10 CFR 70.64(a)(1), 64(a)(2), and 64(a)(4) have been met with regard to the structural analysis method. The acceptance criterion in Section 3.4.3.2(2)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide design information regarding the resistance of the facility to failures caused by credible external events, when those failures may produce consequences exceeding those identified in 10 CFR 70.61. The acceptance criteria in Sections 3.4.3.2(3) and 3.4.3.2(4) of NUREG-1520 (NRC, 2002) address the evaluation of hazards and accident sequences to demonstrate compliance with 10 CFR 70.61. The NRC staff concluded that the applicant's information on structural analysis methodology met these criteria and is, therefore, acceptable.

### 3.3.12.4 Structural Design Criteria, Bases, and Method

The IROFS structures and foundations are designed to meet the design features of ASCE 43-05 (ASCE, 2005).

The applicant developed structural and mechanical design load criteria based on the environmental and geologic features of the applicant's site as identified in Sections 2.5 and 3.3.2 of the ISA Summary (GLE, 2011a) and preliminary analysis by Merrick & Company (Merrick, 2010). The design criteria are based on the applicable baseline design criteria in 10 CFR 70.64(a)(2), which require the design to adequately protect against natural phenomena of the most severe documented historical events for the site. As part of the ISA for external events, the IROFS structures were determined to withstand the design basis natural phenomena and external hazards defined in Sections 1.3.3, 1.3.4, and 1.3.5 of the LA and Section 2.5 of the ISA Summary (GLE, 2011a). As required by 10 CFR 70.64(b), the baseline design criteria for the IROFS structures incorporate defense-in-depth and require engineered controls over administrative controls. The main physical design criteria are related to high straight wind and seismic loads and are further defined and delineated in the appropriate IBC (ICC, 2006) subsections and other consensus codes and standards.

As provided in Table 3-1 of the LA (GLE, 2011b), the applicant will design IROFS steel structures using the allowable design method in AISC N690 (AISC, 2007) and the IROFS concrete structures will be designed using the American Concrete Institute (ACI), ACI-349, "Code Requirements for Nuclear Safety-Related Concrete Structures (ACI 349-06) and Commentary" (ACI, 2007).

Based on this review, the NRC staff concludes, with reasonable assurance, that the regulatory requirements in 10 CFR 70.64(a)(2), 64(a)(4), and 70.64(b) have been met because the structural design criteria, bases, and method the applicant proposed for the IROFS structures are based on industry accepted codes, standards, and procedures. The acceptance criterion in Section 3.4.3.2(2)(c) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide design information regarding the resistance of the facility to failures caused by credible external events, when those failures may produce consequences exceeding those identified in 10 CFR 70.61. The acceptance criteria in Sections 3.4.3.2(3), and 3.4.3.2(4) state that the applicant should address hazards and accident sequences and information demonstrating compliance with the performance requirements of 10 CFR 70.61. The NRC staff concluded that the applicant's structural design information met these criteria and is, therefore, acceptable.

### 3.3.13 MANAGEMENT MEASURES

The regulations in 10 CFR 70.65(b)(4) require that the ISA Summary contain information that demonstrates the applicant's compliance with the performance requirements of 10 CFR 70.61 including a description of the management measures that are applied to IROFS for each accident sequence for which the consequences could exceed the performance requirements of 10 CFR 70.61. The acceptance criteria in Section 3.4.3.1(3) of NUREG-1520 (NRC, 2002) state that the applicant needs to commit to establishing management measures to ensure the reliability and availability of the IROFS identified for each scenario. In addition, the acceptance criteria in Section 3.4.3.2(4)(b) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a description of the management measures applied to IROFS needed to meet the performance requirements.

The regulations in 10 CFR 70.65(b)(4) require that the ISA Summary contain information that demonstrates compliance with the performance requirements in 10 CFR 70.61, including a description of the management measures. The regulations in 10 CFR 70.62(d) require that each applicant establish management measures generally on a continuing basis, which are applied to IROFS, to ensure compliance with the performance requirements of 10 CFR 70.61.

The degree to which management measures are applied to a particular engineered or administrative control or control system may be graded commensurate with the reduction of the risk attributable to that control or control system. Management measures ensure that engineered and administrative controls and control systems, identified as IROFS, are designed, implemented, and maintained, as necessary, to ensure they are available and reliable to perform their function when needed. Chapter 11 of NUREG-1520 (NRC, 2002) includes acceptance criteria for the following eight areas of management measures: (a) configuration management (CM); (b) maintenance; (c) training and qualifications; (d) procedures; (e) audits and assessments; (f) incident investigations; (g) records management; and (h) other quality assurance (QA) elements.

The purpose of the staff's technical evaluation of the applicant's management measures was to ascertain whether the applicant provided information regarding its management measures for IROFS.

Chapter 11 of the LA (GLE, 2011b) describes the management measures applied to IROFS, as well as other quality assurance elements. The NRC staff reviewed the above information and finds the applicant's description of the management measures applied to IROFS and the applicant's application and integration of other QA Elements acceptable. The applicant's management measures are evaluated in Chapter 11 of this SER.

In Chapter 11 of this SER, the staff reviewed the applicant's implementation process concerning its records management system in accordance with the acceptance criteria of Section 11.4 of NUREG-1520 (NRC, 2002). Based on this review, the staff has concluded that the records management system used will be effective in collecting, verifying, protecting, and storing information about the facility and its design, operations, and maintenance. In addition, the records management system will provide an adequate means for retrieval of the information in a readable format for the designated lifetimes of data and information collected and designated as records.

The staff reviewed and evaluated the adequacy of the applicant's approach to records management. In Section 11.7.3.4 of the LA (GLE, 2011b), the applicant stated that it will maintain records of failures and how records of IROFS failures will be readily retrievable and available for NRC inspection.

The staff has reviewed the above information and finds the applicant's description of the management measures applied to IROFS to meet the acceptance criteria in Sections 3.4.3.1(3) and 3.4.3.2(4)(b) of NUREG-1520 (NRC, 2002), regarding establishing and describing management measures and is, therefore, acceptable.

### 3.3.14 IDENTIFICATION OF IROFS

The regulations in 10 CFR 70.65(b)(6) require that the ISA Summary include a list briefly describing each IROFS which is identified pursuant to 10 CFR 70.61(e) in sufficient detail to understand their functions in relation to the performance requirements of 10 CFR 70.61.

The regulations in 10 CFR 70.61(e) require that each engineered or administrative control or control system necessary to comply with the performance requirements of 10 CFR 70.61 be designated as an IROFS. The acceptance criteria in Section 3.4.3.2(6) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a list of all IROFS and a description of their

characteristics. The applicant furnished a list of IROFS in each node or subsection of Chapter 4 of the ISA Summary (GLE, 2011a). A description of each IROFS, its function, and characteristics, is contained in description of each node. The information furnished by the applicant addresses the criteria in Section 3.4.3.2 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

### 3.3.15 LIST OF SOLE IROFS

The regulations in 10 CFR 70.65(b)(8) require that the ISA Summary include a descriptive list that identifies all IROFS that are the sole item preventing or mitigating an accident sequence that exceeds the performance requirements of 10 CFR 70.61. The acceptance criteria in Section 3.4.3.2(8) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide a descriptive list of all IROFS that are the sole item preventing or mitigating an accident sequence.

Discussion of the proposed sole IROFS is found in the non-public version of this SER.

NRC staff determined that the applicant provided a descriptive list of sole IROFS that meets the requirements of 10 CFR 70.65(b)(8) and the acceptance criteria in Section 3.4.3.2(8) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable.

### 3.3.16 DEFINITIONS OF “CREDIBLE,” “UNLIKELY,” AND “HIGHLY UNLIKELY”

The regulations in 10 CFR 70.65(b)(9) require the ISA Summary contain a description of the definitions of “credible,” “unlikely,” and “highly unlikely” as used in the evaluations in the ISA. The acceptance criteria in Section 3.4.3.2(9) of NUREG-1520 (NRC, 2002) state that the applicant needs to provide definitions of “credible,” “unlikely,” and “highly unlikely” when used in the applicant’s method of assessing likelihoods.

#### 3.3.16.1 Credible

In Section 1.2.5.4 of the ISA Summary (GLE, 2011a), the applicant stated that an event or accident sequence is considered “credible” unless it is determined to be “not credible.” In Section 1.2.5.3 of the ISA Summary (GLE, 2011a), an event or accident sequence is considered “not credible” if:

1. It is an external event with a frequency of occurrence can be conservatively estimated to be once in a million years; or
2. Is a process deviation, for which there is a convincing argument, based on physical laws, that the event is not possible or the accident sequence is extremely unlikely; or
3. The accident sequence includes a process deviation that consists of many unlikely human actions or errors for which there is no motive, short of intent to cause harm, and has never occurred in any fuel cycle facility.

NRC staff reviewed the applicant’s proposed definitions for credible and determined that they meet the acceptable sets of qualities listed in Section 3.4.3.2(9) of NUREG-1520 (NRC, 2002) and are acceptable to show compliance with 10 CFR 70.61 based on these commitments.

### 3.3.16.2 Unlikely

In Section 1.2.5.2 of the ISA Summary (GLE, 2011a), the applicant stated that an event or accident is considered unlikely if its frequency is in the range between  $10^{-4}$  and  $10^{-5}$  per-event per-year. NRC staff reviewed the applicant's proposed definition for unlikely and determined that it met the acceptable range listed in Section 3.4.3.2(9) of NUREG-1520 (NRC, 2002) and is acceptable to show compliance with 10 CFR 70.61 based on these commitments.

### 3.3.16.3 Highly Unlikely

In Section 1.2.5.1 of the ISA Summary (GLE, 2011a), the applicant stated that an event or accident sequence is considered highly unlikely if it meets the guideline of  $10^{-5}$  per-event per-year. NRC staff reviewed the applicant's proposed definition for highly unlikely and determined that it met the acceptable range listed in Section 3.4.3.2(9) of NUREG-1520 (NRC, 2002) and is acceptable to show compliance with 10 CFR 70.61 based on these commitments.

The staff reviewed the applicant's proposed definitions of credible, unlikely, and highly unlikely and determined that they are reasonably clear and can reasonably be expected to consistently distinguish accidents that are highly unlikely from those that are merely unlikely based on the methodology discussed above.

## 3.3.17 DESCRIPTION OF THE VERTICAL SLICE REVIEW

The staff performed an onsite review the week of October 12, 2009, using the acceptance criteria in Section 3.5.2.3 of NUREG-1520 (NRC, 2002).

The applicant presented overviews of the ISA, including development of the accident sequences, IROFS, risk determination, organizational roles for maintenance of the ISA under 10 CFR Part 70, demonstration of the ISA database, and management measures.

During the onsite review, the staff interviewed applicant personnel and examined ISA documentation, supporting information, and selected accident sequences. The reviews of the accident sequences included, but were not limited to, process hazards analysis information, IROFS descriptions, consequence and likelihood definitions and calculations, technical reports, What-If Checklists, detailed QRA documents, commitments to codes and standards for fire protection, criticality safety, instrumentation and controls, internal administrative procedures, as well as ISA Team members' qualifications. The focus of the review was to ensure that the ISA method was consistent with that described in the LA (GLE, 2011b), and that it met the regulations. Interviews were held with the applicant's ISA team, and subject matter experts from a variety of safety disciplines. Primary interview questions dealt with the preliminary design, as well as detailed questions regarding specific scenarios. The subsets of the ISA, which the NRC staff selected during the onsite review, were examined to ensure that a range of accidents were evaluated, based on consequences, likelihood, and IROFS. The NRC staff evaluated the underpinnings of the calculations, conclusions, and the design, using the guidance provided for new applications for enrichment facilities, as well as historical safety performance at other fuel cycle facilities. This selection process meets the acceptance criteria in Section 3.5.2.3 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

### **3.4 EVALUATION FINDINGS**

Many hazards and potential accidents can result in unintended exposure of persons to radiation, radioactive materials, or toxic chemicals related to the processing of licensed nuclear material. The staff finds that the applicant has performed an ISA to identify and evaluate these hazards in the site and potential accidents as required by 10 CFR 70 Subpart H. The staff reviewed the ISA Summary (GLE, 2011a) and finds that it provides reasonable assurance that the applicant will maintain process safety information and an ISA, has identified IROFS, and established engineered and administrative controls to ensure compliance with the performance requirements of 10 CFR 70.61. Specifically, the staff finds that the ISA results, as documented in the ISA Summary (GLE, 2011a), provide reasonable assurance that the IROFS, management measures, and programmatic commitments will, if properly implemented, make all credible high consequence accidents highly unlikely and all credible intermediate consequence accidents unlikely.

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## **4.0 RADIATION PROTECTION**

The purpose of the U.S. Nuclear Regulatory Commission's (NRC's) review of the applicant's Radiation Protection (RP) Program is to evaluate whether the application provides adequate information to protect the radiological health and safety of workers and is in compliance with the associated regulatory requirements in 10 CFR Parts 19, 20, 30, 40, and 70. Public and environmental protection is discussed in Chapter 9 of this Safety Evaluation Report (SER).

### **4.1 REGULATORY REQUIREMENTS**

#### **4.1.1 RADIATION PROTECTION PROGRAM**

Regulations applicable to establishment of an RP program are presented in 10 CFR Part 20, Subpart B, "Radiation Protection Programs."

#### **4.1.2 AS LOW AS IS REASONABLY ACHIEVABLE PROGRAM**

Regulations applicable to the As Low As Is Reasonably Achievable (ALARA) program are presented in 10 CFR 20.1101, "Radiation Protection Programs."

#### **4.1.3 ORGANIZATION AND PERSONNEL QUALIFICATIONS**

Regulations applicable to the organization and qualifications of the radiological protection staff are presented in 10 CFR 30.33(a)(3), 10 CFR 40.32(b), 10 CFR 70.22(a)(6), and 10 CFR 70.23(a)(2).

#### **4.1.4 WRITTEN PROCEDURES**

The regulations applicable to RP procedures are presented in 10 CFR 40.32(c), 10 CFR 70.22(a)(8), and 10 CFR 70.23(a)(4).

#### **4.1.5 RADIATION PROTECTION TRAINING**

The following regulations apply to the radiation safety training program:

- 10 CFR 19.12, "Instructions to Workers;" and
- 10 CFR 20.2110, "Form of Records."

#### **4.1.6 VENTILATION AND RESPIRATORY PROTECTION PROGRAMS**

Regulations applicable to the ventilation and respiratory protection programs are presented in 10 CFR Part 20, Subpart H, "Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas."

#### 4.1.7 RADIATION SURVEY AND MONITORING PROGRAMS

The following NRC regulations in 10 CFR Part 20 are applicable to radiation surveys and monitoring programs:

- Subpart C, “Occupational Dose Limits;”
- Subpart F, “Surveys and Monitoring;”
- Subpart L, “Records;” and
- Subpart M, “Reports.”

#### 4.1.8 ADDITIONAL PROGRAM REQUIREMENTS

The following regulations are applicable to the additional program requirements:

- 10 CFR Part 20, Subpart L, “Records;”
- 10 CFR Part 20, Subpart M, “Reports;”
- 10 CFR 70.61, “Performance Requirements;” and
- 10 CFR 70.74, “Additional Reporting Requirements.”

### 4.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA

The guidance applicable to NRC’s review of the RP section of the License Application (LA) for the General Electric-Hitachi Global Laser LLC (GLE) Enrichment Facility (GLE, 2011a) is contained in Chapter 4 of the “Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility,” NUREG-1520 (NRC, 2002). Chapter 4 of NUREG-1520 (NRC, 2002) is applicable in its entirety. The acceptance criteria applicable to this review are contained in Sections 4.4.1.3, 4.4.2.3, 4.4.3.3, 4.4.4.3, 4.4.5.3, 4.4.6.3, 4.4.7.3, and 4.4.8.3 of NUREG-1520 (NRC, 2002).

### 4.3 STAFF REVIEW AND ANALYSIS

In Chapter 4 of the LA (GLE, 2011a), the applicant describes its proposed RP program. The applicant states that the principles of the program will be in accordance with the ALARA principle, and that no individual will receive a radiation dose in excess of any regulatory limit (GLE, 2011a). The Facility Manager has overall responsibility for safety and activities conducted at the proposed facility (GLE, 2011a). The GLE President and Chief Executive Officer provides overall direction and management with the respect to design, construction, operation, and decommissioning activities (GLE, 2011a). This individual is responsible for ensuring the facility complies with all applicable regulatory requirements, ALARA principles, and establishing the basic policies of the Radiation Control Program (GLE, 2011a). The Facility Manager provides for safe and controlled operations and protection of the environment by delegating and assigning responsibility to qualified line management and area managers (GLE, 2011a). The RP Manager (RPM) will be responsible for establishing and implementing the ALARA Program (GLE, 2011a).

#### 4.3.1 RP PROGRAM IMPLEMENTATION

The implementation of the RP program is addressed in Section 4.1 of the LA (GLE, 2011a). Additional information on responsibilities and qualifications for the RP program is found in Section 2.2.9.6 of the LA (GLE, 2011a). The following sections identify each acceptance criterion from Section 4.4.1.3 of NUREG-1520 (NRC, 2002) and discuss the staff's analysis as to whether the information provided by the applicant in the LA (GLE, 2011a) meets the acceptance criteria.

- The acceptance criterion in Section 4.4.1.3(1) of NUREG-1520 (NRC, 2002) is for the applicant to design and implement its RP program to meet the regulatory requirements in 10 CFR Part 20, Subpart B.

In Section 4.1.1 of the LA (GLE, 2011a), the applicant states the facility will use approved, written procedures for the RP program, in accordance with 10 CFR Part 20 Subpart B. Written procedures and engineering controls will be used to implement RP principles to comply with occupational dose limits and maintain constraints on atmospheric releases (GLE, 2011a). In Section 4.1.2 of the LA, the applicant states that it will follow the guidance of Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Reasonably Achievable" (NRC, 1977) and Regulatory Guide 8.2, "Guide for Administrative Practices in Radiation Monitoring" (NRC, 1973) to achieve occupational doses and doses to members of the public that are as low as reasonably achievable (ALARA). Constraints on atmospheric releases will be established such that no member of the public would be expected to receive greater than 10 millirem per year (mrem/yr) total effective dose equivalent (TEDE) from exposure to the release (GLE, 2011a). Also, the RP program content and implementation would be reviewed at least annually (GLE, 2011a).

- The acceptance criterion in Section 4.4.1.3(2) of NUREG-1520 (NRC, 2002) is for the applicant to provide an outline of the RP Program structure and define the responsibilities of key program personnel

Information on responsibilities and qualifications of personnel in the RP program is found in Section 2.2.9.6 of the LA (GLE, 2011a). Section 2.2.7.1 of the LA (GLE, 2011a) states that the Environmental Health and Safety (EHS) Manager reports to the Facility Manager and has responsibility for directing activities to ensure that the proposed facility complies with appropriate rules, regulations, and codes, to include Nuclear Criticality Safety, RP, Material Control and Accounting, Security, Emergency Preparedness, Licensing, and Environmental Protection. The RP Manager (RPM) reports directly to the EHS Manager and will be responsible for annually reviewing the content and implementation of the RP Program (GLE, 2011a).

- The acceptance criterion in Section 4.4.1.3(3) of NUREG-1520 (NRC, 2002) is for the applicant to staff the RP program with suitably trained people, provide sufficient resources, and implement the program.

Section 4.1.2 of the LA (GLE, 2011a) states that the RP group will be staffed with trained individuals who will provide oversight and control of the technical aspects of the program elements that affect RP. Section 2.2.7.8 of the LA (GLE, 2011a) describes the level of

training and experience required of the RPM and the senior RP staff. The applicant used American National Standards Institute/American Nuclear Society (ANSI/ANS) N3.1, "Selection, Qualification and Training of Personnel for Nuclear Power Plants," (ANSI/ANS, 1999) and provisions contained in Sections 4.3.3, 4.4.5, and 4.5.3.2 of American Society for Testing and Materials (ASTM) E1168, "Standard Guide for Radiological Protection Training for Nuclear Facility Workers" (ASTM, 2008) to develop the qualifications of RP personnel (GLE, 2011a).

- The acceptance criterion in Section 4.4.1.3(4) of NUREG-1520 (NRC, 2002) is for the applicant to commit to the independence of the radiation protection function from the facility's operations.

Section 2.2.7.8 of the LA (GLE, 2011a) describes the RP function as independent of Operations, possessing authority to shutdown potentially unsafe operations. RPM responsibilities include maintaining RP Programs, procedures, and training; evaluating radiation exposures of employees, and providing guidance and direction for establishment and implementation of the RP Program (GLE, 2011a). Section 4.1.2.3 of the LA (GLE, 2011a) states the RPM has direct access to the Facility Manager for matters involving RP.

- The acceptance criterion in Section 4.4.1.3(5) of NUREG-1520 (NRC, 2002) is for the applicant to review, at least annually, the content and implementation of the radiation protection program as required by 10 CFR 20.1101(c).

Section 4.1.1 of the LA (GLE, 2011a) commits to review, at least annually, the content and implementation of the RP program. Section 4.1.3 of the LA (GLE, 2011a) states it is the responsibility of the RPM and RP staff to perform audits of the program annually.

The staff reviewed the applicant's RP program implementation against the acceptance criteria in Sections 4.4.1.3 of NUREG-1520 (NRC, 2002) and, based on its review, finds that the commitments in the LA (GLE, 2011a) satisfactorily address the acceptance criteria in Section 4.4.1.3 of NUREG-1520 (NRC, 2002).

#### 4.3.2 ALARA PROGRAM

The implementation of the ALARA Program is addressed in Section 4.2 of the LA (GLE, 2011a). The staff reviewed the applicant's ALARA program implementation against the acceptance criteria in Section 4.4.2.3 of NUREG-1520 (NRC, 2002). The following sections identify each acceptance criterion from Section 4.4.2.3 of NUREG-1520 (NRC, 2002) and discuss the staff's analysis as to whether the information provided by the applicant in the LA (GLE, 2011a) meets the criteria.

- The acceptance criterion in Section 4.4.2.3(1) of NUREG-1520 (NRC, 2002) is for the applicant to establish a comprehensive, effective, and written ALARA program.

In Section 4.2 of the LA (GLE, 2011a), the applicant commits to an ALARA Program, which includes policies, goals and approved written policies and procedures. The applicant committed to design and implement the ALARA program consistently with Regulatory Guide 8.2 (NRC, 1973), Regulatory Guide 8.13, "Instructions Concerning Prenatal Radiation Exposure" (NRC, 1999a), Regulatory Guide 8.29, "Instructions

Concerning Risks From Occupational Radiation Exposure” (NRC, 1996), and Regulatory Guide 8.37, “ALARA Levels For Effluents From Materials Facilities” (NRC, 1993a). These regulatory guides provide guidance on acceptable radiation monitoring and control programs, occupational dose monitoring for pregnant women, information to be provided to workers that may receive occupational exposures, and establishing and maintaining programs for monitoring gaseous and liquid effluents to meet the ALARA requirements.

- The acceptance criterion in Section 4.4.2.3(2) of NUREG-1520 (NRC, 2002) is for the applicant to prepare policies and procedures to ensure occupational exposures are maintained ALARA, and that such exposures are consistent with the requirements of 10 CFR 20.1101.

Section 4.2 of the LA (GLE, 2011a) states that approved, written policies and procedures govern the implementation of the ALARA program. In Section 4.2.3 of the LA (GLE, 2011a), the applicant states that the principles of the program will be to maintain personnel radiation exposures less than the applicable regulatory limit and the release of radioactive effluents in accordance with the ALARA principle to ensure that no individual receives a radiation dose in excess of any regulatory limit. Approved written procedures dictate atmospheric releases will be monitored and measured (GLE, 2011a). Section 4.2.2 of the LA (GLE, 2011a) states that doses to the public will be calculated to ensure compliance with the requirements of 10 CFR 20.1101(d).

- The acceptance criterion in Section 4.4.2.3(3) of NUREG-1520 (NRC, 2002) is for the applicant to outline specific ALARA program goals, establish an ALARA program organization and structure, and have written procedures for its implementation in the facility design and operations.

As previously stated, approved, written policies and procedures govern the implementation of the ALARA program (GLE, 2011a). In Section 2.0 of the LA (GLE, 2011a), the applicant states that the Facility Manager has overall responsibility for establishing these principles and the RPM is responsible for establishing and implementing the ALARA program. Section 4.2.2 of the LA (GLE, 2011a) states that constraints on atmospheric releases will be in place to ensure no member of the public receives a Total Effective Dose Equivalent (TEDE) in excess of 10 millirem per year. In Section 4.2.3 of the LA (GLE, 2011a), the applicant states that radiation exposures will be monitored and the annual average concentration of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area will be in compliance with 10 CFR 20.1302, “Compliance with Dose Limits for Individual Members of the Public,” and will not exceed the values in 10 CFR Part 20, Appendix B, “Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage,” Table 2.

- The acceptance criterion in Section 4.4.2.3(4) of NUREG-1520 (NRC, 2002) is for the applicant to establish an ALARA Committee, or equivalent organization, with sufficient staff, resources, and clear responsibilities to ensure that the occupational radiation exposure dose limits specified in 10 CFR Part 20 are not exceeded under normal operations.

The applicant states in Section 2.2.8.1 of the LA (GLE, 2011a), that it has established an independent advisory committee, the Facility Safety Review Committee (FSRC). The FSRC provides the Facility Manager with an independent overview of the safety of operations, and provides management with guidance relative to involvement in safety risks (GLE, 2011a). The committee provides professional advice and counsel on Environmental Protection, nuclear criticality safety (NCS), RP, and Industrial Safety issues affecting nuclear activities (GLE, 2011a). The FSRC is responsible for completing an annual ALARA review which considers RP training, contamination controls, environmental monitoring, and review of new procedures or technologies (GLE, 2011a). The FSRC is responsible to the Facility Manager (GLE, 2011a). The committee's proceedings, findings and recommendations are reported in writing to the Facility Manager, appropriate line management, and appropriate area manager(s) responsible for operations (GLE, 2011a). Such reports shall be retained for a minimum of three years (GLE, 2011a). The committee shall hold a minimum of three meetings each calendar year with a maximum interval of 180 days between any two consecutive meetings (GLE, 2011a).

- The acceptance criterion in Section 4.4.2.3(5) of NUREG-1520 (NRC, 2002) is for the applicant to use the ALARA program as a mechanism to facilitate interaction between RP and operations personnel.

The ALARA Program is structured to be a means of promoting interaction between RP and Operations personnel. Section 4.2.5 of the LA (GLE, 2011a) states both RP and Operations personnel serve on the Radiation Safety Committee (RSC). RP personnel interact with Operations Personnel in the preparation of Radiation Work Permits (RWPs) for specific radiological hazards associated with the work environment. RP and Operations personnel also interact in the performance of safety audits (GLE, 2011a).

- The acceptance criterion in Section 4.4.2.3(6) of NUREG-1520 (NRC, 2002) is for the applicant to regularly review and revise, when appropriate, the ALARA program goals and objectives and to incorporate, when appropriate, new approaches, technologies, operating procedures or changes that could reduce potential radiation exposures at a reasonable cost.

In Section 4.2.4 of the LA (GLE, 2011a), the applicant states that it will establish an RSC, whose objective is to maintain occupational radiation exposures ALARA through improvements in operations and will advise the Facility Manager on RP concerns. The committee will meet monthly to maintain a continual awareness of the status of projects, performance measurement and trends, and the current radiological safety conditions of site activities (GLE, 2011a). The maximum interval between meetings shall not exceed 60 days (GLE, 2011a). A written report of each RSC meeting will be forwarded to the appropriate line management, area managers, and the EHS Manager (GLE, 2011a). Records of the committee proceedings will be maintained for a minimum of three years (GLE, 2011a). The committee consists of managers or representatives from key functions with activities affecting radiological safety (GLE, 2011a). The RSC will monitor trends in occupational exposure and effluent releases, identify potential radiological safety hazards, review results of audits and proposed activities, and promote continued improvement in limiting employee radiological exposures (GLE, 2011a).



The staff reviewed the applicant's ALARA program against the acceptance criteria in Section 4.4.2.3 of NUREG-1520 (NRC, 2002) and, based on its review, finds that the commitments in the LA (GLE, 2011a) satisfactorily address the acceptance criteria in Section 4.4.2.3 of NUREG-1520 (NRC, 2002).

#### 4.3.3 ORGANIZATION AND PERSONNEL QUALIFICATIONS

The staff reviewed the applicant's organization and personnel qualifications against the acceptance criteria in NUREG-1520, Section 4.4.3.3 (NRC, 2002). The following sections identify each acceptance criterion from NUREG-1520 (NRC, 2002) and discuss the staff's analysis as to whether the information provided by the applicant in the LA (GLE, 2011a) meets the criteria.

- The acceptance criterion in Section 4.4.3.3(1) of NUREG-1520 (NRC, 2002) is for the applicant to appoint suitably trained RP personnel and identify their authority and responsibilities.

Section 4.1.3 of the LA (GLE, 2011a) states the RP Program section will be staffed with adequately trained personnel to implement an effective program. Section 2.2.7.8 of the LA (GLE, 2011a) describes the education and experience requirements for the RPM and senior engineer. Sections 4.1.2 and 4.3 of the LA (GLE, 2011a) describe information regarding the structure of key personnel and the RP organization and staff qualifications. As stated in Section 4.3.1 of the LA (GLE, 2011a), the applicant stated that organizational requirements will be consistent with the guidance of Regulatory Guides 8.2 (NRC, 1973) and 8.10 (NRC, 1977).

- The acceptance criterion in Section 4.4.3.3(2) of NUREG-1520 (NRC, 2002) is for the applicant to establish clear organizational relationships among the individual positions responsible for the radiation protection program and other line managers.

Section 2.2.7.1 of the LA (GLE, 2011a) describes that the EHS Manager reports to the Facility Manager and has responsibility for directing activities to ensure that the proposed facility complies with appropriate rules, regulations, and codes, to include Nuclear Criticality Safety, RP, Material Control and Accounting, Security, Emergency Preparedness, Licensing, and Environmental Protection. Section 2.2.7.8 of the LA (GLE, 2011a) describes the responsibilities of the RP function. The RPM reports directly to the EHS Manager and will be responsible for annually reviewing the content and implementation of the RP Program (GLE, 2011a). The RPM directs the RP program and will be responsible for the implementation of the RP program (GLE, 2011a). Section 4.1.2.3 of the LA (GLE, 2011a) states the RPM has direct access to the Facility Manager for matters involving RP and is independent from the Operations and Technical Services Organizations (GLE, 2011a).

- The acceptance criterion in Section 4.4.3.3(3) of NUREG-1520 (NRC, 2002) is for the applicant to appoint a suitably educated, experienced, and trained RP program director (typically referred to as the radiation safety officer) who: (1) has direct access to the facility manager; (2) is skilled in the interpretation of data and regulations pertinent to radiation protection; (3) is familiar with the operation of the facility and RP concerns of

the site; (4) is used as a resource in radiation safety management decisions and (5) will be responsible for establishing and implementing the radiation protection program.

In Section 2.2.7.8 of the LA (GLE, 2011a), the applicant states that the RPM will have, as a minimum, a bachelor's degree in engineering or scientific field, as well as three years experience including assignments involving responsibilities in RP or the application and direction of RP programs.

- The acceptance criterion in Section 4.4.3.3(4) of NUREG-1520 (NRC, 2002) is to assign responsibility to the radiation protection program staff for implementation of the radiation program functions.

Section 4.1.3 of the LA (GLE, 2011a) assigns responsibilities to the RP Manager and staff in multiple areas, including the establishment and maintenance of the RP Program, development of RP Procedures, staffing of the RP Program, monitoring of exposures, source control, training, performance of audits, posting of spaces, and environmental monitoring. Section 4.3.1 specifies the technical qualification requirements for the RP Manager and RP personnel at the proposed facility.

- The acceptance criterion in Section 4.4.3.3(5) of NUREG-1520 (NRC, 2002) is for the applicant to describe the minimum training requirements and qualifications for the RP director and staff.

In Section 2.2.7.8 of the LA (GLE, 2011a), the applicant describes the responsibilities central to the RP function, to include the minimum educational requirements of the RPM and senior engineers in the RP group. Section 4.3.5 of the LA (GLE, 2011a) states the RP Training Program is consistent with the guidance of ANSI/ANS N3.1 (ANSI/ANS, 1999) and American Society for Testing and Materials (ASTM) E1168, "Standard Guide for Radiological Protection for Nuclear Facility Workers" (ASTM, 2008).

The staff reviewed the applicant's organization and personnel qualifications against the acceptance criteria in Sections 4.4.3.3 of NUREG-1520 (NRC, 2002) and, based on its review, finds that the commitments in the LA (GLE, 2011a) satisfactorily address the application acceptance criteria in Section 4.4.3.3 of NUREG-1520 (NRC, 2002).

#### 4.3.4 WRITTEN PROCEDURES

The staff reviewed the applicant's written procedure commitments against the acceptance criteria in NUREG-1520, Section 4.4.4.3 (NRC, 2002). The following sections identify each acceptance criterion from NUREG-1520 (NRC, 2002) and discuss the staff's analysis as to whether the information provided by the applicant in the LA (GLE, 2011a) meets the criteria.

- The acceptance criterion in Section 4.4.4.3(1) of NUREG-1520 (NRC, 2002) is for the applicant to prepare written, approved RP procedures to carry out activities related to the RP program.

In Section 4.4 of the LA (GLE, 2011a), the applicant describes the commitment to maintain and prepare approved written RP procedures that will be prepared in accordance with the requirements of 10 CFR 70.22(a)(8). Section 4.4.2 of the LA (GLE, 2011a) states RP procedures will be prepared, reviewed, and approved to carry out

activities related to the RP program. They would also be used to ensure RP activities are conducted in a safe, effective, and consistent manner (GLE, 2011a). RP Procedures are distributed to affected managers and available to GLE employees and certain procedures require periodic review (GLE, 2011a).

- The acceptance criterion in Section 4.4.4.3(2) of NUREG-1520 (NRC, 2002) is for the applicant to specify how the radiation protection procedures will be prepared, authorized, approved, and distributed.

Section 4.4.3 of the LA (GLE, 2011a) states that routine work performed in Radiological Controlled Areas (RCAs) will be managed through the use of approved written procedures developed as described in Section 11.4 of the LA (GLE, 2010a). In Section 4.4.2 of the LA (GLE, 2011a), the applicant describes specific commitments to preparation and maintenance of RP procedures, including the approval of RP procedures and the approval of any revisions to the procedures to be completed by the RPM. Section 4.4.3 of the LA (GLE, 2011a) states that the RPM or designee will approve any RWP prior to issue of the procedure. Section 4.4.1 of the LA (GLE, 2011a) states RP procedures are reviewed and revised, as necessary, to incorporate any facility or operational changes, or changes to the Integrated Safety Analysis (ISA).

- The acceptance criterion in Section 4.4.4.3(3) of NUREG-1520 (NRC, 2002) is for the applicant to specify written, approved RWPs for activities involving licensed material that are not covered by written RP procedures.

Section 4.4.3 of the LA (GLE, 2011a) states that non-routine activities are administered through an RWP system. The RWP system is described in approved written procedures (GLE, 2011a). RWPs are issued for unanticipated work or maintenance, and must be approved by the RPM or designee (GLE, 2011a). The RWP specifies necessary controls, personnel monitoring devices, and protective clothing (GLE, 2011a). RWPs have expiration dates and a copy of all RWPs must be retained for the life of the facility (GLE, 2011a). The applicant describes in Section 11.4 of the LA (GLE, 2011a), a management measures program in which procedures are prepared, reviewed, and approved. In Section 4.4.2 of the LA (GLE, 2011a), the applicant describes specific commitments to preparation and maintenance of RP procedures, including the approval of RP procedures and the approval of any revisions to the procedures to be completed by the RPM.

The staff reviewed the applicant's written procedure commitments against the acceptance criteria in Sections 4.4.4.3 of NUREG-1520 (NRC, 2002) and, based on its review, finds that the commitments in the LA (GLE, 2011a) satisfactorily address the acceptance criteria in Section 4.4.4.3 of NUREG-1520 (NRC, 2002).

#### 4.3.5 TRAINING

The staff reviewed the applicant's training commitments against the acceptance criteria in NUREG-1520, Section 4.4.5.3 (NRC, 2002). The following sections identify each acceptance criterion from NUREG-1520 (NRC, 2002) and discuss the staff's analysis as to whether the information provided by the applicant in the LA (GLE, 2011a) meets the criteria.

- The acceptance criterion in Section 4.4.5.3(1) of NUREG-1520 (NRC, 2002) is for the applicant to design and implement an employee RP training program that complies with the requirements of 10 CFR Parts 19 and 20.

In Section 4.5.3 of the LA (GLE, 2011a), the applicant describes the training requirements for workers likely to receive an occupational dose in excess of 100 millirem in one year. The required level of RP training is based on the potential radiological health risks associated with an employee's work responsibilities (GLE, 2011a). This training program outlines the requirements of 10 CFR 19.12(a) and the workers' responsibilities under the applicant's RP program (GLE, 2011a). Training will be consistent with ASTM 1168 (ASTM, 2008).

- The acceptance criterion in Section 4.4.5.3(2) of NUREG-1520 (NRC, 2002) is for the applicant to provide training, to all personnel and visitors entering restricted areas, that is commensurate with the health risk to which they may be exposed, or provide trained escorts who have received the training.

In Section 4.5.2 of the LA (GLE, 2011a), the applicant states that it will require workers, contractors, and visitors who enter controlled areas of the facility to be trained to the appropriate level, commensurate with the hazards. Visitors are escorted by trained personnel (GLE, 2011a).

- The acceptance criterion in Section 4.4.5.3(3) of NUREG-1520 (NRC, 2002) is for the applicant to provide a level of training based on the potential radiological health risks associated with that employee's work responsibilities.

Section 4.5.2 of the LA (GLE, 2011a) states that different training requirements will be established, suited to the need of the individual, and commensurate with the level of radiological risk. In Section 4.5.3 of the LA (GLE, 2011a), the applicant committed to provide a level of training based on the potential radiological health risks associated with the individual's work responsibilities.

- The acceptance criterion in Section 4.4.5.3(4) of NUREG-1520 (NRC, 2002) is for the applicant to incorporate, in the RP training program, the provisions in 10 CFR 19.12 and topics such as: correct handling of radioactive materials; minimization of exposures to radiation or radioactive materials; access and egress controls and escort procedures; radiation safety principles, policies, and procedures; monitoring for internal and external exposures; monitoring instruments; contamination control, including protective clothing and equipment; ALARA and exposure limits; radiation hazards and health risks; and, emergency response.

In Section 4.5.3 of the LA (GLE, 2011a), the applicant describes the training requirements for workers likely to receive an occupational dose in excess of 100 millirem in one year. The required level of RP training is based on the potential radiological health risks associated with an employee's work responsibilities (GLE, 2011a). This training program outlines the requirements of 10 CFR 19.12(a) and the workers' responsibilities under the applicant's RP program (GLE, 2011a). In accordance with the regulatory requirements, the workers will be:

- Kept informed of the storage, transfer, or use of radioactive material;
  - Instructed in health protection issues associated with exposure to radiation and radioactive material, precautions or procedures to minimize exposure, and the purpose and function of protective devices employed;
  - Required to observe, to the extent within the worker's control, the applicable provisions of the NRC regulations and licenses for protection of personnel from exposure to radiation and radioactive material;
  - Instructed of their responsibility to promptly report to management any condition that may lead to or cause a violation of NRC regulations and licenses, or result in unnecessary exposure to radiation and radioactive material;
  - Instructed on the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation and radioactive material; and
  - Advised of the various notifications and reports that a worker may request pursuant to 10 CFR 19.13, *Notifications and Reports to Individuals* (GLE, 2011a).
- The acceptance criterion in Section 4.4.5.3(5) of NUREG-1520 (NRC, 2002) is for the applicant to review the radiation protection training program at least every 3 years and conduct refresher training at least every 3 years that will accurately address changes in policies, procedures, requirements, and the facility ISA.

Section 4.5.5 of the LA (GLE, 2011a) states that the contents of the training program will be reviewed bi-annually and the review will address policies, procedures, requirements, and changes to the ISA. In addition, refresher training will be completed annually, not to exceed 15 months (GLE, 2011a). Section 4.5.6 of the LA (GLE, 2011a) states the majority of the training would be conducted via computer-based training and evaluation. There are classroom instructors, authorized by the facility, used as needed (GLE, 2011a). Practical examination is also a part of the training, dependent upon work requirements and employee qualifications (GLE, 2011a).

- The acceptance criterion in Section 4.4.5.3(6) of NUREG-1520 (NRC, 2002) is for the applicant to review and evaluate the effectiveness and adequacy of the training program's curriculum and instructors.

Section 4.5.6 of the LA (GLE, 2011a) states that the content of the formal training program would be reviewed and updated at least every two years by the RP and NCS Managers, to ensure the program is current and up to date.

The staff reviewed the applicant's training commitments against the acceptance criteria in Sections 4.4.5.3 of NUREG-1520 (NRC, 2002) and, based on its review, finds that the commitments in the LA (GLE, 2011a) satisfactorily address the acceptance criteria in Section 4.4.5.3 of NUREG-1520 (NRC, 2002).

#### 4.3.6 VENTILATION AND RESPIRATORY PROTECTION PROGRAMS

The staff reviewed the applicant's ventilation and respiratory protection program commitments against the acceptance criteria in NUREG-1520, Section 4.4.6.3 (NRC, 2002). The following sections identify each acceptance criterion from NUREG-1520 (NRC, 2002) and discuss the

staff's analysis as to whether the information provided by the applicant in the LA (GLE, 2011a) meets the criteria.

- The acceptance criterion in Section 4.4.6.3(1) of NUREG-1520 (NRC, 2002) is for the applicant to install appropriately sized ventilation and containment systems in areas of the facility identified in the ISA Summary as having potential airborne concentrations of radionuclides that could exceed the occupational, DAC values specified in 10 CFR Part 20, Appendix B, during normal operations.

In Section 4.6 of the LA (GLE, 2011a), the applicant describes the facility ventilation and respiratory protection programs. Design features of the ventilation systems are described in Section 3.3.2.4 of the ISA Summary (GLE, 2011b). Section 4.6.1 of the LA (GLE, 2011a) commits to the use of several engineering controls, including ventilation and containment systems to ensure airborne exposures are kept below regulatory limits in accordance with Subpart H of 10 CFR Part 20. The Operations Building ventilation system has a closed Heating, Ventilation and Air Conditioning (HVAC) and Monitored Central Exhaust (MCES) system, providing airflow from areas of lesser potential contamination to areas of higher potential contamination (GLE, 2011a). Ventilations systems for potentially contaminated areas exhaust to the environment through the Operations Building stack (GLE, 2011a). Potentially contaminated air is exhausted through High Efficiency Particulate Air (HEPA) filters and High Efficiency Gas Absorber (HEGA) filter media to remove particulates and gaseous contaminants (GLE, 2011a). Potentially contaminated air is exhausted through HEPA filters that are 99.97 percent efficient for removal of 0.3 micron particles (GLE, 2011a). Hoods and other localized ventilation designs are utilized to minimize personnel exposure to airborne uranium and hydrogen fluoride (HF) and ensure exposures are meet administrative and regulatory limits (GLE, 2011a). Section 4.6.1.3 of the LA (GLE, 2011a) commits to ventilation systems adequate to ensure the DAC values of Appendix B of 10 CFR Part 20 are not exceeded.

- The acceptance criterion in Section 4.4.6.3(2) of NUREG-1520 (NRC, 2002) is for the applicant to describe management measures, including preventive and corrective maintenance and performance testing, to ensure that the ventilation and containment systems designated as IROFS operate when required, and are within their design specifications.

Section 4.6.1.2 of the LA (GLE, 2011a) states that ventilation systems that are IROFS are monitored on a regular basis, as a routine part of the operating process (GLE, 2011a). Operations and maintenance are performed using approved written procedures as described in Section 11.4 of the LA (GLE, 2011a). The various programs that pertain to preventive and corrective maintenance are described in Section 11.2 of the LA (GLE, 2011a).

- The acceptance criterion in Section 4.4.6.3(3) of NUREG-1520 (NRC, 2002) is for the applicant to describe the design criteria for the ventilation and containment systems, including minimum flow velocity at openings in these systems, maximum differential pressure across filters and types of filters to be used.

Section 4.6.1.1 of the LA (GLE, 2011a) states that all effluents released from potentially contaminated areas would be filtered to remove radioactive particulates before release.

Section 4.6.1.1 of the LA (GLE, 2011a) states that systems would contain HEPA and other prefilters, as needed. The ventilation systems will be designed to maintain the potentially contaminated areas at a slightly negative pressure relative to the uncontaminated areas, to ensure airflow direction is from areas of little or no contamination to areas of higher contamination (GLE, 2011a). Approved, written procedures will be used to specify filter inspection, testing, maintenance, and change-out (GLE, 2011a). Additional features of the ventilation systems are described in Table 4-1 of the LA (GLE, 2011a).

- The acceptance criterion in Section 4.4.6.3(4) of NUREG-1520 (NRC, 2002) is for the applicant to describe the frequency and types of tests to measure ventilation and containment system performance, the acceptance criteria, and actions to be taken when the acceptance criteria are not satisfied.

Section 3.4.9 of the ISA Summary (GLE 2011b) states that effluent air streams will be continuously monitored to assess uranium concentration and daily for gross alpha activity. Section 1.1.2.1.9 of the LA (GLE, 2011a) states the Monitored Central Exhaust System (MCES) is designed to remove both UF<sub>6</sub> and HF. In Section 4.6.1.4 of the LA (GLE, 2011a), the applicant describes testing of ventilation and containment systems. Differential pressure across high efficiency particulate air filters in potentially contaminated exhaust systems would be monitored monthly or automatically (GLE, 2011a). Automatic monitors would have alarm features (GLE, 2011a). Filters would be replaced when differential pressure exceeds the manufacturers' ratings or if the filters fail to function properly (GLE, 2011a).

In Section 4.6.1.1 of the LA (GLE, 2011a), for local or hood use, the applicant commits to maintaining the average air velocity above 80 linear feet per minute (GLE, 2011a). Airflows and differential pressures will be checked monthly or after significant modifications to the ventilation system (GLE, 2011a). Table 4-1, "Specific Facilities and Capabilities," of the LA (GLE, 2011a), indicates that high velocity local ventilation airflow will be maintained at an average of 200 linear feet per minute (GLE, 2011a). Potentially contaminated exhaust systems are monitored at least monthly and alarmed (GLE, 2011a).

- The acceptance criterion in Section 4.4.6.3(5) of NUREG-1520 (NRC, 2002) is for the applicant to establish a respiratory protection program that meets the requirements of 10 CFR Part 20, Subpart H.

Section 4.6.2 of the LA (GLE, 2011a) discusses the establishment of the respiratory protection program, in accordance with 10 CFR 20, Subpart H. Engineering controls would be used to the maximum extent possible and, if the decision is made to permit the use of respiratory protection equipment to limit the intake of radioactive material, only National Institute of Occupational Safety and Health (NIOSH) certified equipment would be used (GLE, 2011a). In Section 4.6.2 of the LA (GLE, 2011a), the applicant states the design of the respiratory protection program would be consistent with Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection," (NRC 1999).

- The acceptance criterion in Section 4.4.6.3(6) of NUREG-1520 (NRC, 2002) is for the applicant to prepare written procedures for the selection, fitting, issuance, maintenance,

maintenance, testing, training of personnel, monitoring, and recordkeeping for individual respiratory protection equipment, and for specifying when such equipment is to be used.

Section 4.6.2.2 of the LA (GLE, 2011a) states that approved written procedures will be used to control respiratory equipment, including selection, fit testing, inventory, maintenance, recordkeeping, and cleaning. Section 4.6.2.2 of the LA (GLE, 2011a) describes the proper techniques for fitness testing and mask fit will be re-evaluated annually. In Section 4.6.2.2.3 of the LA (GLE, 2011a), the applicant states that the determination of medical fitness to use respiratory protection equipment is made by a physician. Individuals are evaluated periodically thereafter, at a frequency specified by a physician (GLE, 2011a). The applicant committed to develop written procedures for the respiratory protection program to address the following subjects:

- Monitoring, including air sampling and bioassays;
- Supervision and training of respirator users;
- Fit testing;
- Respirator selection;
- Breathing air quality;
- Inventory and control;
- Storage, issuance, maintenance, repair, testing, and quality assurance of respiratory protection equipment;
- Record keeping; and,
- Limitations on periods of respirator use and relief from respirator use.

In Section 4.6.2.2.4 of the LA (GLE, 2011a), the applicant states that testing of respiratory equipment will be in accordance with manufacturers' instructions in accordance with the NIOSH specification for each respiratory device (GLE, 2011a). Section 4.6.2.2.6 states training in the proper use of respiratory equipment will be conducted by a qualified instructor (GLE, 2011a). Recordkeeping will comply with 10 CFR Part 20, Subpart L, and the applicant's records management procedures in Section 11.7 of the LA (GLE, 2011a).

- The acceptance criterion in Section 4.4.6.3(7) of NUREG-1520 (NRC, 2002) is for the applicant to revise the written procedures for use of individual respiratory protection equipment as applicable, when processing, facility, or equipment changes are made.

Section 4.6.2.3 of the LA (GLE, 2011a) states that respiratory protection procedures would be revised as necessary, in accordance with procedures identified in Section 11.4.2 of the LA (GLE, 2011a).

- The acceptance criterion in Section 4.4.6.3(8) of NUREG-1520 (NRC, 2002) is for the applicant to maintain records of the respiratory protection program, including training for respirator use, and maintenance.

Section 4.6.2.2.8 of the LA (GLE, 2011a) addresses recordkeeping, specifying approved, written procedures, consistent with 10 CFR Part 20 Subpart L. Records for the respiratory protection program (including training for respirator use and maintenance) would be maintained in accordance with the facility records management program as described in Section 11.7 of the LA (GLE, 2011a). Section 11.7 of the LA (GLE, 2011a) discusses control of records and maintenance of the master file.



The staff reviewed the applicant's ventilation and respiratory protection program against the acceptance criteria in Sections 4.4.6.3 of NUREG-1520 (NRC, 2002) and, based on its review, finds that the commitments in the LA (GLE, 2011a) satisfactorily address the acceptance criteria in Section 4.4.6.3 of NUREG-1520 (NRC, 2002).

#### 4.3.7 RADIATION SURVEY AND MONITORING PROGRAMS

The staff reviewed the applicant's radiation survey and monitoring program commitments against the acceptance criteria in NUREG-1520, Section 4.4.7.3 (NRC, 2002). The following sections identify each acceptance criterion from NUREG-1520 (NRC, 2002) and discuss the staff's analysis as to whether the information provided by the applicant in the LA (GLE, 2011a) meets the criteria.

- The acceptance criterion in Section 4.4.7.3(1) of NUREG-1520 (NRC, 2002) is for the applicant to have radiation survey and monitoring programs consistent with the requirements of 10 CFR Part 20, Subpart F.

In Section 4.7 of the LA (GLE, 2011a), the applicant describes its radiation survey and monitoring programs, which are based on the requirements of 10 CFR Part 20, Subpart F, and implemented through approved, written procedures. Aspects of the program are airborne and surface contamination and personnel dosimetry (GLE, 2011a). In Section 4.7 of the LA (GLE, 2011a), The applicant states that the radiation survey and monitoring program will be consistent with the guidance set forth in Regulatory Guide 8.2 (NRC, 1973), Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Dose Data" (NRC, 2005), and Regulatory Guide 8.9, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program" (NRC, 1993h).

- The acceptance criterion in Section 4.4.7.3(2) of NUREG-1520 (NRC, 2002) is for the applicant to prepare written procedures for the radiation survey and monitoring program that include an outline of the program objectives, sampling procedures, data analysis methods, types of equipment and instrumentation to be used, frequency of measurements, recordkeeping and reporting requirements, and actions to be taken when measurements exceed 10 CFR Part 20 occupational dose limits or administrative levels established by the applicant.

Section 4.7.2 of the LA (GLE, 2011a) states that written procedures will be developed and approved to identify survey and monitoring objectives, as well as procedures and methods of data analysis. Instrumentation to be used, as well as frequency of measurements, will be specified (GLE, 2011a). Recordkeeping and reporting requirements and actions to be taken for exceeding certain thresholds will be established (GLE, 2011a). Section 4.7 of the LA (GLE, 2011a) states that Regulatory Guide 8.7 will be used administratively for this program.

- The acceptance criterion in Section 4.4.7.3(3) of NUREG-1520 (NRC, 2002) is for the applicant to design and implement a personnel monitoring program for external occupational radiation exposures that outlines methods or procedures to:

- a. Identify the criteria for worker participation in the program;
- b. Identify the types of radiation to be monitored;
- c. Specify how exposures will be measured, assessed and recorded;
- d. Identify the type and sensitivity of personal dosimeters to be used, when they will be used, and how the collected data will be processed and evaluated; and
- e. Identify the facility's administrative exposure levels or action levels at which actions are taken to investigate the cause of exposures exceeding these levels.

Section 4.7.3 of the LA (GLE, 2011a) states that approved written procedures will be used and personnel dosimeters are distributed to individuals based on their job functions, commensurate with the amount of time an individual spends working with or near radioactive materials. Personnel monitoring includes issuance of Thermoluminescent Dosimeters (TLDs) for personnel entering Radiologically Controlled Areas (RCAs) to measure external dose (GLE, 2011a). Dosimetry is National Voluntary Laboratory Accreditation Program (NVLAP) approved and will be sensitive to the appropriate type of radiation to be monitored and distribution commensurate with the job function (GLE, 2011a). Personnel dosimeters will be processed by a NVLAP accredited vendor. Action guides for external exposures are established in written procedures also (GLE, 2011a). Expedited processing for emergent circumstance is available (GLE, 2011a). Section 4.2.2 of the LA (GLE, 2011a) describes that an administrative control limit of 80 percent of the limits of 10 CFR 20.1201 is imposed. Exceeding an administrative limit invokes an investigation by the RPM (GLE, 2011a).

- The acceptance criterion in Section 4.4.7.3(4) of NUREG-1520 (NRC, 2002) is for the applicant to "design and implement a personnel monitoring program, for internal occupational radiation exposures, based on the requirements of 10 CFR 20.1201, 20.1204, and 20.1502(b), that outlines methods or procedures to:
  - a. Identify the criteria for worker participation in the program;
  - b. Identify the type of sampling to be used, the frequency of collection and measurement, and the minimum detection levels;
  - c. Specify how worker intakes will be measured, assessed, and recorded;
  - d. Specify how the data will be processed, evaluated, and interpreted; and
  - e. Identify the facility's administrative exposure levels or the levels at which actions are taken to investigate the causes of exposures exceeding these levels.

In Section 4.7.4 of the LA (GLE, 2011a), the applicant states that a personnel monitoring program for internal exposures is implemented under approved, written procedures. The applicant commits to monitoring internal occupational radiation exposures based on the requirements of 10 CFR 20.1201, 10 CFR 20.1204, 10 CFR 20.1502(b), and 10 CFR 20.1704(i) (GLE, 2011a). This program includes a urinalysis program for personnel who work in areas where soluble airborne uranium intakes could result in exceeding 10 percent of the limit established in 10 CFR 20.1201 (GLE, 2011a). An *in vivo* lung counting program is described in Section 4.7.4.2 of the LA (GLE, 2011a) and established for personnel working in areas where insoluble uranium compounds are processed and calls for baseline and termination counting. Action levels are established in approved, written procedures to prevent an individual from exceeding the occupational exposure limits specified in 10 CFR 20.1201 (GLE, 2011a). The guidance of Regulatory Guide 8.9 (NRC, 1993h) is used (GLE, 2011a). Additionally, personnel who are assigned an intake

of 10 percent of the applicable Annual Limit on Intake (ALI) are monitored annually (GLE, 2011a).

- The acceptance criterion in Section 4.4.7.3(5) of NUREG-1520 (NRC, 2002) is for the applicant to comply with the requirements of 10 CFR 20.1202 for summation of external and internal occupational radiation exposures through the use of procedures such as those outlined in Regulatory Guide 8.7 or 8.34.

Section 4.7.5 of the LA (GLE, 2011a) addresses summation of external and internal occupational dose by procedure. Regulatory Guide 8.9 (NRC, 1993h) is the basis for programs used (GLE, 2011a). In addition, the guidance of Regulatory Guide 8.34, "Monitoring Criteria and methods to Calculate Occupational Radiation Doses" (NRC, 1992a) is used in determination of internal doses (GLE, 2011a).

- The acceptance criterion in Section 4.4.7.3(6) of NUREG-1520 (NRC, 2002) is for the applicant to design and implement an air sampling program in areas of the facility identified as potential airborne radioactivity areas, to conduct air surveys, and to calibrate and maintain the airborne sampling equipment in accordance with the manufacturer's recommendations.

In Section 4.7.6 of LA (GLE, 2011a), the applicant states that an air sampling program will be established for the facility as another means of assessing potential airborne contamination in support of the internal monitoring program. Procedures will be established to direct the conduct of air surveys, and to calibrate and maintain airborne sampling equipment according to manufacturers' recommendations (GLE, 2011a).

- The acceptance criterion in Section 4.4.7.3(7) of NUREG-1520 (NRC, 2002) is for the applicant to implement additional procedures, as may be required by 10 CFR Part 20 and the ISA Summary, to control the concentration of airborne radioactive material (e.g., control of access, limitation of exposure times to licensed materials, and use of respiratory protection equipment).

Section 4.7.7 of the LA (GLE, 2011a) states that continuous air sampling will be conducted in areas where airborne concentrations can exceed 0.1 DAC averaged over 40 hours (GLE, 2011a). Written procedures will guide the program and include investigation of any air sample exceeding 2.5 DAC over 8 hours (GLE, 2011a). Regulatory Guide 8.25, "Air Sampling in the Workplace" (NRC, 1992b) is cited as the basis of guidance for the air sampling program (GLE, 2011a).

- The acceptance criterion in Section 4.4.7.3(8) of NUREG-1520 (NRC, 2002) is for the applicant to conduct a contamination survey program in areas of the facility identified in the ISA Summary most likely to be radiologically contaminated (the program must include the types and frequencies of surveys for various areas of the facility and the action levels and actions to be taken when contamination levels are exceeded).

In Section 4.7.1 of the LA (GLE, 2011a), the applicant states that the routine survey program will be established by approved written procedures to determine workplace radiological conditions, to determine effectiveness of contamination control measures, and to ensure identification and posting of radiological hazards. In Section 4.7.9 of the LA (GLE, 2011a), the applicant stated that routine surveys will be carried out in areas

most likely to be contaminated as well as other operational areas. The procedures that would be developed to implement the programs would include an outline of the program objectives, sampling procedures, data analysis methods, types of equipment and instrumentation to be used, frequency of measurements, recordkeeping and reporting requirements, and actions to be taken when measurements exceed 10 CFR Part 20's occupational dose limits or the administrative levels established by the applicant (GLE, 2011a).

- The acceptance criterion in Section 4.4.7.3(9) of NUREG-1520 (NRC, 2002) is for the applicant to implement the facility's corrective action program when the results of personnel monitoring or contamination surveys exceed the applicant's administrative personnel contamination levels.

Section 4.7.10 of the LA (GLE, 2011a) describes the establishment of a Corrective Action Program for personnel contamination. Requirements are established for reducing the potential for the spread of contamination (GLE, 2011a). In Section 4.7.10 of the LA (GLE, 2011a), the applicant states that protective clothing and disposable Personal Protective Equipment (PPE) will be provided for persons entering RCAs where the potential for personnel contamination exists as determined by RP staff. Change rooms will be provided for personnel exiting these areas (GLE, 2011a). The applicant requires monitoring of personnel exiting RCAs (GLE, 2011a). Contamination identified above background levels requires decontamination and assistance from the RP function to oversee decontamination processes (GLE, 2011a). Protective clothing requirements are identified in the LA, Table 4-2, "Personnel Protective Clothing" (GLE, 2011a). RP assistance is directed for instances of facial contamination or difficult decontamination (GLE, 2011a).

- The acceptance criterion in Section 4.4.7.3(10) of NUREG-1520 (NRC, 2002) is for the applicant to implement the facility's corrective action program when any incident results in airborne occupational exposures to radiation exceeding the facility's administrative limits, or the dose limits in 10 CFR Part 20, Appendix B, or 10 CFR 70.61.

Section 11.8.16 of the LA (GLE, 2011a) describes the use of approved written procedures specify requirements for identification and classification of conditions adverse to quality, trending of significant conditions adverse to quality, criteria for determining trends, and follow-up action to be taken to verify implementation of corrective action. Significant conditions, their causes, and corrective actions are documented, reported to appropriate levels of management, and follow-up action is taken to verify implementation of corrective actions (GLE, 2011a).

- The acceptance criterion in Section 4.4.7.3(11) of NUREG-1520 (NRC, 2002) is for the applicant to use equipment and instrumentation with sufficient sensitivity for the type or types of radiation being measured and to calibrate and maintain equipment and instrumentation in accordance with manufacturers' recommendations.

RP instrumentation uses and ranges are listed in the LA, Table 4.3, "Types and Uses of Available Instrumentation" (GLE, 2011a). The instruments will be sufficient in number and selected to measure the types and energies of radiation encountered in facility operations (GLE, 2011a). The applicant commits to calibrating instruments before initial use, after major maintenance, and on a routine basis (GLE, 2011a). Portable

instrumentation is calibrated in accordance with Institute of Electrical and Electronics Engineers (IEEE) IEEE N323, "American National Standard Radiation Protection Instrumentation Test and Calibration" (IEEE, 1978) and manufacturing recommendations before initial use, after major maintenance, and on a routine basis following the last calibration (GLE, 2011a).

- The acceptance criterion in Section 4.4.7.3(12) of NUREG-1520 (NRC, 2002) is for the applicant to establish policies to ensure equipment and materials removed from restricted areas to unrestricted areas are not contaminated above the specified release levels in NRC Branch Technical Position, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," (NRC, 1993b).

In Section 4.7.13 of the LA (GLE, 2011a), the applicant states that it will restrict the release of materials, equipment, and other items for unrestricted use if removable surface contamination levels equal or exceed those specified in NRC's Branch Technical Position entitled, "Guidelines for Decontamination of Facilities and Equipment prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material" (NRC, 1993b). In Section 1.2.5.1 of the LA (GLE, 2011a), the applicant requested a special authorization to use "Guidelines for Decontamination of Facilities and Equipment prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material" (NRC, 1993b). The evaluation of the special authorization is further discussed in Section 1.2.3.7.1 of this SER. For the reasons stated in Section 1.2.3.7.1 of this SER, the special authorization request is acceptable, and the special authorization is granted.

- The acceptance criterion in Section 4.4.7.3(13) of NUREG-1520 (NRC, 2002) is for the applicant to leak-test all sealed sources in accordance with the following NRC Branch Technical Positions: 1) "License Condition for Leak-Testing Sealed Byproduct Material Sources" (NRC, 1993c); 2) "License Condition for Leak-Testing Sealed Plutonium Sources" (NRC, 1993d); 3) "License Condition for Plutonium Alpha Sources" (NRC, 1993e); 4) "License Condition for Leak-Testing Sealed Source Which Contains Alpha and/or Beta-Gamma Emitters" (NRC, 1993f); and 5) "License Condition for Leak-Testing Sealed Uranium Sources" (NRC, 1993g).

The storage and leak-testing of sealed sources is addressed in Section 4.7.14 of the LA (GLE, 2011a). As described in Section 4.7.14 of the LA (GLE, 2011a), the applicant committed to use Branch Technical Position, "License Condition for Leak-Testing Byproduct Material Sources" (NRC, 1993c) and Regulatory Guide 8.24 "Health Physics Surveys During Enriched Uranium-235 Processing and Fuel Fabrication" (NRC, 1979). In accordance with these guidance documents, the applicant will: 1) store sealed sources when not in use in a closed container designed to contain radioactive material; 2) leak test sealed sources containing more than 100 microcuries ( $\mu\text{Ci}$ ) of beta or gamma emitting material or more than 10 Curies (Ci) of alpha emitting material, other than  $\text{H}_3$ , with a half-life greater than 30 days and in any form other than gas, for leakage or contamination at intervals not to exceed 6 months (GLE, 2011a); and 3) test sealed plutonium alpha sources containing 0.1 Ci or more of plutonium when in use at least every 3 months (GLE, 2011a).

- The acceptance criterion in Section 4.4.7.3(14) of NUREG-1520 (NRC, 2002) is for the applicant to establish and implement an access control program that ensures that: (a) signs, labels, and other access controls are properly posted and operative; (b) restricted areas are established to prevent the spread of contamination and are identified with appropriate signs; and (c) step-off pads, change facilities, protective clothing facilities, and personnel-monitoring instruments are provided in sufficient quantities and locations.

In Section 4.7.15 of the LA (GLE, 2011a), the applicant states that access to RCAs is controlled from access points through change rooms. Postings are provided at routine access points to identify requirements, such as use of survey meters, protective clothing requirements, and decontamination methods (GLE, 2011a). Areas will be posted in accordance with the requirements of 10 CFR 20, Subpart J, except as described in its exemption request discussed in Section 1.2.5.2 of the LA (GLE, 2011a) and below (GLE, 2011a). The applicant will provide radiological control by controlling access to areas where radioactive material may be encountered, by requiring that each person who enters those areas or facilities receives the appropriate level of radiological worker training, and by requiring personnel monitoring before exiting established step-off pad areas (GLE, 2011a).

In Section 1.2.5.2 of the LA (GLE, 2011a), the applicant requested an exemption from the posting requirements of 10 CFR 20.1904(a). Instead, the applicant committed to posting signs at all entrances into RCAs in which radioactive materials are processed, used, or stored with a sign stating, "Every container in this area may contain radioactive material" (GLE, 2011a). The exemption is acceptable because review of the RP program and training demonstrates this provides adequate protection and security. This exemption is evaluated in Section 1.2.3.7.4 of this SER. For the reasons stated in Section 1.2.3.7.4 of this SER, the exemption request is acceptable, and the exemption is granted.

- The acceptance criterion in Section 4.4.7.3(15) of NUREG-1520 (NRC, 2002) is for the applicant to have a radiation reporting program consistent with the requirements of 10 CFR Parts 19 and 20.

As described in Section 4.7.16 of the LA (GLE, 2011a), the applicant will establish a Radiation Reporting Program for routine occupational exposure, as well as for incident reporting requirements of 10 CFR 20, Subpart M. The applicant will submit personnel monitoring information to the Radiation Exposure Information and Reporting System (REIRS) based on the personnel exposure database, in compliance with the requirements of 10 CFR 20.2206 (GLE, 2011a). The guidance of Regulatory Guide 8.7 (NRC, 2005) applies (GLE, 2011a). Additional program commitments applicable to records and reports: 10 CFR 20 Subpart L, "Records;" Subpart M, "Reports;" Section 70.61, "Performance requirements," and Section 70.74, "Additional Reporting Requirements" (GLE, 2011a) The facility would maintain complete records of the Radiation Protection Program for at least the life of the facility (GLE, 2011a).

As described in Section 4.7.16 of the LA (GLE, 2011a), by procedure, the applicant will report to the NRC, within the time specified in 10 CFR 20.2202 and 10 CFR 70.74, any event that results in an occupational exposure to radiation exceeding the dose limits in 10 CFR Part 20. The facility would prepare and submit to the NRC an annual report of the results of individual monitoring, as required by 10 CFR 20.2206(b) (GLE, 2011a).

The staff reviewed the applicant's radiation survey and monitoring program against the acceptance criteria in Sections 4.4.7.3 of NUREG-1520 (NRC, 2002) and, based on its review, finds that the commitments in the LA (GLE, 2011a) satisfactorily address the acceptance criteria in Section 4.4.7.3 of NUREG-1520 (NRC, 2002).

#### 4.3.8 ADDITIONAL PROGRAM REQUIREMENTS

The staff reviewed the applicant's additional program commitments against the acceptance criteria in Section 4.4.8.3 of NUREG-1520 (NRC, 2002). The following sections identify each acceptance criterion from NUREG-1520 (NRC, 2002) and discuss the staff's analysis as to whether the information provided by the applicant in the LA (GLE, 2011a) meets the criteria.

- The acceptance criterion in Section 4.4.8.3(1) of NUREG-1520 (NRC, 2002) is for the applicant to maintain records of the RP program (including program provisions, audits, and reviews of the program content and implementation), radiation survey results (air sampling, bioassays, external-exposure data from monitoring of individuals, internal intakes of radioactive material), and results of its corrective action program referrals, RWPs, and planned special exposures.

The applicant stated in Section 4.8.1 of the LA (GLE, 2011a) that the facility would maintain complete records of the RP Program in accordance with 10 CFR Part 20, Subpart M. This would specifically include: RP program provisions, audits, and reviews of the program content and implementation, radiation survey results (air sampling, bioassays, external-exposure data from monitoring of individuals, internal intakes of radioactive material), and results of corrective action program referrals, RWPs and planned special exposures (GLE, 2011a). This is described further in Section 11.7.2 of the LA (GLE, 2011a).

- The acceptance criterion in Section 4.4.8.3(2) of NUREG-1520 (NRC, 2002) is for the applicant to establish a program to report to the NRC, within the time specified in 10 CFR 20.2202 and 10 CFR 70.74, any event that results in an occupational exposure to radiation exceeding the dose limits in 10 CFR Part 20.

As stated in Section 4.8.2 of the LA (GLE, 2011a), the applicant would develop procedures such that the facility would report to the NRC, within the time specified in 10 CFR 20.2202, any event that results in an occupational exposure to radiation exceeding the dose limits in 10 CFR 20.

- The acceptance criterion in Section 4.4.8.3(4) of NUREG-1520 (NRC, 2002) is for the applicant to prepare and submit to the NRC an annual report required by 10 CFR 20.2206(b).

Also in Section 4.8.3 of the LA (GLE, 2011a), the applicant commits to prepare and submit to the NRC an annual report of the results of individual monitoring, as required by 10 CFR 20.2206(b).

- The acceptance criterion in Section 4.4.8.3(4) of NUREG-1520 (NRC, 2002) is for the applicant to refer to the facility's corrective action program any radiation incident that results in an occupational exposure that exceeds the dose limits in 10 CFR Part 20,

Appendix B, or is required to be reported per 10 CFR 70.74, and to report to the NRC both the corrective action taken (or planned) to protect against a recurrence and the proposed schedule to achieve compliance with the applicable license condition or conditions.

The applicant stated in Sections 4.8.4 of the LA (GLE, 2011a) that any radiation incident resulting in an exposure exceeding occupational dose limits will be evaluated within the Corrective Action Program. Planned corrective actions and a schedule to achieve compliance will be submitted to the NRC (GLE, 2011a).

The staff reviewed the applicant's additional program commitments against the acceptance criteria in Sections 4.4.8.3 of NUREG-1520 (NRC, 2002) and, based on its review, finds that the commitments in the LA (GLE, 2011a) satisfactorily address the acceptance criteria in Section 4.4.8.3 of NUREG-1520 (NRC, 2002).

#### 4.3.9 EXEMPTIONS

1. In Section 1.2.5.2 of the LA (GLE, 2011a), the applicant requested exemption from the requirements of 10 CFR 20.1904(a) which requires that each container of licensed material bear a durable, clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL." Instead, the applicant commits to posting signs at all entrances into Radiologically Controlled Areas (RCA) in which radioactive materials are processed, used, or stored with a sign stating, "Every container in this area may contain radioactive material" (GLE, 2011a). The exemption is acceptable because review of the Radiation Protection Program and training demonstrates this provides adequate protection and security. The evaluation of this exemption request is further discussed in Sections 1.2.3.7.4 and 4.3.7.14 of this SER.
2. In Section 1.2.5.4 of the LA (GLE, 2011a), the applicant requested an authorization to allow the use of DAC and ALI values based on dose coefficients published in the International Commission on Radiological Protection (ICRP) Publication 68, "Dose Coefficients for Intakes of Radionuclides by Workers" (ICRP, 1995a). This is currently considered an exemption request from all requirements of 10 CFR 20 that refer to quantities in Appendix B of 10 CFR Part 20. However, the Commission by Staff Requirements Memorandum dated April 21, 1999 (NRC, 1999c), authorized the staff to grant such requests on a case-by-case basis.

The models used in 10 CFR Part 20 to regulate internal dose are those described in ICRP Publications 26 (ICRP, 1977) and 30 (ICRP, 1978), adopted by ICRP in 1977 and 1978, respectively. Much of the basic structure of these models was developed in 1966, although some of its components and parameters were altered somewhat between 1966 and their formal adoption by ICRP in 1978. In 1991, the NRC published a final rule (Standards for Protection Against Radiation, 56 Fed. Reg. 23360 (May 21, 1991)) revising 10 CFR Part 20 to incorporate the revised ICRP guidance in ICRP Publications 26 (ICRP, 1977) and 30 (ICRP, 1978). In 1991, ICRP published ICRP Publication 60 (ICRP, 1991), a major revision of its radiation protection recommendations. In the several years following this revision, ICRP published a series of reports in which it described the components of an extensively updated and revised internal dosimetry model. These reports include ICRP Publications 66 (ICRP, 1995b), 67 (ICRP, 1994), 68



(ICRP, 1995a), 71 (ICRP, 1996a), 72 (ICRP, 1996b), and 78 (ICRP, 1999). Because internal dose calculations in 10 CFR Part 20 are currently based on ICRP Publications 26 and 30, NRC licensees must obtain an exemption to be permitted to use the revised and updated internal dosimetry models.

The staff concluded that use of the ICRP Model can be effective in limiting occupational doses to those listed in 10 CFR 20.1201(d), i.e, doses to less than NRC's regulatory limit of 0.05 Sieverts (5 Rems). The applicant's request for an exemption under 10 CFR 20.2301 is acceptable, because it gives its workers equivalent radiological protection as required by 10 CFR Part 20. Thus, the exemption is authorized by law and will not result in undue hazard to life or property. The evaluation of this exemption is also discussed in greater detail in Section 1.2.3.7.3 of this SER.

#### **4.4 EVALUATION FINDINGS**

The applicant has established and will maintain an acceptable RP program that includes:

1. An effective documented program to ensure that occupational radiological exposures are ALARA;
2. An organization with adequate qualification requirements for the RP personnel;
3. Approved, written RP procedures and RWPs for RP activities;
4. RP training for all personnel who have access to restricted areas;
5. A program that will control airborne concentrations of radioactive materials with engineering controls and respiratory protection;
6. A radiation survey and monitoring program that will include requirements for controlling radiological contamination within the facility and monitoring of external and internal radiation exposures; and
7. Other programs to maintain records, report to NRC in accordance with 10 CFR Parts 20 and 70, and correct for upsets at the facility.

Based on the staff's analysis of the LA, the staff concludes that the applicant's RP program is adequate and meets the requirements of 10 CFR Parts 19, 20, 30, 40, and 70. Conformance to the LA (GLE, 2011a) and license conditions will ensure safe operation of the facility.

#### **4.5 REFERENCES**

(ANSI/ANS, 1999). American National Standard Institute/American Nuclear Society (ANSI/ANS) ANSI/ANS N3.1, "Selection, Qualification and Training of Personnel for Nuclear Power Plants." 1999.

(ASTM, 2008) American Society of Testing and Materials (ASTM). ASTM E1168, "Standard Guide for Radiological Protection Training for Nuclear Facility Workers." 2008.

(GLE, 2011a) General Electric-Hitachi Global Laser Enrichment (GLE). "GE-Hitachi Global Laser Enrichment LLC Commercial Facility License Application," Revision 6, 2011.

(GLE, 2011b) General Electric-Hitachi Global Laser Enrichment (GLE). "Integrated Safety Analysis Report for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility," Revision 4, 2011.

(ICRP, 1977) International Commission on Radiological Protection (ICRP). Publication No. 26, "Recommendations of the International Commission on Radiological Protection," 1977.

(ICRP, 1978) International Commission on Radiological Protection (ICRP). Publication No. 30, "Limits for Intakes of Radionuclides by Workers," 1978.

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(ICRP, 1994) International Commission on Radiological Protection (ICRP). Publication No. 67, "Age-dependent Doses to Members of the Public from Intake of Radionuclides: Part 2 Ingestion Dose Coefficients," 1994.

(ICRP, 1995a) International Commission on Radiological Protection (ICRP). Publication No. 68, "Dose Coefficients for Intakes of Radionuclides by Workers," 1995.

(ICRP, 1995b) International Commission on Radiological Protection (ICRP). Publication No. 66, "Respiratory Tract Model for Radiological Protection," 1995.

(ICRP, 1996a) International Commission on Radiological Protection (ICRP). Publication No. 71, "Age-dependent Doses to Members of the Public from Intake of Radionuclides: Part 4 Ingestion Dose Coefficients," 1996.

(ICRP, 1996b) International Commission on Radiological Protection (ICRP). Publication No. 72, "Age-dependent Doses to Members of the Public from Intake of Radionuclides: Part 5 Compilation of Ingestion and Inhalation Dose Coefficients," 1996.

(ICRP, 1999) International Commission on Radiological Protection (ICRP). Publication No. 78, "Individual Monitoring for Internal Exposure of Workers," 1999.

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(NRC, 1973) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.2, "Guide for Administrative Practices in Radiation Monitoring." February 1973.

(NRC, 1977) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Exposures As Low As Is Reasonably Achievable." May 1977.

(NRC, 1979) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.24, "Health Physics Surveys During Enriched Uranium-235 Processing and Fuel Fabrication." October 1979.

(NRC, 1992a) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Dose." July 1992.

(NRC, 1992b) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.25, "Air Sampling in the Workplace." June 1992.

(NRC, 1993a) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.37, "ALARA Levels For Effluents From Materials Facilities." July 1993.

(NRC, 1993b) U.S. Nuclear Regulatory Commission (NRC). Branch Technical Position, "Guidelines for Decontamination of Facilities and Equipment prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material." April 1993.

(NRC, 1993c) U.S. Nuclear Regulatory Commission (NRC). Branch Technical Position, "License Condition for Leak-Testing Byproduct Material Sources." April 1993.

(NRC, 1993d) U.S. Nuclear Regulatory Commission (NRC). Branch Technical Position, "License Condition for Leak-Testing Sealed Plutonium Sources," April 1993.

(NRC, 1993e) U.S. Nuclear Regulatory Commission (NRC). Branch Technical Position, "License Condition for Plutonium Alpha Sources," April 1993.

(NRC, 1993f) U.S. Nuclear Regulatory Commission (NRC). Branch Technical Position, "License Condition for Leak-Testing Sealed Source Which Contains Alpha and/or Beta-Gamma Emitters," 1993.

(NRC, 1993g) U.S. Nuclear Regulatory Commission (NRC). Branch Technical Position, "License Condition for Leak-Testing Sealed Uranium Sources," April 1993.

(NRC, 1993h) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.9, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program." July 1993.

(NRC, 1996) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.29, "Instructions Concerning Risks From Occupational Radiation Exposure." February 1996.

(NRC, 1999a) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.13, "Instructions Concerning Prenatal Radiation Exposure." June 1999.

(NRC, 1999b) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection." October 1999.

(NRC, 1999c) U.S. Nuclear Regulatory Commission (NRC). Staff Requirements Memorandum, SECY-99-077, "To Request Commission Approval to Grant Exemptions from Portions of 10 CFR Part 20," April 21, 1999.

(NRC, 2002) U.S. Nuclear Regulatory Commission (NRC). NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility." March 2002.

(NRC, 2005) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Dose Data." November 2005.

## **5.0 NUCLEAR CRITICALITY SAFETY**

The purpose of this review is to determine whether the General Electric-Hitachi Global Laser Enrichment LLC's (GLE's or the applicant's) nuclear criticality safety (NCS) program is adequate to support safe design, construction, and operation of the facility, as required by 10 CFR Part 70. The applicant's NCS program is described in Chapter 5 of its License Application (LA) (GLE, 2011a). In addition, the purpose of this review is to determine whether the Integrated Safety Analysis (ISA) and ISA Summary (GLE, 2011b) meet the regulatory requirement specified in 10 CFR Part 70, Subpart H, "Additional Requirement for Certain Licensees Authorized to Possess a Critical Mass of special Nuclear Material," for NCS.

The NCS programmatic review determines whether: (1) the applicant provided for the appropriate management of the NCS program; (2) the applicant identified, and committed to, the responsibilities and authorities of individuals for developing and implementing the NCS program; (3) the facility management measures described in 10 CFR 70.62 have been committed to and will support implementing and maintaining the NCS program; and (4) an adequate NCS program is described, which includes identifying and committing to the NCS methods, and NCS technical practices used to ensure the safe operation of the facility, as required by 10 CFR Part 70. This review also included review of the applicant's criticality code validation report (GLE, 2010) to determine whether its use of calculation methods provides assurance that processes will be subcritical under normal and credible abnormal conditions, as specified in 10 CFR 70.61(d).

The NCS ISA review was performed to determine whether: (1) the ISA program is acceptable for NCS; (2) the ISA has been acceptably performed and will be maintained for NCS; and (3) the ISA Summary (GLE, 2011b) contains necessary information, such that the NCS accident sequences are "highly unlikely."

### **5.1 REGULATORY REQUIREMENTS**

The review of applicant's NCS program should verify that the information the applicant provided meets the requirements of 10 CFR 70.22 and 70.65, which, respectively, specify the general and additional content of an application. In addition, the NCS review verifies compliance with the following regulatory requirements:

10 CFR 70.24, which contains requirements for criticality alarm and associated emergency response;

10 CFR 70.52 and Appendix A to 10 CFR Part 70, which contain event notification requirements for criticality events;

10 CFR 70.61 (b), which requires that the risk of each credible high-consequence event must be limited by using engineered or administrative controls to reduce the likelihood of the event or to mitigate its consequences; 10 CFR 70.61(d), which requires that the risk of nuclear criticality accidents must be limited by assuring that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for

safety, and which states that preventive controls and measures must be the primary means of protection against nuclear criticality events.

10 CFR 70.61(e), which requires that engineered or administrative controls necessary to comply with the performance requirements in 10 CFR 70.61 shall be designated as an item relied on for safety (IROFS), and that each IROFS will be available and reliable to perform its intended function when needed.

10 CFR 70.62, which requires establishment and maintenance of a safety program that demonstrates compliance with the performance requirements of 10 CFR 70.61;

10 CFR 70.64(a)(9), which requires that the design of new and existing facilities must provide for criticality control including adherence to the double contingency principle; and

10 CFR 70.72, which contains requirements concerning configuration management and the change control process.

The NCS review of the applicant's ISA program and ISA Summary (GLE, 2011b) verifies if the information the applicant provided meets the requirements of 10 CFR 70.62 and 70.65 with respect to NCS. These regulations specify: (1) the requirements for establishing and maintaining a safety program (10 CFR 70.62), including an ISA program that addresses NCS; (2) requirements for conducting and maintaining an ISA (10 CFR 70.62(c)) for NCS; and (3) requirements for the contents of an ISA Summary (10 CFR 70.65(b)) for NCS.

## **5.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA**

The acceptance criteria for the U.S. Nuclear Regulatory Commission's (NRC's) review of the applicant's NCS program are outlined in Section 5.4 of the NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (NRC, 2002). Section 5.4 of NUREG-1520 (NRC, 2002) contains all the acceptance criteria for review of the applicant's NCS Program, including organization and administration, management measures, and technical practices. This includes the commitment to use Regulatory Guide 3.71, "Nuclear Criticality Safety Standards for Fuels and Material Facilities," Revision 2 (NRC, 2010), which endorsed the use of the American National Standards Institute/American Nuclear Society Series 8 (ANSI/ANS 8) NCS standards with specified modifications. In addition, the acceptance criteria in Section 3.4 of NUREG-1520, (NRC, 2002) are applicable to the NRC's review of the applicant's ISA program and ISA Summary (GLE, 2011b). Section 3.4 of NUREG-1520 (NRC, 2002) contains the acceptance criteria for the staff's review of the applicant's ISA and ISA Summary. In general, the staff used Revision 0 of NUREG-1520 to perform the review. Where staff deviated from this version of NUREG-1520, the reasons for the deviation are explained in the text. The applicability of specific acceptance criteria to this facility is also discussed in the applicable evaluation sections.

## **5.3 STAFF REVIEW AND ANALYSIS**

### **5.3.1 INDUSTRY STANDARDS**

The review described in this section of the Safety Evaluation Report (SER) was based on Sections 5.4 and 5.4.2 of NUREG-1520 (NRC, 2002), which describe the use of industry

consensus standards related to the NCS Program. Section 5.4 of NUREG-1520 (NRC, 2002) describes criteria for the use of NRC-endorsed standards, in particular commitments to comply with the requirements (“shall” statements) in standards and the need for more specific commitments to describe how the applicant will comply with the standards. Section 5.4.2 summarizes the standards that have been endorsed in Regulatory Guide 3.71 (NRC, 2010). Regulatory Guide 3.71 (NRC, 2010) endorses a number of ANSI/ANS-8 national standards in full or in part. NRC endorsement of these standards means that they provide procedures and methodology generally acceptable to NRC staff for the prevention and mitigation of nuclear criticality accidents.

In its LA (GLE, 2011a), the applicant committed to following the requirements (as defined in Section C of RG 3.71 (NRC, 2010)) in the ANSI/ANS 8 standards listed below:

- ANSI/ANS 8.1, “Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors” (ANSI/ANS, 2007a) (see Sections 5.2.1 and 5.4.1.3 of the LA (GLE, 2011a));
- ANSI/ANS 8.3, “Criticality Accident Alarm System,” as modified by NRC Regulatory Guide 3.71 (ANSI/ANS, 1997a) (see Section 5.3.5 of the LA (GLE, 2011a));
- ANSI/ANS 8.19, “Administrative Practices for Nuclear Criticality Safety” (ANSI/ANS, 2005) (see Sections 5.2.1, 5.3.2, 5.3.3, and 5.3.4 of the LA (GLE, 2011a));
- ANSI/ANS 8.20, “Nuclear Criticality Safety Training” (ANSI/ANS, 1991) (see Sections 2.3.3.1 and 11.3.2.2 of the LA (GLE, 2011a));
- ANSI/ANS 8.21, “Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors” (ANSI/ANS, 1995) (see Section 5.4.4.8 of the LA (GLE, 2011a));
- ANSI/ANS 8.22, “Nuclear Criticality Safety Training Based on Limiting and Controlling Moderators” (ANSI/ANS, 1997b) (see Section 5.4.4.5 of the LA (GLE, 2011a));
- ANSI/ANS 8.23, “Nuclear Criticality Accident Emergency Planning and Response” (ANSI/ANS, 1997c) (see Section 5.3.5 of the LA (GLE, 2011a));
- ANSI/ANS 8.24, “Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations,” (ANSI/ANS, 2007b) (see Section 5.4.1.3 of the LA (GLE, 2011a)); and
- ANSI/ANS 8.26, “Criticality Safety Engineering Training and Qualification Program” (ANSI/ANS, 2007c) (see Section 5.3.1 of the LA (GLE, 2011a)).

As stated in Section 5.4 of NUREG-1520 (NRC, 2002), the criteria for the use of NRC-endorsed standards, if an applicant performs activities to which a standard endorsed by an NRC Regulatory Guide applies notwithstanding a general commitment to a standard, an applicant should clarify its intended compliance with those requirements in the standard that are expressed only as general principles by more specific commitments and description in the license application. Additional commitments, beyond what these standards require, are specified in the above-referenced sections of the LA (GLE, 2011a) listed in the bullets above, as evaluated in subsequent sections of this chapter.

The applicant's commitments to the ANSI/ANS standards above are consistent with Section 5.4.2 of NUREG-1520 (NRC, 2002), the summary of standards that have been endorsed by NRC. As discussed below, the other ANSI/ANS 8 standards endorsed in Regulatory Guide 3.71 (NRC, 2010) are either not relevant to operations at the proposed facility or are adequately addressed by other commitments.

The following standards are not applicable to operations at the facility:

- ANSI/ANS 8.5, "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material" (ANSI/ANS, 1996);
- ANSI/ANS 8.6, "Safety in Conducting Subcritical Neutron-Multiplication Measurements In Situ" (ANSI/ANS, 1983a);
- ANSI/ANS 8.10, "Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement" (ANSI/ANS, 1983b);
- ANSI/ANS 8.12, "Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors" (ANSI/ANS, 1987a);
- ANSI/ANS 8.15, "Nuclear Criticality Control of Special Actinide Elements" (ANSI/ANS-1981); and
- ANSI/ANS 8.17, "Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors" (ANSI/ANS, 1984).

In addition, ANSI/ANS 8.7, "Guide for Nuclear Criticality Safety in the Storage of Fissile Materials" (ANSI/ANS, 1975), may have some applicability to some operations at the facility. For example, this standard contains tables of mass limits for different storage configurations that have not been described for currently proposed activities, but could be applicable to future activities at the applicant's facility. However, the applicant can derive its own limits by using calculational methods validated in accordance with its commitments to ANSI/ANS 8.1 (ANSI/ANS, 1998) and ANSI/ANS 8.24 (ANSI/ANS, 2007a) rather than making use of the values in ANSI/ANS 8.7 (ANSI/ANS, 1975). Therefore, a commitment to ANSI/ANS 8.7 (ANSI/ANS, 1975) is not necessary.

Section 5.4.2 of NUREG-1520 (NRC, 2002) also contains a reference to ANSI/ANS-8.9, "Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials" (ANSI/ANS, 1987b). However, this standard has been withdrawn by ANS and is, therefore, no longer endorsed by the NRC. Therefore, there is no need for the applicant to commit to its use.

### 5.3.2 ORGANIZATION AND ADMINISTRATION

The review described in this section of the SER was based on Sections 5.4.3.2 (organization and administration of the NCS Program, including responsibilities and qualifications of key positions, training of key personnel, reporting of defective conditions, use of postings, and use of appropriate standards) and 5.4.3.1.4 (applicant outlines an NCS Program structure and defines the responsibilities and authorities of key program personnel) of NUREG-1520 (NRC, 2002), which describes the organization and administration of the NCS Program, including the



use of staff with the requisite qualifications to implement the functions of the NCS Program. The acceptance criteria pertain to the roles and responsibilities, and education and experience levels required, by NCS staff, and the organization structure and independence from operations of the NCS organization.

In Sections 2.2.9.2 and 5.2 of the LA (GLE, 2011a), the applicant describes its proposed organization for the design and construction phase, the operations phase, and the transition phase of the facility. The NCS function is within the Environmental, Health, and Safety (EHS) function during all three phases (GLE, 2011a). The EHS Manager reports to the GLE President and Chief Executive Officer (CEO) during the design and construction and to the Facility Manager during operations (GLE, 2011a). During the transition from design and construction to operations, the EHS manager reports to the GLE President and CEO for design and construction matters and to the Facility Manager for operations matters (GLE, 2011a). In addition, there will be an NCS Manager having oversight over the NCS Program (GLE, 2011a). This addresses the acceptance criteria in the applicant meets the acceptance criteria in Section 2.4 of NUREG-1520 (NRC, 2002) as they relate to NCS, including organizational positions, functional responsibilities, experience, and qualifications of personnel responsible for NCS; Section 5.4.3.2(6) of NUREG-1520 (NRC, 2002) that the applicant commits to describe organizations positions, experience of personnel, qualifications of personnel, and functional responsibilities, and also outlines organizational relations between the individual positions, and Section 5.4.3.2(7) of NUREG-1520 (NRC, 2002) that the applicant commits to designate an NCS program director who will be responsible for implementation of the NCS Program.

As discussed in Section 5.3.1 of this SER, the applicant committed to ANSI/ANS 8.1 (ANSI/ANS, 2007a) and ANSI/ANS 8.19 (ANSI/ANS, 2005) with regard to administrative practices (GLE, 2011a). This addresses the acceptance criteria in Section 5.4.3.2(2) of NUREG-1520 (NRC, 2002) that the applicant commits to ANSI/ANS 8.1 (ANSI/ANS, 2007a) and ANSI/ANS 8.19 (ANSI/ANS, 2005), as they relate to organization and administration.

As stated in Section 5.2.2 of the LA (GLE, 2011a), the EHS function is independent of Operations and has the authority to shutdown processes when safety cannot be assured. The NCS Manager reports to the EHS Manager (GLE, 2011a). This addresses the acceptance criteria in Section 5.4.3.2(3) of NUREG-1520 (NRC, 2002) that NCS specialists should be independent of operations supervision. The NCS function also has the authority to shutdown potentially unsafe operations (GLE, 2011a). As stated in Section 5.2.3 of the LA (GLE, 2011a), the NCS Manager must approve the restart of any operation shutdown by the NCS function. This addresses the acceptance criteria in Section 5.4.3.2(5) of NUREG-1520 (NRC, 2002) that the applicant commits to the policy that personnel report defective NCS conditions to the NCS function and perform actions only in accordance with written, approved procedures. Unless a specific procedure deals with the situation, personnel shall report defective NCS conditions to the NCS function and take no action until the NCS function has evaluated the situation and provided recovery procedures.

As described in Section 2.2.9.2 of the LA (GLE, 2011a), at a minimum, the NCS Manager has a bachelor's degree in an engineering or scientific field, four years experience with regulatory activities, and experience with NCS programs. This addresses the acceptance criteria in Section 5.4.3.2(1) of NUREG-1520 (NRC, 2002) that the applicant meet the acceptance criteria in Section 2.4 of NUREG-1520 (NRC, 2002) as they relate to NCS regarding organizational positions, functional responsibilities, experience, and qualifications of personnel responsible for NCS.

As described in Section 2.2.9.2 of the LA (GLE, 2011a), training and qualification of NCS engineers will be done in accordance with ANSI/ANS 8.26 (ANSI/ANS, 2007c). At a minimum, an NCS Engineer will have a bachelor's degree in an engineering or scientific field and experience in the assigned safety function (GLE, 2011a). In addition to the requirements for an NCS Engineer, a Senior NCS Engineer must have at least three years of NCS experience. NCS Engineers and Senior NCS Engineers have the authority and responsibility to conduct activities assigned to the NCS function, with the exception that an NCS Engineer cannot perform independent verifications of NCS analyses (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.2(1) of NUREG-1520 (NRC, 2002) for specifying organizational positions, function responsibilities, experience, and qualifications of personnel responsible for NCS. As stated in Section 5.3.1 of the LA (GLE, 2011a), in addition to specifying qualifications for these positions, NCS staff will be trained in accordance with an NCS Engineer Training and Qualification Program. This addresses the acceptance criteria of Section 5.4.3.2(8) of NUREG-1520 (NRC, 2002) that the applicant commits to staff the NCS Program with suitably trained personnel and to provide sufficient resources for its operation.

Responsibilities and authorities of the NCS Manager are described in Section 2.2.9.2 of the LA (GLE, 2011a). Other NCS personnel have the authority and responsibility to conduct activities assigned to the NCS function; these activities are as described throughout Chapter 5, but specifically as listed in Section 5.1.2 of the LA (GLE, 2011a). This addresses the acceptance criteria in Section 5.4.3.1(4) of NUREG-1520 (NRC, 2002) that the applicant outlines an NCS Program structure and defines the responsibilities and authorities of key program personnel.

As described in Section 5.2.4 of the LA (GLE, 2011a), the applicant committed to have postings to summarize key NCS requirements and limits, and to label fissile material containers where practicable. This addresses the acceptance criteria in Section 5.4.3.2(4) of NUREG-1520 (NRC, 2002) that the applicant commits to provide NCS postings in areas, operations, work stations, and storage locations.

The staff reviewed the applicant's organizational structure and finds that it is acceptable because the NCS function is independent from the production staff, NCS evaluations are performed by qualified reviewers, with independent review to ensure quality assurance, and the applicant's administrative practices are consistent with the requirements in ANSI/ANS 8.19 (ANSI/ANS, 2005). The staff finds that the applicant has adequately addressed the acceptance criteria in Sections 5.4.3.1(4) of NUREG-1520 (NRC, 2002) that the applicant commits to outline an NCS Program structure and defines the responsibilities and authorities of key program personnel and 5.4.3.2 of NUREG-1520 (NRC, 2002) that the organization and administration of the NCS Program, including responsibilities and qualifications of key positions, training of key personnel, reporting of defective conditions, use of postings, and use of appropriate standards..

### 5.3.3 MANAGEMENT OF THE NCS PROGRAM

The review described in this section of the SER was based on Section 5.4.3.1 of NUREG-1520 (NRC, 2002), which describes the management of the NCS Program. The acceptance criteria in this section include general program policies, objectives, and roles and responsibilities appropriate to the NCS Program.

In Section 5.1.2 of the LA (GLE, 2011a), the applicant committed to develop, implement, and maintain an NCS Program to meet the requirements of 10 CFR Part 70. This addresses the acceptance criteria in Section 5.4.3.1(1) of NUREG-1520 (NRC, 2002) that the applicant commits to develop, implement, and maintain an NCS Program to meet the regulatory

requirements of 10 CFR Part 70. In Section 5.1 of the LA (GLE, 2011a), the applicant discusses the management of the NCS program. The NCS Manager is responsible for the NCS program. As stated in Section 5.1.2 of the LA (GLE, 2011a), the objectives of the NCS program include:

- Develop, implement, and maintain an NCS Program that meets 10 CFR Part 70;
- Preventing the occurrence of nuclear criticality accidents, including by establishing sufficient IROFS and defense-in-depth and demonstrating an adequate margin of safety;
- Protecting against the occurrence of nuclear criticality accident sequences identified in the ISA Summary (GLE, 2011b);
- Establishing and maintaining NCS controlled parameters, procedures, postings, IROFS, subcritical limits, and operating limits for identified IROFS based upon current NCS determinations as stated in Sections 5.1.1 and 5.1.2 of the LA (GLE, 2011a);
- Conducting NCS evaluations to assure that under normal and credible abnormal conditions processes remain subcritical with an adequate margin of safety;
- Establishing and maintaining training in emergency procedures to respond to a criticality accident as stated in Section 5.1.2 of the LA (GLE, 2011a); and
- Compliance with the regulatory requirements in 10 CFR 70.61, 70.64(a), 70.65(b), and 70.72 as they relate to NCS.

This list of objectives addresses the acceptance criteria in Section 5.4.3.1(2) of NUREG-1520 (NRC, 2002) that the applicant states the NCS Program objectives, which should include those objectives listed in Section 5.3.1 of NUREG-1520 (NRC, 2002); Section 5.4.3.1(3) of NUREG-1520 (NRC, 2002) that the applicant establishes NCS safety parameters and procedures; Section 5.4.3.1(6) of NUREG-1520 (NRC, 2002) that the applicant commits to use the NCS Program to establish and maintain NCS safety limits and operating limits for IROFS in nuclear processes and commits to maintain adequate management measures to ensure the availability and reliability of the IROFS; Section 5.4.3.1(7) of NUREG-1520 (NRC, 2002) that the applicant commits to preparation of NCS postings, training, and emergency response training; Section 5.4.3.4.1(10)(b) of NUREG-1520 (NRC, 2002) that NCS safety limits, operating limits, and limits on controlled parameters will be derived from NCS determinations; and Section 5.4.3.4.4(1) of NUREG-1520 (NRC, 2002) that the applicant commits to the use of NCS controls and controlled parameters to ensure that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety. The acceptance criteria in Section 5.4.3.1 of NUREG-1520 (NRC, 2002) describe the functions and objectives of the NCS Program with regard to establishing a program, parameters and controls, postings, training, and change control. The remaining acceptance criteria above relate to the setting of limits and assurance of subcriticality. Section 5.4.3.4.1(10)(c) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that NCS safety limits, operating limits, and limits on controlled parameters will be based on the proper application of NCS methodology. Section 5.4.3.4.1(10)(b) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that NRC safety limits, operating limits, and limits on controlled parameters will be derived from NCS determinations. The specific commitments expressed in the fourth and fifth bullets in the above

list, and more generally the commitments to NCS methods as described in Section 5.4.1 of the LA (GLE, 2011a), together adequately cover this criterion.

As stated in Section 5.1.1 of the LA (GLE, 2011a), NCS design criteria and reviews are applicable to: (1) new and existing processes, facilities, or equipment which involves fissile materials; and (2) any change in existing processes, facilities, or equipment which may have an impact on the established basis for NCS. These commitments address the acceptance criterion in Section 5.4.3.1(9) of NUREG-1520 (NRC, 2002) that the applicant commits to use the NCS Program to evaluate modifications to operations, recommend process parameter changes necessary to maintain the safe operation of the facility, and select appropriate IROFS and management measures. In Section 5.1.2 of the LA (GLE, 2011a), the applicant committed to adhering to the NCS baseline design criteria, for new facilities and new processes at existing facilities requiring a license amendment under 10 CFR 70.72. These commitments address the acceptance criterion in Section 5.4.3.1(8) of NUREG-1520 (NRC, 2002) that the applicant commits to adhere to the NCS baseline design criteria requirements in 10 CFR 70.64(a)(9) for new facilities and new processes at existing facilities that require a license amendment under 10 CFR 70.72.

The applicant described its NCS methods and technical practices in Section 5.4 of the LA (GLE, 2011a). This includes, among other provisions, control over the calculational method software and hardware configurations (GLE, 2011a). Because a commitment to configuration control of this hardware and software means that the configuration will not be improperly changed, a specific commitment to keep NCS methods and technical practices applicable to current configurations, as stated in the acceptance criterion in Section 5.4.3.1(5) of NUREG-1520 (NRC, 2002) that the applicant commits to keep NCS methodologies and technical practices applicable to the current configuration by means of the configuration management function), is unnecessary.

The staff reviewed the applicant's management of the NCS program and finds that it is acceptable because the applicant has adequately addressed the acceptance criteria in Section 5.4.3.1 of NUREG-1520 (NRC, 2002) that the applicant maintain and develop an NCS Program that meets the requirements of 10 CFR Part 70, including stating program objectives, establishing safety parameters and procedures, defining responsibilities and authorities of key personnel, keep NCS methodologies applicable to the current configuration, establish and maintain safety limits and operating limits for IROFS and maintain appropriate management measures, prepare NCS postings, training, and emergency procedure training, adhere to the baseline design criteria in 10 CFR 70.64(a), and evaluate modifications to operations, including selection of appropriate IROFS and management measures; Section 5.4.3.4.1(10)(b) of NUREG-1520 (NRC, 2002) that the applicant commits to derive safety limits, operating limits, and limits on controlled parameters from NCS determinations; Section 5.4.3.4.1(10)(c) of NUREG-1520 (NRC, 2002) that the applicant commits to base safety limits, operating limits, and limits on controlled parameters on the proper application of the NCS approach; and Section 5.4.3.4.4(1) of NUREG-1520 (NRC, 2002) that the applicant commits to the use of NCS controls and controlled parameters to ensure subcriticality under normal and credible abnormal conditions. The staff concludes that the applicant's commitments to develop, implement, and maintain an NCS program meet the regulatory requirements of 10 CFR Part 70.

#### 5.3.4 NCS MANAGEMENT MEASURES

The review described in this section of the SER was based on Section 5.4.3.3 of NUREG-1520 (NRC, 2002), which describes acceptance criteria pertaining to management measures such as

training, procedures, and audits and assessments, applied to both facility operations and the NCS Program.

#### 5.3.4.1 Training

The review described in this section of the SER was based on Section 5.4.3.3(1) of NUREG-1520 (NRC, 2002), which describes training of facility personnel related to criticality safety and emergency response, including adherence to ANSI standard ANSI/ANS 8.19 (ANSI/ANS, 2005) and ANSI/ANS 8.20 (ANSI/ANS, 1991).

In Sections 5.3.1 and 11.3.2.2 of the LA (GLE, 2011a), the applicant discusses the proposed NCS training program. Section 5.3.1 of the LA (GLE, 2011a) addresses training and qualification of the NCS staff. Section 11.3.2.2 of the LA (GLE, 2011a) addresses NCS training for operators and other personnel having contact with fissile materials. In Section 2.3.3 of the LA (GLE, 2011a), the applicant stated that training will be provided for all individuals at the proposed facility commensurate with their roles and responsibilities. Training and qualification requirements will be met prior to the full assumption of duties for safety significant positions and before assigned tasks are independently performed (GLE, 2011a).

All personnel and contractors must participate in general employee training (GET) (GLE, 2011a). Not all aspects of GET are required for all personnel (GLE, 2011a). However, nuclear safety training, which includes NCS, must be completed to have unescorted access to radiological controlled areas (GLE, 2011a). Those with unescorted access are retrained at least annually (GLE, 2011a). Exams will be used to verify the effectiveness of the training program (GLE, 2011a).

As stated in Section 11.3.2.2 of the LA (GLE, 2011a), NCS training will be conducted consistent with the requirements of ANSI/ANS 8.19 (ANSI/ANS, 2005) and ANSI/ANS 8.20 (ANSI/ANS, 1991). This addresses the acceptance criteria of Section 5.4.3.3(1)(a) of NUREG-1520 (NRC, 2002) that the applicant commits to the above standards as they relate to training. The applicant's commitment to ANS-8.20 (ANSI/ANS, 1991) requires training on the appropriate response to a criticality accident alarm (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.3(1)(b) of NUREG-1520 (NRC, 2002) that the applicant commits to provide training to all personnel to recognize the criticality accident alarm system (CAAS) signal and evacuate promptly to a safe area.

As stated in Section 5.2.3 of the LA (GLE, 2011a), operations personnel will also be trained to perform actions only in accordance with written procedures. They will also be instructed to stop an operation if they encounter a condition not covered by procedure and report the condition to the NCS function (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.3(1)(c) of NUREG-1520 (NRC, 2002) that the applicant commits to provide training regarding the policy that personnel shall report defective NCS conditions to the NCS function and perform actions only in accordance with written, approved procedures.

The staff has reviewed the applicant's commitments regarding personnel training as they relate to NCS and finds them acceptable because the applicant has adequately addressed the acceptance criteria in Section 5.4.3.3(1) of NUREG-1520 (NRC, 2002) that describes training of facility personnel related to NCS and emergency response.

#### 5.3.4.2 Procedures

The review described in this section of the SER was based on Section 5.4.3.3(2) of NUREG-1520 (NRC, 2002), which relates to facility procedures for prevention of criticality, including adherence to ANSI standard ANSI/ANS 8.19 (ANSI/ANS, 2005).

In Sections 5.2.3 and 5.3.4 of the LA (GLE, 2011a), the applicant discusses the use of procedures at the proposed facility.

As stated in Section 5.3.4 of the LA (GLE, 2011a), the applicant committed to ANSI/ANS 8.19 (ANSI/ANS, 2005) as it relates to procedures. This addresses the acceptance criteria of Section 5.4.3.3(2)(a) of NUREG-1520 (NRC, 2002) that states, in part, that the applicant commits to ANSI/ANS 8.19 (ANSI/ANS, 2005) as it relates to procedures. Fissile material operations are performed in accordance with approved written operating procedures (GLE, 2011a). Procedures for handling enriched uranium must be reviewed and approved by the NCS function, which will assure that no single, inadvertent departure from a procedure could cause a criticality accident (GLE, 2011a). If a condition exists which is not covered by procedure, the operator will stop the operation and the NCS function will be performed. Restart of the operation cannot occur until the NCS function evaluates the situation and the necessary procedures are provided (GLE, 2011a).

Section 5.4.3.3(2)(a) of NUREG-1520 (NRC, 2002) also states that an applicant should commit to the policy that no single, inadvertent departure from a procedure could cause an inadvertent criticality. The staff has determined that compliance with this acceptance criterion is adequately covered by the applicant's commitment to follow the double contingency principle, as it relates to the use of administrative criticality controls.

The staff has reviewed the applicant's commitments regarding procedures as they relate to NCS, which include the use of ANSI/ANS 8.19 (ANSI/ANS, 2005) and committing to a policy where no single, inadvertent departure from a procedure could cause an inadvertent criticality. The staff finds the applicant's commitments acceptable because the applicant has adequately addressed the acceptance criteria in Section 5.4.3.3(2) of NUREG-1520 (NRC, 2002) that relates to facility procedures for prevention of criticality.

#### 5.3.4.3 Audits and Assessments

The review described in this section of the SER was based on Section 5.4.3.3(3) of NUREG-1520 (NRC, 2002), which relates to audits and assessments of facility operations and the NCS Program. This includes adherence to ANSI standard ANSI/ANS 8.19 (ANSI/ANS, 2005), which address commitments to periodic walkthroughs of all process areas and periodic audits of management measures.

In Sections 5.3.2 and 11.5.2 of the LA (GLE, 2011a), the applicant discusses the use of audits and assessments at the proposed facility. As stated in Section 5.3.2 of the LA (GLE, 2011a), the applicant commits to ANSI/ANS 8.19 (ANSI/ANS, 2005) as it relates to audits and assessments. This addresses the acceptance criteria of Section 5.4.3.3(3)(a) of NUREG-1520 (NRC, 2002) that the applicant commits to ANSI/ANS 8.19 (ANSI/ANS, 2005) as it relates to audits and assessments.

As stated in Section 11.5.2 of the LA (GLE, 2011a), quarterly audits will be conducted by NCS personnel to determine that operations conform to NCS requirements. This addresses the

acceptance criteria in Section 5.4.3.3(3)(c) of NUREG-1520 (NRC, 2002) that the applicant commits to conduct and document quarterly NCS audits such that all NCS aspects of management measures will be audited at least every two years. Audit results are reported in writing to the Facility Manager, EHS Manager, NCS Manager, area managers, and other management as appropriate. The EHS manager will review audit results to determine if other safety impacts exist (GLE, 2011a).

As stated in Section 11.5.2 of the LA (GLE, 2011a), weekly walkthroughs in accordance with written procedures will also be conducted. Findings will be submitted to the affected line or area manager for resolution (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.3(3)(b) of NUREG-1520 (NRC, 2002) that the applicant commits to conduct and document weekly NCS walkthroughs of all operating process areas such that all areas will be reviewed at least every two weeks, and identified weaknesses should be referred to the facility corrective action function and promptly and effectively resolved. Given the limited size and extent of hands-on operation in the facility, review of all operating process areas every two weeks, as stated in the acceptance criterion, is not necessary.

Assessments to verify the effective implementation of the NCS program, management measures, and other programs will be performed (GLE, 2011a). Personnel from the area being assessed may perform the assessment, provided that they do not have direct responsibility for the specific activity being assessed (GLE, 2011a). However, the applicant also commits to have NCS professionals, independent of NCS personnel, conduct an assessment of the NCS program every three years (GLE, 2011a). An assessment of each management measure will be conducted annually (GLE, 2011a). Results of assessments are documented and reported to the appropriate management (GLE, 2011a). This addresses acceptance criteria 5.4.3.3(3)(c) of NUREG-1520 (NRC, 2002) that the applicant commits to conduct and document quarterly NCS audits such that all NCS aspects of management measures will be audited at least every two years.

Corrective actions needed to address audit and assessment results are documented and approved by management and tracked to completion by the EHS function (GLE, 2011a). The audit program described above and the commitment to corrective actions address the acceptance criteria of Section 5.4.3.4.7(1) of NUREG-1520 (NRC, 2002) that the applicant commits to use the NCS Program to promptly detect and NCS deficiencies by means of operational inspections, audits, or investigations, and refer to the facility's corrective action function any unacceptable performance deficiencies in IROFS, NCS functions, or management measures, so as to prevent recurrence.

Besides the information in Section 11.5 of the LA (GLE, 2011a), the applicant states that the system described above is designed to ensure comprehensive program oversight at least once every three years. The staff has reviewed the applicant's commitments regarding audits and assessments as they relate to NCS and finds them acceptable because the applicant has adequately addressed the acceptance criteria in Section 5.4.3.3(3) of NUREG-1520 (NRC, 2002) that address adherence to ANSI standard ANSI/ANS 8.19 (ANSI/ANS, 2005), commitments to periodic walkthroughs of all process areas, and periodic audits of management measures) and Section 5.4.3.4.7(1) of NUREG-1520 (NRC, 2002) that the applicant commits to use the NCS Program to promptly detect and NCS deficiencies by means of operational inspections, audits, or investigations, and refer to the facility's corrective action function any unacceptable performance deficiencies in IROFS, NCS functions, or management measures, so as to prevent recurrence.

### 5.3.5 NCS METHODS AND TECHNICAL PRACTICES

The review described in this section of the SER was based on Section 5.4.3.4 of NUREG-1520 (NRC, 2002), which describes NCS methodologies and technical practices. Section 5.4.3.4.1 of NUREG-1520 (NRC, 2002) pertains to an applicant's evaluation approach, which include criteria for setting limits on NCS controlled parameters, the use and validation of calculational methods used to set these limits and demonstrate subcriticality, and the establishment of suitable margins of safety and subcriticality. Section 5.4.3.4.2 of NUREG-1520 (NRC, 2002) pertains to an applicant's technical practices, which include criteria for complying with the double contingency principle, the selection of controls and controlled parameters, performing evaluations to demonstrate subcriticality under normal and credible abnormal conditions, and criteria for modeling and controlling each of the possible controlled parameters.

Section 5.4.3.4.7(5) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the applicant should commit to use NCS methods and technical practices to evaluate NCS accident sequences in operations and processes. The staff finds that the use of such methods and technical practices is only applicable to the evaluation of normal and credible abnormal configurations, which consist of static arrangements of fissionable and other material. These methods are used to demonstrate that such configurations are subcritical. They differ from accident sequences, which are not static configurations, but sequences of events. Accident sequences are evaluated by using ISA methods, rather than NCS methods and technical practices. Therefore, this acceptance criterion is not applicable to the evaluation of accident sequences.

#### 5.3.5.1 NCS Methodologies

The review described in this section of the SER was based on Section 5.4.3.4.1 of NUREG-1520 (NRC, 2002), which describes NCS methodologies, which include, as described above, the use of calculational and other methods for assessment of subcriticality, and the means used to validate them.

#### Double Contingency Principle

In Sections 5.1.1, 5.1.3, and 5.3.3 of the LA (GLE, 2011a), the applicant discusses the implementation of the double contingency principle at the proposed facility. The applicant committed to the double contingency principle as follows:

“Process designs shall incorporate sufficient margins of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible.” (GLE, 2011a)

Section 5.1.1 of the LA (GLE, 2011a) commits the applicant to the double contingency principle as identified in ANSI/ANS 8.1 (ANSI/ANS, 2007a). In addition to restating the principle, this section discusses the independence and concurrency, as well as the use of both single and dual-parameter control, consistent with the guidance in Section 5.4.3.4.4(7) of NUREG-1520 (NRC, 2002). Section 5.1.3 of the LA (GLE, 2011a) describes one purpose of criticality safety analyses (CSAs) as being demonstration of meeting the double contingency principle through the establishment of controls. Section 5.3.3 of the LA (GLE, 2011a) reiterates this role of the CSA.



At the proposed facility, the double contingency principle serves as the fundamental technical basis for design and operation of the facility with respect to NCS (GLE, 2011a). Adherence to the double contingency principle will be ensured for fissile material operations by either controlling at least two independent parameters or providing at least two controls on a single parameter (GLE, 2011a). Section 5.4.3.4.2(1) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the use of a single control to maintain the value of two or more controlled parameters should only constitute a single leg of double contingency. This will necessarily be covered by the applicant's correct application of the double contingency principle, and so a specific commitment to this is not necessary. At the proposed facility, the applicant has chosen to use the double contingency principle to ensure that each process will be adequately subcritical under normal and credible abnormal conditions. As discussed in Interim Staff Guidance (ISG), FCSS-ISG-03, "Nuclear Criticality Safety Performance Requirements and Double Contingency Principle" (NRC, 2005), application of the double contingency principle is "one means of meeting the performance requirements of §70.61(d)," provided: (1) controls are established on controlled parameters, and those controls designated as IROFS; (2) conditions resulting from occurrence of a single contingency are shown to be subcritical with an acceptable margin; and (3) controls are sufficiently reliable to ensure that changes in process conditions are "unlikely." The staff finds that these three conditions are met. Although not all NCS controls will be designated as IROFS, in the "Glossary of Definitions" in the LA (GLE, 2011a), the applicant stated that any controls that are needed to meet 10 CFR 70.61(d) will be IROFS (see Section 5.3.5.2 of this SER). The applicant's methods and technical practices (Section 5.4 of the LA (GLE, 2011a) include evaluation of abnormal conditions and demonstration that they meet the appropriate  $k_{\text{eff}}$  limit, and that NCS controls will be appropriately maintained. The staff, therefore, concludes that this way of meeting the subcriticality requirement of 10 CFR 70.61(d) is acceptable. The applicant's commitments with regard to double contingency address the acceptance criteria of Section 5.4.3.4.4(7) of NUREG-1520 (NRC, 2002) that the applicant commits to implement an NCS Program that ensures double contingency protection, when practicable. Specifically, the commitments discussed above in Section 5.1.1 of the LA (GLE, 2011a), as well as the commitment to ANSI/ANS 8.1 (ANSI/ANS, 1998), address Section 5.4.3.4.4(7)(a) of NUREG-1520 (NRC, 2002) that addresses specifying the preferred method of adherence to double contingency protection, which is two-parameter control (although single-parameter control is also acceptable) and Section 5.4.3.4.4(7)(b) of NUREG-1520 (NRC, 2002) (b) that addresses defining 'concurrency' and the need for rapid detection and correction of control failures). The applicant is not taking any exceptions to double contingency protection, and therefore, Section 5.4.3.4.4(7)(c) of NUREG-1520 (NRC, 2002), which addresses discussing what will be acceptable in cases of exceptions to double contingency protection, is not applicable.

Section 5.4.3.4.5(1) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the applicant should commit to the double contingency principle in determining NCS controls and IROFS in the design of new facilities and new processes at existing facilities that require a license amendment under 10 CFR 70.72. Section 5.4.3.4.5(2) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the applicant should commit to double contingency protection as discussed in Section 5.4.3.4.4(9) of NUREG-1520 (NRC, 2002) (should be 5.4.3.4.4(7) of NUREG-1520 (NRC, 2002) as discussed in the previous paragraph). These criteria are duplicative of other criteria in NUREG-1520 (NRC, 2002), such as those discussed in the paragraphs above.

## Criticality Safety Analyses

In Sections 5.1.3 and 5.3.3 of the LA (GLE, 2011a), the applicant discusses the use of CSAs at the proposed facility. At the proposed facility, the terms “CSA” and “NCS evaluation” are synonymous (GLE, 2011a). The purpose of a CSA is to demonstrate compliance with the double contingency principle (GLE, 2011a). As discussed in the previous section of this SER, this ensures that the CSA will demonstrate that a specified process is subcritical under normal and credible abnormal conditions in accordance with 10 CFR 70.61(d) (GLE, 2011a).

Section 5.4.3.4.2(5) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the applicant should commit to perform an evaluation for all controlled parameters that show the parameter will be maintained during both normal and credible abnormal conditions. There is no specific commitment to performing such an evaluation in the LA (GLE, 2011a). However, a specific commitment is unnecessary because ensuring that operations are subcritical under normal and credible abnormal conditions, and compliance with the double contingency principle, is all that the regulations in 10 CFR Part 70, Subpart H require for criticality. Many abnormal conditions, in fact, will necessarily involve the failure of one or more controlled parameters, so this criterion cannot be met under all circumstances. Therefore, the staff determined that this criterion is not applicable.

CSAs document the safety basis for a fissile material process, establish limits for controlled parameters, and establish controls to maintain these limits (GLE, 2011a). In addition, the CSAs will also specify certain management measures and additional controls which provide defense-in-depth (GLE, 2011a). CSAs are controlled elements of the ISA and are conducted in accordance with the requirements of ANSI/ANS 8.19 (ANSI/ANS, 2005) (GLE, 2011a). The CSAs will not assess risk or show that criticality accidents are highly unlikely as required by 10 CFR 70.61(b), but will inform such assessments (GLE, 2011a).

The demonstration of compliance with the double contingency principle will be sufficiently conservative such that each process is ensured to be subcritical under normal and credible abnormal conditions (GLE, 2011a). Analysis of normal conditions will assume the NCS controlled parameters are at the optimum credible conditions (i.e., most reactive) that would be expected when the identified criticality controls are functioning properly (GLE, 2011a). Analysis of credible abnormal conditions will assume the NCS controlled parameters are at the optimum credible conditions for credible process upsets, including failures of NCS controls (GLE, 2011a). These commitments address the acceptance criteria of Section 5.4.3.4.1(10)(a) of NUREG-1520 (NRC, 2002) that NCS safety limits, operating limits, and limits on controlled parameters will be established by assuming credible optimum conditions unless specified controls are implemented to control the limit to a certain range of values.

As discussed in Section 5.4.1.2 of the LA (GLE, 2011a), methods used at the proposed facility to demonstrate subcriticality of processes include hand calculations utilizing published experimental data, solid angle calculations, and Monte Carlo computer codes (GLE, 2011a). When computer codes are used, the CSA must demonstrate that the effective neutron multiplication factor ( $k_{\text{eff}}$ ), plus three times the standard deviation, for the system does not exceed the established upper subcritical limit (USL) for credible process upsets (GLE, 2011a). Mathematically, this is written as:

The USL conservatively accounts for the bias, bias uncertainty, and a margin of subcriticality (MoS), which are determined in the code validation process (see following SER section on code validation) (GLE, 2011a).<sup>1</sup>

The applicant also analyzed the sensitivity of  $k_{\text{eff}}$  to key parameters by performing a set of parametric calculations (GLE, 2011a). The impact of varying these parameters is quantified and documented (GLE, 2011a). The variability and uncertainty in process conditions will also be taken into consideration when establishing safety and operating limits (GLE, 2011a). This information helps in selecting adequate NCS controls for a system (GLE, 2011a). This set of parametric calculations, along with the consideration of variability and uncertainty, address the acceptance criteria of Section 5.4.3.4.4(6) of NUREG-1520 (NRC, 2002) that the applicant commits to perform parametric calculations to correlate the change in a value of a controlled parameter and its  $k_{\text{eff}}$  value.

The commitments in Section 5.4.1.1 of the LA (GLE, 2011a) to establish limits on controlled parameters and ensure subcriticality with an adequate margin address the acceptance criteria of Section 5.4.3.4.1(2) of NUREG-1520 (NRC, 2002) that NCS limits on controls and controlled parameters will be established to ensure an adequate margin of subcriticality for safety; and Section 5.4.3.4.1(10)(d) of NUREG-1520 (NRC, 2002) that operating limits will be derived from NCS safety limits by taking into consideration changes in operating parameters to ensure processes will remain subcritical under both normal and credible abnormal conditions; Section 5.4.3.4.1(10)(e) of NUREG-1520 (NRC, 2002) that NCS operating limits will establish sufficient margins of safety for processes and take into consideration the variability and uncertainty in processes and NCS subcritical limits; and Section 5.4.3.4.1(10)(f) of NUREG-1520 (NRC, 2002) that NCS safety limits will establish sufficient margins of safety for processes and take into consideration the variability and uncertainty in processes and NCS operating limit. The commitment to consider variability and uncertainty, as well as the applicant's commitment to ANSI/ANS 8.1 (ANSI/ANS, 1998), and ANSI/ISA 67.04.01 (ANSI/ISA, 2006) regarding setpoint methods (see Section 16.3.2.3.3 of the non-public version of this SER), ensure that the intent of the acceptance criteria of Section 5.4.3.4.4(2) of NUREG-1520 (NRC, 2002) that the intent of which is that the applicant follows the policy stated in ANSI/ANS-8.1 (ANSI/ANS, 2007a) that process specifications shall incorporate margins to protect against uncertainties in process variables and against a limit being accidentally exceeded is met. Staff has reasonable assurance based on the above commitments that when instrument setpoints for NCS limits are determined, they will include appropriate allowances for variability and uncertainty. Section 5.4.3.4.4(3) of NUREG-1520 (NRC, 2002) also contains the acceptance criteria that the applicant commit to ANSI/ANS 8.7 (ANSI/ANS, 1975), 8.9 (ANSI/ANS, 1987b), 8.10 (ANSI/ANS, 1983b), 8.12 (ANSI/ANS, 1987a), 8.15 (ANSI/ANS, 1981), and 8.17 (ANSI/ANS, 1984) as they relate to subcriticality. The applicant's commitments to applicable ANSI standards are discussed in Section 5.3.1 of this SER.

### Computer Code Validation

In Sections 5.4.1.3 and 5.4.1.4 of the LA (GLE, 2011a), the applicant discusses the validation of NCS computer codes at the proposed facility. The applicant uses a proprietary Monte Carlo code called GEMER (GLE, 2010) to calculate  $k_{\text{eff}}$  (GLE, 2011a). The GEMER code (GLE, 2010)

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<sup>1</sup> The margin of subcriticality (MoS) is the administrative margin in  $k_{\text{eff}}$  to provide added assurance of subcriticality after bias and bias uncertainty are taken into account. This SER will use the applicant's terminology, which is identical to the quantity referred to as the minimum margin of subcriticality in FCSS-ISG-10 (NRC, 2006).

has been used by Global Nuclear Fuel—Americas (GNF-A) for many years, and the GEMER code validation report (GLE, 2010) is shared by GNF-A and the applicant (GLE, 2011a). The staff reviewed portions of the GEMER validation report (GLE, 2010) to verify that the validation is consistent with the LA (GLE, 2011a) and relevant to facility operations. Those portions of the GEMER validation report reviewed are described in Appendix A to Chapter 5 of the non-public version of this SER. They consisted of those portions material to the staff's determination of whether the Upper Subcritical Limit and area of applicability were acceptable and provided reasonable assurance that nuclear processes evaluated to be subcritical will indeed be subcritical. The applicant may use other computer codes for NCS calculations once properly validated. This description of methods to be used addresses the acceptance criteria of Section 5.4.3.4.1(1) of NUREG-1520 (NRC, 2002) that NCS determinations will be performed using acceptable methods.

The commitment to validate calculational methods addresses the acceptance criteria of Section 5.4.3.4.1(3) of NUREG-1520 (NRC, 2002) that methods used to develop NCS limits will be validated to ensure they are within acceptable ranges and the applicant used appropriate assumptions and computer codes and implicitly in Section 5.4.3.4.1(7)(d) of NUREG-1520 (NRC, 2002) that the applicant commits to use pertinent computer codes, assumptions, and techniques in its methodology. Computer code validation, including documentation, is consistent with the requirements of ANSI/ANS 8.24 (ANSI/ANS, 2007b) and Section 4.3 of ANSI/ANS 8.1 (ANSI/ANS, 2007a) (GLE, 2010). This addresses the acceptance criteria of Section 5.4.3.4.1(5) of NUREG-1520 (NRC, 2002) that the applicant commits to ANSI/ANS 8.1 (ANSI/ANS, 2007a) as it relates to methods. (The version of NUREG-1520 (NRC, 2002) in use during this review contains references to ANSI/ANS 8.1 (ANSI/ANS, 1998), but not to ANSI 8.24 (ANSI/ANS, 2007a)). The applicant's validation method considers parameters such as neutron energy spectra, degree of moderation, and geometric configuration of materials (GLE, 2010). The code validation process establishes the bias, bias uncertainty and MoS using well-characterized and adequately documented critical experiments (GLE, 2010). If a statistically significant trend exists between a selected parameter and the critical experiments, then the bias will be determined by regression analysis, otherwise the bias is constant (GLE, 2010). Under no circumstance will the applicant use a positive bias (GLE, 2010). The bias uncertainty is estimated using one of the four methods identified in Section 5.4.1.3.2 of the LA (GLE, 2011a): (1) the Single-Sided Lower Confidence Band; (2) Single-Sided Lower Tolerance Band; (3) Single-Sided Lower Tolerance Limit; and (4) Non-Parametric Method. The choice of method depends on the statistical characteristics of the benchmark data (e.g., normality, presence of trends) (GLE, 2011a). Each of these methods ensures that the calculated  $k_{\text{eff}}$  for a critical system will lie above the calculated limit with a 95 percent level of confidence (GLE, 2011a). Each of these methods includes margin to account for uncertainty in the methodology, data, and bias, addressing the acceptance criteria in Section 5.4.3.4.4(5) of NUREG-1520 (NRC, 2002) that the applicant must provide adequate allowance for uncertainty in the methodology, data, and bias to ensure subcriticality.

Critical experiments used for validation are assessed for completeness and applicability to the applicant's proposed processes, and come from multiple sources to minimize systematic errors (GLE, 2010). The applicant may reject data outliers only when based upon inconsistency of the data with known physical behavior (GLE, 2010). Experiments are selected to cover the range of parameters relevant to the normal and credible abnormal conditions for the modeled systems (GLE, 2010).

The parameter range of selected critical experiments defines the area of applicability (AOA) for the code (GLE, 2010). This description of an AOA addresses the acceptance criteria of Section

5.4.3.4.1(6)(2) of NUREG-1520 (NRC, 2002) that the calculation of  $k_{\text{eff}}$  is based on a set of variables whose values lie in a range for which the methodology used to determine  $k_{\text{eff}}$  has been validated and Section 5.4.3.4.1(10)(g) of NUREG-1520 (NRC, 2002) that  $k_{\text{eff}}$  is calculated from a set of variables whose values lie in a range for which the validity of the NCS method has been demonstrated. Any extension to the AOA must be justified in the CSA (GLE, 2010). The AOA may be extrapolated beyond the experimental parameter range using an established mathematical method or sound engineering judgment (GLE, 2010). The mathematical approach uses a leverage statistic to determine when an extrapolation is sufficiently reliable (GLE, 2010).

The staff determined that the term “sound engineering judgment,” as used in the basis for extrapolating beyond the range of benchmark data, is rather vague. Use of an “established mathematical methodology” for extrapolation is consistent with Section 4.3.2 of ANSI/ANS-8.1 (ANSI/ANS, 1998), which states that extrapolation should be performed “by making use of the trends in the bias” and that, if the extrapolation is large, the method should be “supplemented by other calculational methods.” These require a rigorous mathematical approach, but the meaning of “sound engineering judgment” is unclear. However, the staff review of the aforementioned validation reports did not identify any concerns with the extent of the defined AOA. The staff notes that the applicant has not committed to provide notification of changes to its validation reports to the NRC as discussed in Section 5.4.3.4.1(7) of NUREG-1520 (NRC, 2002) that the applicant includes a reference to, and summary description of, a documented, reviewed, and approved validation report for each methodology that will be used to make an NCS determination, and whenever there are changes to the validation report, the change will be reported to NRC by letter. The staff considers the description of the validation method in the LA (GLE, 2011a) sufficiently detailed to ensure that it will not be changed without prior NRC review and approval. However, the staff does not have assurance that the AOA will not be inappropriately changed, due to the subjectivity of “sound engineering judgment” and lack of a commitment to provide notification of changes to the validation report. Therefore, the staff is proposing the following license condition:

*The licensee shall not make changes to the validation report that decrease the effectiveness of commitments in Section 5.4.1.3 or 5.4.1.4 of the license application, or that degrade the approved margin of subcriticality for safety, without prior NRC approval. Prior NRC approval is required for changes that meet one or more of the following criteria: (1) result in an increase in the upper subcritical limit, (2) expand the area of applicability, (3) necessitate extrapolation beyond the area of applicability, (4) employ a statistical method less conservative than that described in Section 5.4.1.3.2 of the license application (including less conservative levels of confidence), or (5) use new codes or calculational methods, or (6) use any other non-conservative change to the validation method or results.*

By requiring notification to the NRC and NRC approval, including justification of any extensions to the AOA, for any changes to the validation reports, the acceptance criteria of Section 5.4.3.4.1(6)(3) of NUREG-1520 (NRC, 2002), that trends in the bias are used to support any extension of the methodology to areas outside the area(s) of applicability, are rendered moot.

The description of the validation method in the LA (GLE, 2011a) addresses the acceptance criteria of Section 5.4.3.4.1(7)(a)-(j) of NUREG-1520 (NRC, 2002) that address validation code criteria. Specifically, the description of the method in Section 5.4.1.4 of the LA (GLE, 2011a) addresses Section 5.4.3.4.1(7)(a) of NUREG-1520 (NRC, 2002) that the summary of the

validation report contains a summary of the theory of the method that is sufficiently detailed and clear to allow understanding of the method. The AOA is not described in detail in the LA (GLE, 2011a); however, it is described in the validation report (GLE, 2010), which on account of the notification requirement in the above license condition addresses the acceptance criteria in Section 5.4.3.4.1(7)(b) of NUREG-1520 (NRC, 2002) that the summary of the validation report contains a summary of the area(s) to which the validation report applies. Because the applicant cannot change the AOA without notification and approval, the acceptance criterion in Section 5.4.3.4.1(7)(c) of NUREG-1520 (NRC, 2002) that the summary of the validation report contains a justification for applying the methodology outside the area(s) of applicability will also be met. The description of an acceptable validation method also implicitly addresses Section 5.4.3.4.1(7)(d) of NUREG-1520 (NRC, 2002) that the summary of the validation report contains a commitment to use pertinent computer codes, assumptions, and techniques in the method and Section 5.4.3.4.1(7)(e) of NUREG-1520 (NRC, 2002) that the summary of the validation report contains a commitment to properly perform the mathematical operations in the method. The bullets discussing the use of benchmark-quality experiments in Section 5.4.1.3 of the LA (GLE, 2011a) addresses the acceptance criteria of Section 5.4.3.4.1(7)(f) of NUREG-1520 (NRC, 2002) that the summary of the validation report contains a commitment to use data based upon reliable and reproducible experimental measurements. These include assessing benchmark applicability, ensuring that they span the full range of necessary parameters, use of multiple independent series to minimize systematic errors, use of appropriate code options, and treatment of outliers. The criterion that the benchmarks must encompass appropriate parameters spanning the range of normal and credible abnormal conditions addresses the acceptance criteria of Section 5.4.3.4.1(7)(g) of NUREG-1520 (NRC, 2002) that the summary of the validation report contains a commitment to use plant-specific benchmark experiments and data derived therefrom to validate the method. The commitments regarding the bias, bias uncertainty, and upper subcritical limit in Sections 5.4.1.3.1, 5.4.1.3.2, and 5.4.1.3.4 of the LA (GLE, 2011a) address the acceptance criteria of Section 5.4.3.4.1(7)(h) of NUREG-1520 (NRC, 2002) that the summary of the validation report contains a commitment to determine the bias, uncertainty in the bias, uncertainty in the methodology, uncertainty in the data, uncertainty in the benchmark experiments, and margin of subcriticality for safety, when using the method. Lastly, the description of computer software and hardware configuration control in Section 5.4.1.5 of the LA (GLE, 2011a), including verification of the computer code system, addresses the acceptance criteria of Section 5.4.3.4.1(7)(i) of NUREG-1520 (NRC, 2002) that the summary of the validation report contains a commitment to use controlled software and hardware when using the method and Section 5.4.3.4.1(7)(i) of NUREG-1520 (NRC, 2002) that the summary of the validation report contains a commitment to use a verification process when using the method.

The acceptance criteria of Sections 5.4.3.4.1(7)(a)-(j) of NUREG-1520 (NRC, 2002) addressing validation code criteria pertain to the summary description of the validation report (GLE, 2010) in the LA (GLE, 2011a). Analogous acceptance criteria listed in Sections 5.4.3.4.1(8)(a)-(i) of NUREG-1520 (NRC, 2002), which address commitments to have a documented, reviewed, and approved validation for each method used to make NCS determinations, pertain to the committed contents of the validation report itself. The contents of the validation report are delineated in Section 5.4.1.4 of the LA (GLE, 2011a). These commitments address the acceptance criteria in Section 5.4.3.4.1(8)(a) of NUREG-1520 (NRC, 2002) that the validation report should contain a description of the theory of the method that is sufficiently detailed and clear to allow understanding of the method and independent duplication of results; Section 5.4.3.4.1(8)(b) of NUREG-1520 (NRC, 2002) that the validation report should contain a description of the area(s) of applicability that define the range of values for which valid results have been obtained for the parameters used in the method and also, in accordance with

ANSI/ANS 8.1(ANSI/ANS, 2007a) that any extrapolation beyond the area(s) of applicability should be supported by an established mathematical method; Section 5.4.3.4.1(8)(d) of NUREG-1520 (NRC, 2002) that the validation report should contain a description of the proper functioning of the mathematical operations in the method; Section 5.4.3.4.1(8)(e) of NUREG-1520 (NRC, 2002) that the validation report should contain a description of the data used in the methodology, showing that the data were based on reliable experimental measurements; Section 5.4.3.4.1(8)(f) of NUREG-1520 (NRC, 2002) that the validation report should contain a description of the plant-specific benchmark experiments and the data derived therefrom that were used for validating the method; Section 5.4.3.4.1(8)(g) of NUREG-1520 (NRC, 2002) that the validation report should contain a description of the bias, uncertainty in the bias, uncertainty in the methodology, uncertainty in the data, uncertainty in the benchmark experiments, and margin of subcriticality for safety, as well as the basis for these items if used in the methodology. In addition, the use of positive bias is proscribed; and Section 5.4.3.4.1(8)(i) of NUREG-1520 (NRC, 2002) that the validation report should contain a description of the verification process and results. The remaining acceptance criteria in Section 5.4.3.4.1(8)(c) of NUREG-1520 (NRC, 2002) that the validation report should contain a description of the use of pertinent computer codes, assumptions, and techniques in the method and Section 5.4.3.4.1(8)(h) of NUREG-1520 (NRC, 2002) that the validation report should contain a description of the software and hardware that will use the method are covered by the fact that the applicant is committed to perform and document a validation report that must be consistent with the summary description of the validation in the LA (GLE, 2011a). The applicant's commitment to include the validation report in its configuration management system (Section 5.4.1.4 and 5.4.1.5 of the LA (GLE, 2011a)) addresses the acceptance criteria in Section 5.4.3.4.1(9) of NUREG-1520 (NRC, 2002) that the applicant commits to incorporate each documented, reviewed, and approved validation report for a method, and the assumptions used, into the facility configuration management program.

The regulations in 10 CFR 70.61(d) contain the requirement that under normal and credible abnormal conditions, all nuclear processes must be subcritical, including use of an approved margin of subcriticality for safety. This "approved margin of subcriticality for safety" consists of the applicant's MoS (identical to the administrative margin, or "minimum margin of subcriticality" in FCSS-ISG-10 (NRC, 2006)) together with the margin due to the applicant's conservative technical practices as described in Section 5.4 of the LA (GLE, 2011a). This is consistent with the guidance in FCSS-ISG-10 (NRC, 2006) that assurance of subcriticality may be provided by specifying a margin in  $k_{\text{eff}}$  (MoS), or specifying conservative modeling practices, or both.

The applicant will apply an MoS of at least 0.03 for all criticality calculations, which has been the historical safety basis margin used at GNF-A (GLE, 2010). For AOAs in which the bias uncertainty exceeds 0.03 (e.g., AOA-6), an MoS of 0.05 will be employed (GLE, 2010). This distinction is reflected in Section 5.4.1.3.4 of the LA (GLE, 2011a), which states that a larger MoS will be used when the combination of bias and uncertainty exceeds 0.03. In addition, the applicant has also stated (GLE, 2011c) that AOA-1, covering low-enriched homogeneous systems, is the only one applicable to currently envisioned facility processes. AOA-2 concerns high-enriched uranium, which is not present in sufficient quantities to constitute a criticality concern. AOA-6 concerns heterogeneous fuel systems with boron. Neither of these types of material is expected at the facility in any significant quantities. Changing this would require the applicant to undergo the facility change process, and the staff considers such a significant change would require a license amendment. Therefore, the use of an MoS of 0.03 for calculations applicable to the proposed facility operations is acceptable to the staff.

Section 5.4.3.4.4(4) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the applicant needs to commit to NRC pre-approval for any administrative margins (identical to the MoS). The staff determined that a specific commitment to this criterion is not necessary, because the MoS is being reviewed as part of the licensing review, as required by 10 CFR 70.61(d). This addresses the acceptance criteria of Section 5.4.3.4.1(6)(1) of NUREG-1520 (NRC, 2002), which states that the MoS is intended to be large compared to the uncertainty in the calculated  $k_{\text{eff}}$  values. Acceptability of the MoS is justified by the use of critical experiments which closely match the applications at the proposed facility, conservative methods to derive the bias and bias uncertainty, and a consistent conservative set of modeling assumptions defined by internal procedures. The most important of these conservative assumptions is evaluating all nuclear processes at an enrichment of 8 weight (wt) percent uranium-235 ( $^{235}\text{U}$ ), whereas facility operations will be limited to no more than 5 wt percent  $^{235}\text{U}$ . The applicant indicated that there may be a need to increase the target enrichment in the future above 5 wt percent  $^{235}\text{U}$  (GLE, 2011a).

The staff finds that the conservative margin due to enrichment is a significant part of the technical basis for approval of the MoS and is also relied on in the validation review for justifying extending the area of applicability beyond experimental benchmark data (see Appendix A to Chapter 5 of the non-public version of this SER). Given this reliance on this conservative margin, the staff will impose the following license condition:

*The licensee shall provide a minimum 60-day notice to NRC prior to initial customer product withdrawal of licensed material exceeding 5 weight percent  $^{235}\text{U}$  enrichment. This notice shall identify the necessary equipment and operational changes to support customer product shipment for these assays and shall provide the facility documents demonstrating compliance with all criticality safety regulatory requirements. The licensee may not implement the changes in enrichment until NRC approves the changes.*

This 60-day notification period will allow NRC staff time to assess the proposed change, to determine the impact on the basis for the MoS and extensions of the area of applicability. The staff notes that this margin in enrichment is only applicable to normal operations; abnormal conditions that result in exceeding the target enrichment would erode the basis for the MoS. The staff considers a reduced margin under these limited circumstances to be acceptable, because of the very low likelihood that the target enrichment would be significantly exceeded.

Enrichment would be monitored closely for production purposes, and experience at other enrichment facilities indicates that such evolutions occur very rarely.

As stated above, the applicant's set of conservative modeling practices, as described in the technical practices part of its LA (GLE, 2011a), provide margin that supports the acceptability of the MoS. While the most important of these modeling practices (in terms of the margin produced in  $k_{\text{eff}}$ ) is in terms of the bounding enrichment, it is the totality of the applicant's technical practices that supports the finding of acceptability of the MoS. Therefore, in addition to the license condition regarding increasing product enrichment, the staff will impose the following license condition:

*No changes shall be made, without prior NRC approval, to Section 5.4 of the License Application that would result in modifying the current values for criticality-based analysis in a less conservative direction, with regard to either validation or criticality evaluation of nuclear processes.*



Section 5.4.3.4.4(8) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the applicant should meet the acceptance criteria in Section 3.4 of NUREG-1520 as they relate to subcriticality. The staff finds that this criterion is met by commitments to several other acceptance criteria in Section 5.4.3.4.4(1) of NUREG-1520 (NRC, 2002) that the applicant commits to the use of NCS controls and controlled parameters to ensure that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety; Section 5.4.3.4.1(2) of NUREG-1520 (NRC, 2002) that NCS limits on controls and controlled parameters will be established to ensure an adequate margin of subcriticality for safety; and Section 5.4.3.4.1(6) of NUREG-1520 (NRC, 2002) that the applicant commits to the intent of the validation report statement in Regulatory Guide 3.71 (NRC, 2010), which states the applicant should demonstrate: (1) the adequacy of the margin of safety for subcriticality by ensuring the margin is large compared to the uncertainty in the calculated value of  $k_{\text{eff}}$ , (2) the calculation of  $k_{\text{eff}}$  is based on a set of variables whose values lie in a range for which the methodology used to determine  $k_{\text{eff}}$  has been validated, and (3) trends in the bias support the extension of the methodology to areas outside the area(s) of applicability. Thus, a specific commitment to meet the acceptance criteria in Section 3.4 as they relate to subcriticality is not necessary.

Based on independent calculations, the staff determined that a 1 wt percent increase in enrichment translates into at least a 3 percent change in  $k_{\text{eff}}$  (NRC, 2011). Based on this staff analysis, the conservative margin in enrichment of 3 wt percent produces, in combination with the MoS of 0.03 to 0.05 and margin due to the applicant's other technical practices, an acceptable margin of subcriticality for safety to satisfy the requirement of 10 CFR 70.61(d).

#### 5.3.5.2 NCS Technical Practices

The review described in this section of the SER was based on Section 5.4.3.4.2 of NUREG-1520 (NRC, 2002), which describes technical practices related to NCS, which include, as described above, the use of controlled parameters to prevent criticality, the inclusion of controlled parameters in calculational models, and the establishment of controls to maintain parameters within appropriate limits.

In Sections 5.4.2 and 5.4.5 of the LA (GLE, 2011a), the applicant discusses NCS technical practices. NCS controls are established to ensure that limits on controlled parameters are maintained. The parameters that the applicant may control for NCS are: (1) mass; (2) geometry; (3) enrichment; (4) reflection; (5) moderation; (6) concentration or density; (7) interaction; (8) neutron absorbers; and (9) process characteristics.

#### NCS Controls

In Section 5.4.3 of the LA (GLE, 2011a), the applicant discusses NCS controls. The four means of control, in order of preference, are passive engineered control, active engineered control, augmented administrative control, and simple administrative control (GLE, 2011a). Active engineered controls are designed such that the failure of the control will result in a safe condition (i.e., fail-safe) (GLE, 2011a). Administrative controls which are combined with a physical device to alert operators or otherwise add substantial assurance to human performance are preferred over simple administrative controls (GLE, 2011a). Administrative controls which require operator action before proceeding with an operation are preferred to those which require operator actions to interrupt an operation (GLE, 2011a). In general, administrative controls will be limited to situations where an engineered control is impractical

(GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.4.2(3) of NUREG-1520 (NRC, 2002) that address the order of preference for NCS controls.

Each NCS control must be capable of preventing a criticality accident independent of the operation or failure of any other NCS control for credible initiating events (GLE, 2011a). The relative effectiveness and reliability of controls are considered during the CSA process (GLE, 2011a).

All NCS controls are considered to be *safeguards* for the purpose of conducting the ISA (GLE, 2011a) though not all NCS controls will be IROFS. The ISA process will be used to determine which of these NCS controls are to be designated as IROFS (GLE, 2011a). As stated in the “Glossary of Definitions” in the LA (GLE, 2011a), at a minimum, an NCS control will be designated as an IROFS when: (1) the control is needed to maintain the system subcritical under normal and credible abnormal conditions; and (2) the control is relied on to ensure that the likelihood of a criticality accident sequence does not exceed  $10^{-5}$  events per year (GLE, 2011a). These commitments are consistent with the requirements of 10 CFR 70.61(e), which requires that engineered and administrative controls relied on to meet the performance requirements of 10 CFR 70.61(b) or (d) must be IROFS, and are, therefore, acceptable to the staff.

### Mass

In Section 5.4.4.1 of the LA (GLE, 2011a), the applicant discusses mass control. Mass control may be used to limit the amount of uranium in process operations or vessels. Mass may be controlled by direct measurement, fixed geometric dimensions, analytic methods, or non-destructive methods (GLE, 2011a). A conservative process density is assumed when geometry is used to control mass (GLE, 2011a). This addresses the acceptance criteria of Sections 5.4.3.4.2(7)(a) of NUREG-1520 (NRC, 2002). This acceptance criterion states that when a given mass has been determined, a percentage factor is used to determine mass percentage of Special Nuclear Material (SNM). In the staff’s judgment, this criterion only applies when mass limits are based on assumptions about the percentage of SNM, and states that any such assumptions should be confirmed by physical measurement, or else the entire mass should be assumed to be SNM. The applicant’s commitment with regard to analytic or non-destructive methods meet the intent of confirming the percentage of SNM in bulk material, whereas the applicant’s commitment to direct measurement is applicable to the case where the entire mass is assumed to be SNM. Therefore, the above commitments meet the intent of Section 5.4.3.4.2(7)(a) of NUREG-1520 (NRC, 2002) that mass be determined based on material composition.

A conservative process density is assumed when geometry is used to control mass (GLE, 2011a). This addresses the acceptance criterion of Section 5.4.3.4.2(7)(b) of NUREG-1520 (NRC, 2002) that when fixed geometric devices are used to limit the mass, a conservative process density is used. Establishment of mass limits will also consider enrichment, moderation, reflection, geometry, spacing, and material composition (GLE, 2011a). The consideration of material composition address the acceptance criteria of Section 5.4.3.4.2(7)(a) of NUREG-1520 (NRC, 2002) that mass be determined based on material composition.

Section 5.4.3.4.2(7)(c) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that when mass is measured, instrumentation will be used. The general commitment to use instrumentation when NCS parameters are controlled by measurement is made in Section 5.4.2.1 of the LA (GLE, 2011a). This general commitment addresses the acceptance criteria in

Section 5.4.3.4.2(6) of NUREG-1520 (NRC, 2002) that address avoiding human error through the use of reliable measurement instruments and Section 5.4.3.4.2 (7)(c) of NUREG-1520 (NRC, 2002) that when mass is measured, instrumentation will be used.

The applicant will either use handbook values or validated analytic methods to establish mass limits (GLE, 2011a). For handbook values, the minimum critical mass is assumed to be an optimally moderated sphere with full water reflection and the maximum credible enrichment (GLE, 2011a). When double batching is credible and mass is the only controlled parameter, the most conservative mass limits are applied (GLE, 2011a). In this case, mass will be limited to 45 percent of the minimum critical mass when handbook values are used or to 50 percent of the safe mass when an analytic method is used (GLE, 2011a). This is appropriate because the values listed in the acceptance criterion are only applicable to limits derived from experimental data, not analytic methods. When engineered controls prevent over batching or mass is one of two or more parameters being controlled, mass will be limited to either 75 percent of the minimum critical mass listed in a handbook or to a safe mass as determined by an analytic method (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.4.2(7)(d) of NUREG-1520 (NRC, 2002) that when using double-batching as a single-parameter limit control from experimental data, and double-batching is possible, the mass of special nuclear material is limited to no more than 45 percent of the minimum critical mass based on spherical geometry and Section 5.4.3.4.2(7)(e) of NUREG-1520 (NRC, 2002) that when using double-batching as a single-parameter limit control from experimental data and double-batching is not possible, the mass of special nuclear material is limited to no more than 75 percent of the critical mass based on spherical geometry.

### Geometry

In Section 5.4.4.2 of the LA (GLE, 2011a), the applicant discusses geometry controls. Subcritical limits for geometry controls are derived using either a validated analytic method or experimental data (GLE, 2011a). When experimental data is used, the geometry is limited to no more than 90 percent of the minimum critical cylinder diameter, 85 percent of the minimum critical slab thickness, or 75 percent of the minimum critical sphere volume (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.4.2(8)(b) of NUREG-1520 (NRC, 2002) that when using large single units as a single-parameter control from experimental data, the margins of safety are 90 percent of the minimum critical cylinder diameter, 85 percent of the minimum critical slab thickness, and 75 percent of the minimum critical sphere volume.

Favorable geometry assumes full water or concrete equivalent reflection, optimal moderation, worst credible heterogeneity, and maximum credible enrichment (GLE, 2011a). Fabrication tolerances and dimensional changes that may occur are evaluated when establishing geometry controls (GLE, 2011a).

Consistent with ANSI/ANS 8.1 (ANSI/ANS, 2007a), processes are examined in the as-built condition to validate the safety design and verify the equipment conforms to the specifications in the CSA (GLE, 2011a). This addresses the acceptance criteria in Section 5.4.3.4.2(8)(a) of NUREG-1520 (NRC, 2002) that before beginning operations, all dimensions and nuclear properties that use geometry control are verified, and the facility configuration management program should be used to maintain these dimensions and nuclear properties.

## Enrichment

In Section 5.4.4.3 of the LA (GLE, 2011a), the applicant discusses enrichment controls. Enrichment controls can be used to segregate materials by enrichment or to prevent over enrichment of materials (GLE, 2011a). Enrichment controls can be active engineered or administrative controls used either to: (1) measure or verify enrichment; or (2) to prevent the introduction of higher enriched material than allowed in a particular system (GLE, 2011a).

Section 5.4.3.4.2(10)(b) of NUREG-1520 (NRC, 2002) addresses the acceptance criteria that, when enrichment is measured, instrumentation will be used. The general commitment to use instrumentation when NCS parameters are controlled by measurement is made in Section 5.4.2.1 of the LA (GLE, 2011a).

The proposed facility will be designed for a target enrichment of 8 wt percent  $^{235}\text{U}$ , which means that the applicant does not intend to produce greater than 8 wt percent  $^{235}\text{U}$  at any point in the process (GLE, 2011a). Based upon the 8 wt percent  $^{235}\text{U}$  target enrichment, the applicant assumes the maximum credible enrichment for the facility is 8 wt percent  $^{235}\text{U}$ , which is used in the CSA when enrichment is not a controlled parameter (GLE, 2011a).

Section 5.4.3.4.2(10)(a) of NUREG-1520 (NRC, 2002) addresses the acceptance criteria that a method of segregating enrichments will be used to ensure that differing enrichments are not interchanged, unless the most limiting enrichment is used for all materials. The applicant stated that 8 wt percent enrichment will be used for all areas except Tails and In-Process Pads, Feed Vaporization, and Tails Withdrawal (GLE, 2011a). All these areas will be limited to natural or depleted uranium (GLE, 2011a). Controls on enrichment will primarily be used to ensure that enriched uranium is kept separate from natural or depleted uranium (GLE, 2011a). Therefore, the staff determined that the commitments above to prevent intermixing of natural and enriched uranium adequately address these acceptance criteria.

## Reflection

In Section 5.4.4.4 of the LA (GLE, 2011a), the applicant discusses reflection controls. Systems are typically evaluated using optimum reflection (e.g., 12 inches of water surrounding a system) so controls on reflection are not typically required (GLE, 2011a). Reflectors that are more effective than water (e.g., concrete) and any adjacent structural materials are considered when appropriate (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.4.2(11)(a) of NUREG-1520 (NRC, 2002) that when investigating an individual unit, the wall thickness of the unit and all reflecting adjacent materials of the unit are considered and any adjacent materials should be further than twelve inches from the unit. Less than optimal reflection may be used when controls on reflection are applied (GLE, 2011a).

Section 5.4.3.4.2(11)(b) of NUREG-1520 (NRC, 2002) contains the acceptance criteria that controls used to prevent the presence of potential reflectors should be identified as IROFS in the ISA Summary. The staff determined that this acceptance criterion is not applicable. If reflection controls are required to meet the performance requirements of 10 CFR 70.61, the ISA approach requires they be identified as IROFS. If they are not credited to meet the performance requirements, it is unnecessary to consider them IROFS to comply with the regulations.

## Moderation

In Section 5.4.4.5 of the LA (GLE, 2011a), the applicant discusses moderation controls. The applicant commits to ANSI/ANS 8.22 (ANSI/ANS, 1997b). The applicant committed to identify credible sources of moderation intrusion and preclude or control the ingress of moderator in accordance with the double contingency principle (GLE, 2011a). This addresses the acceptance criteria in Section 5.4.3.4.2(12)(g) of NUREG-1520 (NRC, 2002) that, after evaluating all credible sources of moderation for the potential intrusion into a moderation-controlled area, the ingress of moderation is precluded or controlled. The applicant commits to ANSI/ANS 8.22 (ANSI/ANS, 1997b). Areas where moderation is controlled for NCS purposes are designated as a Moderator Controlled Area (MCA). The MCA designation would fall under the definition of a *moderator control area* as used in ANSI/ANS 8.22 (ANSI/ANS, 1997b), and would be subject to the provisions in the standard that apply to *moderator control areas*. This addresses the acceptance criteria in Section 5.4.3.4.2(12)(a) of NUREG-1520 (NRC, 2002) that when using moderation, the applicant commits to ANSI/ANS 8.22 (ANSI/ANS, 1997b).

When moderation is a controlled parameter, the applicant will ensure that combustible materials are controlled and fire fighting methods are documented in approved procedures. This commitment ensures that any use of moderating fire fighting agents will be subject to review by NCS, resulting in any appropriate restrictions on moderators being included in the approved procedures. The acceptance criteria in Section 5.4.3.4.2(12)(f) of NUREG-1520 (NRC, 2002) that, when developing firefighting procedures for use in a moderation controlled area, restrictions are placed on the use of moderating material. This may or may not be appropriate, depending on the results of the criticality analysis. Therefore, the applicant's commitment is sufficient to ensure that the intent of the acceptance criterion in Section 5.4.3.4.2(12)(f) of NUREG-1520 (NRC, 2002) that when developing firefighting procedures for use in a moderation controlled area, restrictions are placed on the use of moderating material is met.

If moderation is the only controlled parameter, and moderator control relies upon sampling, the applicant will use redundant independent sampling methods (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.4.2(12)(e) of NUREG-1520 (NRC, 2002) that when moderation needs to be sampled, dual independent sampling methods are used.

Section 5.4.3.4.2(12)(c) of NUREG-1520 (NRC, 2002) addresses the acceptance criteria that when moderation is measured, the measure is obtained by using instrumentation. The general commitment to use instrumentation when NCS parameters are controlled by measurement is made in Section 5.4.2.1 of the LA (GLE, 2011a), which addresses these acceptance criteria.

Section 5.4.3.4.2(12)(b) of NUREG-1520 (NRC, 2002) addresses the acceptance criteria that when process variables can affect moderation, the process variables are shown in the ISA Summary to be controlled by IROFS. The staff determined that these acceptance criteria are not applicable. If moderation controls are required to meet the performance requirements of 10 CFR 70.61, the ISA approach requires they be identified as IROFS pursuant to 10 CFR 70.61(e). If they are not credited to meet the performance requirements, it is unnecessary to consider them IROFS to comply with the regulations.

Section 5.4.3.4.2(12)(d) of NUREG-1520 (NRC, 2002) addresses the acceptance criteria that when designing physical structures, the design precludes the ingress of moderation. However, the ISA considers all credible accident sequences leading to criticality, including those resulting from the ingress of moderation (GLE, 2011a), which may or may not be a criticality concern (e.g., it would not be a criticality concern if processes are shown to be subcritical with optimum

moderation). If necessary to comply with the performance requirements of 10 CFR 70.61 and the double contingency principle, controls will be established (GLE, 2011a). The controls could include other forms of moderation control, or moderation control may not be necessary to demonstrate subcriticality. Thus, it is not necessary to address these acceptance criteria.

### Concentration/Density

In Section 5.4.4.6 of the LA (GLE, 2011a), the applicant discusses concentration/density controls. The applicant may use concentration or density as a controlled parameter (GLE, 2011a). For NCS purposes, the applicant treats concentration and density as the same parameter since they are both controlled by limiting the fissile material mass to volume ratio (GLE, 2011a). For this section, concentration and density are considered synonymous (GLE, 2011a).

The most reactive credible fissile material concentration is assumed unless engineering controls are used to detect or mitigate the effects of high concentration within the system (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.4.2(13)(b) of NUREG-1520 (NRC, 2002) that high concentrations of SNM in a process are precluded unless the process is analyzed safe at any credible concentration. When concentration is the only controlled parameter to prevent a criticality accident, two controls will be used that are independently capable of preventing the concentration limit from being exceeded (GLE, 2011a). This commitment, applied to sampling, addresses the acceptance criteria of Section 5.4.3.4.2(13)(d) of NUREG-1520 (NRC, 2002) that when concentration needs to be sampled, dual independent sampling methods are used. Precautions will be taken to ensure that precipitating agents are not inadvertently introduced into concentration-controlled solutions (GLE, 2011a). This addresses the acceptance criteria in Section 5.4.3.4.2(13)(e) of NUREG-1520 (NRC, 2002) that after identifying possible precipitating agents, precautions are taken to ensure that such agents will not be inadvertently introduced.

Sections 5.4.3.4.2(9)(a) and (13)(a) of NUREG-1520 (NRC, 2002) address the acceptance criteria that when process variables can affect density or concentration respectively, they are shown in the ISA Summary to be controlled by IROFS. The staff determined that these acceptance criteria are not applicable. If moderation controls are required to meet the performance requirements of 10 CFR 70.61, the ISA approach requires they be identified as IROFS pursuant to 10 CFR 70.61(e). If they are not credited to meet the performance requirements, it is unnecessary to consider them IROFS to comply with the regulations.

Section 5.4.3.4.2(9)(b) of NUREG-1520 (NRC, 2002) addresses the acceptance criteria that when density is measured, the measurement will be obtained using instrumentation. The general commitment to use instrumentation when NCS parameters are controlled by measurement is made in Section 5.4.2.1 of the LA (GLE, 2011a). Therefore, these acceptance criteria have been addressed.

Section 5.4.3.4.2(13)(c) of NUREG-1520 (NRC, 2002) addresses the acceptance criteria that when using a tank containing concentration controlled solution, the tank is normally closed. This is not specifically addressed in the LA (GLE, 2011a). However, the regulations in 10 CFR Part 70, Subpart H, require that all credible accident sequences leading to criticality be identified. This would require the establishment of IROFS if the accidental dumping of high concentration solutions or precipitating agents into a concentration-controlled tank could lead to criticality. These controls may include closing or locking the tank lid, or other means, but other appropriate controls could also be used to meet the regulatory requirements, as long as they

are sufficiently available and reliable to meet the performance requirements of 10 CFR 70.61. Therefore, the staff determined that a specific commitment to keep the lid closed is not needed to comply with the regulations.

### Interaction

In Section 5.4.4.7 of the LA (GLE, 2011a), the applicant discusses interaction controls. Interaction controls are based on either isolation or spacing of units (GLE, 2011a). Spacing refers to the separation of units to control the neutron leakage of the system of units (GLE, 2011a). Isolated units are effectively non-interacting, this condition depends upon both spacing and shielding between units (GLE, 2011a). Models of interacting equipment or arrays should be modeled using the most reactive credible interstitial moderation. While there was not an explicit commitment to this, the applicant has committed to evaluate processes assuming credible optimum conditions when parameters are not specifically controlled. This general commitment would require consideration of the most reactive interstitial moderation for systems containing interacting arrays. The criteria for determining that a unit is isolated are specified in the license application; these are consistent with common industry practice and what has previously been approved at other fuel facilities.

If controlling interaction, physical separation between operations, vessels, or containers may be provided by engineered or augmented administrative controls (GLE, 2011a). Where engineered controls are required (e.g., spacers or racks), the structural integrity must be sufficient for both normal and credible abnormal conditions. This addresses the acceptance criteria in Section 5.4.3.4.2(14)(a) of NUREG-1520 (NRC, 2002) that when maintaining a physical separation between units, engineered controls or augmented administrative controls are used to ensure a minimum spacing; structural integrity of spacers or racks should be sufficient for normal and credible abnormal conditions.

### Neutron Absorbers

In Section 5.4.4.8 of the LA (GLE, 2011a), the applicant discusses neutron absorption controls. If the applicant uses fixed neutron absorbers for NCS purposes, they will be used in a manner consistent with ANSI/ANS 8.21 (ANSI/ANS, 1995). This addresses the acceptance criteria of Section 5.4.3.4.2(15)(b) of NUREG-1520 (NRC, 2002) that the applicant commits to ANSI/ANS 8.21 (ANSI/ANS, 1995). With regard to materials of construction used as neutron absorbers, the applicant stated that it did not currently credit these materials in this manner (GLE, 2011a). However, in the event materials of construction were credited, the applicant will evaluate systems with and without the use of these materials to determine the effect on the calculated  $k_{\text{eff}}$  (GLE, 2011a). If the use of materials of construction is needed to demonstrate subcriticality under normal or credible abnormal conditions, neutron absorption will be identified as a controlled parameter and the absorber designated as an IROFS (GLE, 2011a). ANSI/ANS 8.21 (ANSI/ANS, 1995) will, therefore, apply (GLE, 2011a).

The neutron spectrum will be considered when evaluating the absorber effectiveness in the CSA (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.4.2(15)(c) of NUREG-1520 (NRC, 2002) that when evaluating absorber effectiveness, neutron spectra are considered. Non-fixed neutron absorbers (e.g., borated Raschig Rings) will not be used at the proposed facility for NCS purposes (GLE, 2011a). Thus, a specific commitment to the acceptance criterion in Section 5.4.3.4.2(15)(a) of NUREG-1520 (NRC, 2002) is unnecessary.

## Volume

Volume is not a distinct controlled parameter used by the applicant, but may be used as a means of mass or geometry control (see Sections 5.4.4.1 and 5.4.4.2 of the LA (GLE, 2011a)). Thus, it is unnecessary to address the acceptance criteria in Section 5.4.3.4.2(16)(a) of NUREG-1520 (NRC, 2002) that when using volume control, fixed geometry is used to restrict the volume of SNM with engineered devices to limit accumulation) and Section 5.4.3.4.2(16)(b) of NUREG-1520 (NRC, 2002) that when volume is measured, instrumentation is used, because mass and geometry control are covered by their own acceptance criteria as discussed previously.

## Process Characteristics

In Section 5.4.4.9 of the LA (GLE, 2011a), the applicant discusses process characteristic controls. The applicant may decide to use process characteristics as a means of NCS control (GLE, 2011a). For NCS purposes, process characteristics are the physical, chemical, and nuclear properties of the process or materials (GLE, 2011a). In the CSA, credit for process characteristics is identified as either a bounding condition or an operating limit (GLE, 2011a). Bounding conditions must be based upon established physical, chemical, or nuclear reactions, scientific principles, or facility-specific experimental data supported by operational history (GLE, 2011a). Operating limits are maintained by a control (engineered or administrative) that must be treated in the same manner as any other NCS control to take credit for it in the CSA (GLE, 2011a).

Acceptance criteria for use of process characteristics are contained under the headings for the main controlled parameters (e.g., Section 5.4.3.4.2(9)(a), (12)(b), and 13(a) of NUREG-1520 (NRC, 2002) for process variable control related to density, moderation, and concentration). The staff finds that the commitments above adequately address the acceptance criteria in these sections.

## Heterogeneity

Although not an NCS controlled parameter, heterogeneity will be considered in the CSA for systems where the particle size varies (see Section 5.4.4.2 of the LA (GLE, 2011a)). This addresses the acceptance criteria in Section 5.4.3.4.2(4) of NUREG-1520 (NRC, 2002) that when evaluating a controlled parameter, the applicant should consider heterogeneous effects.

### 5.3.5.3 NCS Methods and Technical Practice Findings

The staff has reviewed the NCS methods and technical practices and finds that they are acceptable because the applicant has adequately addressed the acceptance criteria in Sections 5.4.3.4.1, 5.4.3.4.2, 5.4.3.4.4, and 5.4.3.4.5 of NUREG-1520 (NRC, 2002). These acceptance criteria include, as summarized previously, criteria for the use and validation of calculational methods to demonstrate subcriticality under normal and credible abnormal conditions (Section 5.4.3.4.1); the selection of controls and controlled parameters, adherence to the double contingency principle, and criteria for evaluating and controlling each of the possible controlled parameters (Section 5.4.3.4.2); establishing suitable controls to meet the requirements of 10 CFR 70.61(d) (Section 5.4.3.4.4); and adherence to the baseline design criteria of 10 CFR 70.64 (Section 5.4.3.4.5). The applicant commits to the double contingency principle as required by 10 CFR 70.64(a)(9). The staff finds that the NCS methods and



technical practices, if applied as described in the LA (GLE, 2011a), will provide an adequate margin of subcriticality for safety as required by 10 CFR 70.61(d).

### 5.3.6 CRITICALITY ACCIDENT ALARM SYSTEM

The review described in this section of the SER was based on the acceptance criteria in Section 5.4.3.4.3 of NUREG-1520 (NRC, 2002), which describes criteria for the installation, operation, and maintenance of CAAS systems, including adherence to ANSI/ANS 8.3 (ANSI/ANS, 1997a) and for the establishment of associated emergency response procedures.

#### 5.3.6.1 Criticality Accident Alarm System Description

In Section 5.3.5 of the LA (GLE, 2011a), the applicant discusses the CAAS. The applicant commits to have a CAAS that meets the requirements of 10 CFR 70.24 and ANSI/ANS 8.3 (ANSI/ANS, 1997a), as modified by Regulatory Guide 3.71, (NRC, 2010). This addresses the acceptance criteria of Section 5.4.3.4.3(2) of NUREG-1520 (NRC, 2002) that the CAAS meets the requirements of 10 CFR 70.24 and ANSI/ANS 8.3 (ANSI/ANS, 1997a), as modified by Regulatory Guide 3.71, (NRC, 2010). In addition, the CAAS will be designed and located such that it will be:

- Operational during a design basis earthquake;
- Protected to minimize damage due to fire, and other credible events;
- Uniform throughout the facility; and
- Clearly audible in areas that must be evacuated or a visual means of notifying personnel to evacuate will be provided (GLE, 2011a).

These commitments address the acceptance criteria of Section 5.4.3.4.3(3) of NUREG-1520 (NRC, 2002) that the applicant commits to having a CAAS that is uniform throughout the facility for the type of radiation detected, mode of detection, alarm signal, and system dependability; Section 5.4.3.4.3(5) of NUREG-1520 (NRC, 2002) that the applicant commits to having a CAAS that is designed to remain operational during credible events such as a fire, an explosion, a corrosive atmosphere, and other credible conditions; and Section 5.4.3.4.3(6) of NUREG-1520 (NRC, 2002) that the applicant commits to having a CAAS alarm that is clearly audible in areas that must be evacuated or provides alternate notification methods documented to be effective in notifying personnel that evacuation is necessary.

Section 5.4.3.4.3(4) of NUREG-1520 (NRC, 2002) addresses the acceptance criteria that the CAAS be designed to remain operational during credible events such as a seismic shock equivalent to a design basis earthquake or equivalent value specified in the International Building Code (ICC, 2006). This is addressed by the applicant's commitment with regard to a seismic event. Other such events are covered by provisions in ANSI/ANS 8.3 (ANSI/ANS, 1997a) and ANSI/ANS 8.23 (ANSI/ANS, 1997c), to which the applicant has committed. The applicant will maintain documentation demonstrating compliance with the requirements of 10 CFR 70.24 (GLE, 2011a).

The regulations in 10 CFR 70.24(a) require the applicant to provide CAAS coverage in each area where it will handle, use, or store SNM. The applicant identified the areas where it will handle, use, or store SNM in Sections 1.1.2.1 and 1.1.2.2 of the LA (GLE, 2011a). The applicant will provide CAAS coverage, with at least two detectors, for all of these areas except the UF<sub>6</sub> Cylinder Storage Pads, Trailer Storage Area, and UF<sub>6</sub> Cylinder Staging Area. (The

applicant applied for an exemption for these areas; see Section 1.2.5.7 of the LA (GLE, 2011a) and Sections 1.2.3.7.7 and 5.3.6.3 of the SER). This commitment to have CAAS coverage in all areas of the facility in which special nuclear material is present (with the exception of those areas covered by any exemption that is granted) addresses the acceptance criteria in Section 5.4.3.4.3(1) of NUREG-1520 (NRC, 2002) that the applicant documents that the CAAS meets the requirements of 10 CFR Part 70.

The applicant has an emergency plan and commits to follow ANSI/ANS 8.23 (ANSI/ANS, 1997c) (GLE, 2011a). This addresses the acceptance criteria in Section 5.4.3.4.3(8)(a) and (b) of NUREG-1520 (NRC, 2002) that the applicant commits to the requirements of ANSI/ANS-8.23-1997 (ANSI/ANS, 1997c) and Section 5.4.3.4.3(8)(b) of NUREG-1520 (NRC, 2002) that the applicant either has an emergency plan or satisfies the alternate requirements in 10 CFR 70.11(h)(1)(i). The CAAS is backed up by emergency power that will automatically activate upon loss of normal power. This addresses the acceptance criteria in Section 5.4.3.4.3(8)(d) of NUREG-1520 (NRC, 2002) that the applicant commits to provide emergency power for the CAAS or provide justification for the use of continuous monitoring with portable instruments. If CAAS coverage is lost, operations in the affected areas will promptly be put into a safe condition (GLE, 2011a). The exact time to shut down an operation or put it in a safe state is dependent upon the process and conditions at the time of the event (GLE, 2011a). When the CAAS is not functioning, compensatory measures such as limiting access and halting fissile material movement will be employed (GLE, 2011a). As discussed in Section 5.3.5 of the LA (GLE, 2011a), the applicant defines 'promptly' as being initiated within one hour and completed within previously specified completion times. Processes will be rendered safe by initially going into Standby Mode, in which all fissile material activities are suspended, or by suspending that portion of processes with the potential to result in an inadvertent criticality (those involving fissile material of a sufficient quantity and enrichment to sustain criticality) (GLE, 2011a). This action will be taken within four hours, unless longer time periods have been determined and justified in advance (GLE, 2011a). During such suspension of fissile activities, process systems will be idled, enrichment will be ceased, and any manual movement, handling, or processing of fissile materials outside of process equipment will be halted (GLE, 2011a).

The staff determined that the suspension of activities within the time frames specified will be acceptable given the low risk of criticality in the facility. The criticality alarms do not prevent criticality, but provide an added layer of protection that mitigates the dose to workers in the event of criticality. Criticality accidents must be rendered 'highly unlikely,' using other preventive controls, and therefore the risk of criticality occurring in a four-hour period would be acceptable. In some cases, longer time periods may be required to suspend operations in a safe manner, and this would be justified and documented.

The applicant stated in Section 5.3.5 of the LA (GLE, 2011a) that extending the time period would be justified in the event that it is either not feasible, or not safe, to shut down operations within four hours. One example would be placing the facility into Modified Standby Mode, in which gaseous UF<sub>6</sub> must be desublimed to the solid state. Although this would take more than four hours, it would result in transforming the material into a more stable and safe form in the case of an emergency. The staff finds that extending the time in such situations along with such measures (e.g., placing the facility into Modified Standby Mode) would be justified because it results in a net reduction in risk, or, as stated in the acceptance criterion in Section 5.4.3.4.3(7) of NUREG-1520 (NRC, 2002) that the applicant commits to rendering operations safe, by shutdown and quarantine if necessary, in any area where CAAS coverage has been lost and not restored within a specified number of hours, this time to be determined on a process-by-process basis, because shutting down certain processes, even to make them safe, may carry a

larger risk than being without a CAAS for a short time. The applicant further commits to compensatory measures (e.g., limit access, halt movement) when the CAAS system is not function, because shutting down certain processes, even to make them safe, may carry a larger risk than being without a CAAS for a short time. The applicant's plan for addressing a non-functional CAAS, as described in the preceding paragraphs, addresses the acceptance criteria in Section 5.4.3.4.3(7) of NUREG-1520 (NRC, 2002) that the applicant render operations safe if CAAS coverage is lost and not restored within a set time.

Section 5.4.3.4.3(8)(c) of NUREG-1520 (NRC, 2002) addresses the acceptance criterion that the applicant provide fixed and personnel accident dosimeters in areas requiring a CAAS. This is not specifically addressed in the LA (GLE, 2011a). However, the applicant has committed to ANSI/ANS-8.23 (ANSI/ANS, 1997c). Sections 4.1(9) and 5.2.4(4) of this standard require fixed and personnel accident dosimeters. Therefore, a specific commitment to this criterion is unnecessary.

These commitments for the CAAS system will ensure that a nuclear criticality will be detected promptly so as to minimize radiation exposure to workers, addressing the acceptance criteria of Section 5.4.3.4.1(4) of NUREG-1520 (NRC, 2002) that an inadvertent criticality will be detected promptly to ensure that radiation exposures to workers are minimized.

#### 5.3.6.2 CAAS in the ISA Summary

The regulations in 10 CFR 70.65(b)(4) require that the ISA Summary contain information that demonstrates compliance with the criticality monitoring and alarm requirements of 10 CFR 70.24. The acceptance criteria for the CAAS are described in Section 5.4.3.4.3 of NUREG-1520 (NRC, 2002), which address the applicant's commitments to establish a CAAS that meets the requirements on 10 CFR 70.24. The ISA Summary (GLE, 2011b) did not contain sufficient information regarding the CAAS, because the detailed CAAS designs have not been completed at this time. To satisfy the requirements in 10 CFR 70.65(b)(4), an applicant must provide information in the ISA Summary demonstrating compliance with 10 CFR 70.24. To ensure that these requirements will be met, the staff is granting an exemption to the requirements in 10 CFR 70.65(b)(4), and is imposing the following license condition:

*The licensee is granted an exemption to the requirements in 10 CFR 70.65(b)(4) to require that the ISA Summary contain information that demonstrates compliance with the criticality monitoring and alarm requirements of 10 CFR 70.24. At least 90 days prior to obtaining licensed material, the licensee shall submit to the NRC for approval Criticality Accident Alarm System design information to demonstrate compliance with 10 CFR 70.65(b)(4) for all areas for which NRC has not granted an exemption to 10 CFR 70.24, and in which special nuclear material is handled, used, stored, or transported (including outdoor transport routes), and include this information in the ISA Summary.*

The basis for the exemption to 10 CFR 70.65(b)(4) is discussed in Section 1.2.3.7.8 of this SER.

The applicant indicated that CAAS coverage will be necessary for the Operations Building (except the laser area, which does not contain SNM), classified storage area, and unclassified storage area. These areas plus those areas where an exemption to the CAAS requirements has been requested covers the primary areas where fissile material is expected to be handled, used, or stored. In the LA (GLE, 2011a), the applicant did not indicate CAAS coverage would be provided for transport paths between these areas; however, coverage of these areas is expected and can be verified once the final CAAS system layout is determined. The staff

determined that the applicant's statements concerning CAAS coverage, combined with the above imposed license condition are sufficient to provide reasonable assurance that CAAS coverage of the transportation paths will be provided.

### 5.3.6.3 CAAS Exemption Request

In Section 1.2.5.7 of the LA (GLE, 2011a), the applicant discusses its exemption request related to the CAAS. In the request, the applicant requested an exemption from the CAAS coverage requirements of 10 CFR 70.24 for the UF<sub>6</sub> Cylinder Storage Pads, Trailer Storage Area, and UF<sub>6</sub> Cylinder Staging Area. The exemption request is also discussed in Section 1.2.3.7.7 of this SER. (There are no acceptance criteria related to the review of a CAAS exemption request; the staff evaluated this against the criteria in 10 CFR 70.17, as discussed below.)

The exemption will not apply to any of the areas where 48GLE cylinders with enriched material will be handled, used, or stored. These cylinders are much larger than 30B cylinders normally used for enriched material. Procedures will be in place to preclude the transfer and storage of 48GLE or 30B cylinders to the CAAS-exempt areas, which would be readily apparent due to their different color.

The UF<sub>6</sub> Cylinder Storage Pads consist of the Tails, In-Process, and Product Pads (GLE, 2011a). The Tails and In-Process Pads do not require CAAS coverage under normal circumstances since no SNM will be present (GLE, 2011a). It is possible that a 30B could inadvertently be transferred to either the Tails or In-Process Pads, but due to the size difference between 30B and other cylinders this should be obvious and quickly remedied.

Enriched uranium will be handled and stored in 30B cylinders on the Product Pads, Trailer Storage Area, and UF<sub>6</sub> Cylinder Staging Area. Transportation, handling, and storage of 30B cylinders only involve solid UF<sub>6</sub>. All other NCS commitments will continue to be met, such that the operations with 30B cylinders will be adequately subcritical, a criticality accident is highly unlikely, and the double contingency principle will be met. The 30B cylinder is engineered, tested, and inspected in accordance with ANSI N14.1, "Nuclear Materials—Uranium Hexafluoride—Packaging for Transport" (ANSI, 2001), such that they are leak-tight and will prevent moderators from entering the cylinder. Only approved overhead crane rigging, forklift, or transport carrier will be used to prevent cylinder breach.

30B cylinders will not be stored for long periods of time, so it is considered highly unlikely for a breach to go unnoticed for a significant amount of time (GLE, 2011a). In addition, it would take several days of extremely heavy rainfall before a criticality would be possible if a large breach were to occur (GLE, 2011a). In addition, as discussed in Section 1.1.2.2.1 through 1.1.2.2.3 of the LA (GLE, 2011a), the storage pads are designed to preclude the buildup of rainwater on the outside of the cylinders.

The installation of the criticality monitors would have to be mounted high over the storage pads (GLE, 2011a). The maintenance requirements for the CAAS would increase vehicular traffic and, therefore, the likelihood of a cylinder breach (GLE, 2011a). Installation of criticality monitors would also increase the likelihood that an individual would be present in the area and susceptible to both routine radiation and criticality accident doses (GLE, 2011a). Therefore, the installation of criticality monitors would increase the overall risk to workers (GLE, 2011a).

Based on the above evaluation of the request for an exemption to 10 CFR 70.24 for the UF<sub>6</sub> Cylinder Storage Pads, Trailer Storage Area, and UF<sub>6</sub> Cylinder Staging Area, the NRC staff

finds that there is a low risk of a criticality accident with product cylinders in these areas. In addition, the staff finds that the installation of a CAAS in these areas would not significantly reduce the risk to the workers or the public:

Under 10 CFR 70.17, the Commission may grant exemptions from the requirements of the regulations as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. NRC staff evaluated the applicant's exemption request and determined that the requested exemption is not prohibited by law. Staff also determined that the installation of a CAAS in the UF<sub>6</sub> Cylinder Storage Pads, the Trailer Storage Area, and the UF<sub>6</sub> Cylinder Staging Area would not significantly reduce the risk to the workers or the public because there is a low risk of a criticality accident with product cylinders in these areas. Therefore, the approach will not endanger life or property or the common defense and security. Because the proposed approach will reduce the applicant's expenses in implementing its nuclear criticality safety program, the staff has determined that the proposed approach will be in the public interest by reducing unnecessary regulatory costs. Therefore, the staff grants the requested exemption as provided in Section 1.2.5.7 of the LA (GLE, 2011a). The following license condition will be imposed in the license to address the applicant's proposed changes to the CAAS program:

*The licensee is granted an exemption to the requirements in 10 CFR 70.24, which require the licensee to maintain a criticality accident alarm system, for the UF<sub>6</sub> Cylinder Storage Pads, the Trailer Storage Area, and the UF<sub>6</sub> Cylinder Staging Area.*

#### 5.3.6.4 CAAS Findings

The staff reviewed the applicant's commitment to the CAAS requirements in 10 CFR 70.24 and finds that it is acceptable because the applicant maintains a CAAS that is capable of energizing a clearly audible alarm signal if accidental criticality occurs, and the applicant maintains emergency procedures for each area in which SNM is handled, used, or stored to ensure prompt personnel evacuation upon the sounding of the alarm. Additionally, the staff finds that the applicant adequately addressed the acceptance criteria in Section 5.4.3.4.3 of NUREG-1520 (NRC, 2002), which pertain to the implementation of a CAAS system meeting the requirements of 10 CFR 70.24(a), including adherence to the ANSI standard ANSI/ANS 8.3 (ANSI/ANS, 1997a).

The staff has reviewed the information about the CAAS provided in the applicant's LA (GLE, 2011a) and ISA Summary (GLE, 2011b) and determined that the applicant's commitments in regard to 10 CFR 70.24 and ANSI/ANS 8.3 (ANSI/ANS, 1997a) meet the acceptance criteria discussed above. In addition, 10 CFR 70.65(a)(4) requires, in part, that the ISA Summary include information that demonstrates compliance with the requirements for criticality monitoring and alarms in 10 CFR 70.24. Because a criticality cannot occur if there is no fissionable material onsite, an operating CAAS is not needed until the applicant obtains licensed material. Therefore, the staff is granting an exemption to the requirements in 10 CFR 70.65(b)(4) and is imposing the following license condition to ensure that the regulatory requirement is met before the licensee obtains licensed material:

*The licensee is granted an exemption to the requirements in 10 CFR 70.65(b)(4) to require that the ISA Summary contain information that demonstrates compliance with the criticality monitoring and alarm requirements of 10 CFR 70.24. At least 90 days prior to obtaining licensed material, the licensee shall submit to the NRC for approval Criticality Accident Alarm System design information to demonstrate compliance with 10 CFR*

*70.65(b)(4) for all areas for which NRC has not granted an exemption to 10 CFR 70.24, and in which special nuclear material is handled, used, stored, or transported (including outdoor transport routes), and include this information in the ISA Summary.*

The staff has reviewed the request for an exemption to 10 CFR 70.24 for the UF<sub>6</sub> Cylinder Storage Pads, Trailer Storage Area, and UF<sub>6</sub> Cylinder Staging Area and finds that there is a low risk of a criticality accident with product cylinders in these areas. In addition, the staff finds that the installation of a CAAS in these areas would not significantly reduce the risk to the workers or the public. The staff has reasonable assurance that, with the following license condition, the exemption to 10 CFR 70.24 for the areas requested will not endanger life or property or the common defense and security:

*The licensee is granted an exemption to the requirements in 10 CFR 70.24, which require the licensee to maintain a criticality accident alarm system in the UF<sub>6</sub> Cylinder Storage Pads, the Trailer Storage Area, and the UF<sub>6</sub> Cylinder Staging Area.*

### 5.3.7 REPORTING REQUIREMENTS

The review described in this section of the SER was based on Section 5.4.3.4.7(7) of NUREG-1520 (NRC, 2002), which describes the reporting of certain NCS-related events to the NRC, which include evaluating the criticality safety significance of events, making the necessary notifications to the NRC Operations Center, and meeting the applicable requirements of 10 CFR 70.50 and 10 CFR Appendix A.

In Section 5.5 of the LA (GLE, 2011a), the applicant discusses NCS reporting requirements. The applicant will establish a program to evaluate the significance of events, in terms of NCS, using qualified individuals (GLE, 2011a). This addresses the acceptance criteria in Section 5.4.3.4.7(7)(a) of NUREG-1520 (NRC, 2002) that the applicant has a program for qualified individuals to evaluate the criticality significance of NCS events and apparatus in place for making the required notification to the NRC Operations Center. The criteria for reporting events to the NRC Operations Center under 10 CFR 70.50 and Appendix A to 10 CFR 70 will be incorporated into written procedures (GLE, 2011a). This addresses the acceptance criteria in Section 5.4.3.4.7(7)(b) of NUREG-1520 (NRC, 2002) that the applicant incorporates the reporting criteria of 10 CFR 70.50 and Appendix A into the facility emergency procedures. Reports will be made based upon IROFS failure regardless of whether or not safety limits are exceeded (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.4.7(7)(c) of NUREG-1520 (NRC, 2002) that the applicant commits to issue the necessary report based on whether the IROFS credited were lost, irrespective of whether the safety limits of associated parameters were actually exceeded. An event will be reported within one hour of discover when the reporting criteria in 10 CFR 70, Appendix A, Paragraph (a), apply or when it cannot be determined that these criteria do not apply (GLE, 2011a). This addresses the acceptance criteria of Section 5.4.3.4.7(7)(d) of NUREG-1520 (NRC, 2002) that the applicant commits that, if it cannot ascertain within one hour whether the criteria of 10 CFR Part 70 Appendix A, paragraphs (a) or (b) apply, the event will be treated as a one-hour reportable event. An event will be reported within 24 hours of discovery when the reporting criteria in 10 CFR 70, Appendix A, Paragraph (b), apply or when it cannot be determined that these criteria do not apply (GLE, 2011a).

The staff reviewed the applicant's commitments to report NCS events to the NRC Operations Center and finds that they are acceptable because the applicant has adequately addressed all

the acceptance criteria in Section 5.4.3.4.7(7) of NUREG-1520 (NRC, 2002) that the applicant describe measures to implement the reporting requirements in 10 CFR Part 70, Appendix A.

### 5.3.8 INTEGRATED SAFETY ANALYSIS

The review described in this section of the SER was based primarily on Chapter 3 and Section 5.4.3.4.6, of NUREG-1520 (NRC, 2002). Chapter 3 describes the review of the ISA for all regulated facility hazards, while Section 5.4.3.4.6 describes the review as applied specifically to criticality hazards. Specifically, Section 5.4.3.4.6 of NUREG-1520 (NRC, 2002) states that the criticality hazards should be evaluated consistent with other facility hazards, but that prevention must be primary means of control, and that applicable ANSI standards should be followed, as is discussed in detail below.

The purpose of the ISA review is to determine that there is reasonable assurance that an ISA is conducted in accordance with 10 CFR 70.62(c) which will ensure that the requirements of 10 CFR 70.61, as they relate to NCS, will be met. This review is divided into two parts: (1) review of commitments regarding the conduct of an ISA and ISA Summary and (2) review of the ISA Summary. The conclusions reached in this section are supported by a review of selected onsite ISA documents. The non-public portions of the ISA Summary and onsite ISA document (horizontal and vertical slice) review are discussed in Section 3.3.8 of the non-public SER.

#### 5.3.8.1 ISA Commitments

In Chapter 3 of the LA (GLE, 2011a), the applicant discusses commitments applicable to the ISA. This chapter of the SER will only give a brief synopsis of the applicant's ISA, and will only discuss in detail those aspects that are unique to criticality safety. The applicant conducted and will maintain an ISA that identifies—for each process—the NCS hazards, credible accident sequences (including consequences and likelihood), and IROFS. CSAs are part of the ISA and document the criticality hazards and credible criticality accident scenarios. The ISA was conducted and will be maintained by a team which includes at least one qualified NCS engineer.

The applicant's ISA is a two step process as discussed in Chapter 3 of the LA (GLE, 2011a) (see Chapter 3 of this SER for more details). The first step is to perform a process hazard analysis (PHA) based upon the approach described in Chapter 3, Appendix A, of NUREG-1520 (NRC, 2002). The second step is to perform a quantitative risk assessment (QRA) for each scenario identified in the PHA as having unacceptable risk. The CSAs will be used to inform the PHA and QRA.

The What-If/Checklist method is used to identify potential hazards. For each credible hazard, the ISA team assigns a severity level and unmitigated likelihood using a semi-quantitative risk index method. The applicant considers potential criticality accidents to be high consequence events. This means that for each criticality accident scenario the ISA team must determine that the scenario is either not credible or highly unlikely to occur. An accident sequence is considered to be *highly unlikely* if it occurs at a frequency of less than or equal to  $10^{-5}$  per year. Thus, for criticality hazards there are only three possible outcomes from the PHA:

1. A criticality accident is determined to be not credible. No further analysis is required and IROFS are not needed to meet the performance requirements.
2. A criticality accident is presumed credible, but the initiating event is determined to be highly unlikely without the need for any controls. The unmitigated accident sequence is

assigned a severity ranking of 3 and a likelihood category of 1. The unmitigated risk is acceptable and no IROFS or further analysis is required.

3. A criticality accident is presumed credible and the initiating event is determined not to be highly unlikely (without crediting any controls). The unmitigated accident sequence is assigned a severity ranking of 3 and a likelihood category of 2 or 3. The unmitigated risk is unacceptable and IROFS must be defined. A QRA is performed to demonstrate the adequacy of the IROFS.

The QRA follows probabilistic risk assessment methods developed for the commercial nuclear power industry. The QRA report uses event trees to evaluate accident sequences and provides a detailed discussion of the initiating events, IROFS, and justification for the overall event frequencies.

The applicant commits to select IROFS that are independent of the initiating event and other credited IROFS. For criticality hazards, IROFS are a subset of the NCS controls identified in CSAs (see Section 5.3.5.2 of this SER).

The staff reviewed the applicant's commitments regarding the conduct of its ISA against the acceptance criteria in Section 3.4.3.1 of NUREG-1520 (NRC, 2002), as documented in Chapter 3 of this SER. Section 3.4.3.1 of NUREG-1520 (NRC, 2002) contains acceptance criteria that pertain to the review of 10 CFR 70.62 information, specifically process safety information, ISA, and management measures. The discussion of their acceptability as applied to NCS hazards is documented in Section 3.3.8 of this SER. The following discussion addresses commitments related to NCS-specific acceptance criteria in Chapter 5 of NUREG-1520 (NRC, 2002).

Section 5.4.3.4.6 of NUREG-1520 (NRC, 2002) includes acceptance criteria related to the performance of the ISA, as discussed below.

Section 5.4.3.4.6(1) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the applicant should meet the acceptance criteria of Section 3.4 of NUREG-1520 (NRC, 2002), as they relate to NCS. (Section 3.4 of NUREG-1520 (NRC, 2002) contains acceptance criteria pertaining broadly to the overall ISA review.) The staff's review of the applicant's ISA Summary (GLE, 2011b), which includes consideration of criticality hazards, is discussed in Chapter 3 of this SER. (The staff's review of the NCS-related portion of the ISA Summary (GLE, 2011b) is discussed in Section 3.3.8 of the non-public SER.)

Section 5.4.3.4.6(2) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the applicant should commit to use Appendix A of ANSI/ANS 8.1 (ANSI/ANS, 1998) in determining NCS accident sequences. Appendix A is not part of the ANSI standard (meaning that it does not need to be followed to be in conformity with the standard). It is simply an example of upsets that should be considered as part of a criticality safety review. Criticality accident sequences were evaluated as part of the ISA process (GLE, 2011b), as discussed in Section 3.3.8 in Chapter 3 of this SER. The ISA is a structured process intended to identify and evaluate any credible accident scenarios, including but not limited to any applicable ones in Appendix A of the standard. Therefore, the staff's evaluation in Chapter 3 addresses this criterion.

Section 5.4.3.4.6(3) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the applicant should commit to ANSI/ANS 8.10 (ANSI/ANS, 1983b) (as modified by Regulatory Guide 3.71 (NRC, 2010)) to determine the consequences of NCS accident sequences. The applicant's facility is not a shielded facility, and therefore the ANSI/ANS 8.10 standard is not



applicable. In addition, criticality is considered a high consequence event for the purpose of the ISA. Since this is the highest consequence category, this determination is conservative and no consequence determination is needed. Therefore, the acceptance criterion does not apply.

#### 5.3.8.2 ISA Summary Review

The purpose of the ISA Summary (GLE, 2011b) review is to verify that the applicant complied with the requirements of 10 CFR 70.65(b) as it relates to NCS. The staff review of the ISA Summary (GLE, 2011b) against the acceptance criteria in Section 3.4.3.2 of NUREG-1520 (NRC, 2002), regarding completeness and description of the site, facility, processes, accident sequences, the ISA team, IROFS (including sole IROFS), and definitions of “credible,” “highly unlikely,” and “unlikely.” This review was based on the current facility design. As discussed in Section 5.3.5 of the SER, the staff is exempting the applicant from the requirements of 10 CFR 70.65(b)(4) with respect to providing information in the ISA Summary that demonstrates compliance with the CAAS requirements in 10 CFR 70.24. The staff is imposing a license condition to ensure that this information will be provided to the NRC and included in the ISA Summary prior to obtaining licensed material. The only area where the staff is aware of a lack of a complete design is the CAAS system. The applicant committed to revising the ISA Summary (GLE, 2011b) for any subsequent design changes made in accordance with 10 CFR 70.72.

In Section 1.2 of the ISA Summary (GLE, 2011b), the applicant discusses the NCS ISA program. The ISA Summary requirements that are important for NCS are 10 CFR 70.65(b)(3)–(6) and (8)–(9). Since the ISA Summary (GLE, 2011b) contains proprietary, security-related, and export controlled information, the review of information required to meet 10 CFR 70.65(b)(3), (4), (6), and (8) is discussed in Section 3.3.8 of the non-public SER. The following paragraphs discuss the ISA requirements as they apply to criticality hazards. The requirements of 10 CFR 70.65(b)(5) and (b)(9) are important to NCS, but also apply to other disciplines, and they are discussed generally in Chapter 3 of both the public and non-public SERs. Review of CAAS information required by 70.65(b)(4) is discussed in Section 5.3.6 of this SER.

#### 10 CFR 70.65(b)(3): Process Description

The ISA Summary (GLE, 2011b) is divided into 17 nodes. A node can be a particular process (e.g., blending) or can be applicable site-wide (e.g., utilities, external events) (GLE, 2011b). Each node contains a description of the processes and major components within the node, and a list of interfaces with other nodes or systems (GLE, 2011b). The ISA Summary (GLE, 2011b) identified the areas where enriched uranium may be present, which is sufficient for determining where the criticality hazards exist. Natural and depleted uranium is also used at the facility; however no criticality hazards exist for this material (GLE, 2011b). Information regarding equipment geometry, presence of moderators, and other factors important to NCS were also included in the descriptions (GLE, 2011b).

The staff reviewed the process descriptions for each node in the ISA Summary (GLE, 2011b). Specifically, the applicant provided sufficient process information in the ISA Summary (GLE, 2011b) describing the facility processes, hazards and types of accident sequences to determine where criticality hazards exist, and how operations might affect NCS. Therefore, the staff finds that the information adequately addresses the acceptance criteria in Section 3.4.3.2(3) of NUREG-1520 (NRC, 2002), which contains criteria for review of the applicant’s processes, hazards, and accident sequences, as it relates to NCS. This is discussed in more detail in Section 3.3.8 of the non-public SER.

#### 10 CFR 70.65(b)(4): Compliance with the Performance Requirements of 10 CFR 70.61

The set of nodes in the ISA Summary (GLE, 2011b) covers all processes at the facility where NCS is important. Based upon reviewing each process node, the staff has reasonable assurance that, based on the current facility design, all credible criticality accidents have been identified in the ISA Summary (GLE, 2011b).

In Section 4.16 of the ISA Summary (GLE, 2011b), the applicant discusses the external event accident sequences. External events with the potential to impact NCS are earthquakes, flooding, and extreme precipitation (GLE, 2011b). The likelihood of an earthquake occurring which would cause equipment to fail in a manner which would exceed the performance requirements is demonstrated to be highly unlikely (GLE, 2011b). The facility is above the 500 year floodplain and no means of rapid flooding (e.g., extreme precipitation, pipe break) exist, so the applicant will have ample time to render operations safe (GLE, 2011b). Any increase in reflection conditions due to flooding is already accounted for since the CSAs use conservative reflection conditions (GLE, 2011b). Section 4.16 of the ISA Summary (GLE, 2011b) also considers loss of moderation control for each process where this is relevant.

The staff reviewed the information in the ISA Summary (GLE, 2011b) provided to demonstrate compliance with the performance requirements of 10 CFR 70.61 and finds it is acceptable because it adequately addresses the acceptance criteria in Section 3.4.3.2(4)(a) of NUREG-1520 (NRC, 2002) that relates to the review of accident sequences and IROFS as they relate to NCS; and Section 3.4.3.2(4)(b) of NUREG-1520 (NRC, 2002) that relates to management measures as they relate to NCS. This is discussed in more detail in Section 3.3.8 of the non-public SER.

#### 10 CFR 70.65(b)(4): Compliance with 10 CFR 70.64 (Baseline Design Criteria and Defense-in-Depth)

Throughout the ISA Summary (GLE, 2011b) for each node, the applicant discusses the baseline design criteria and defense-in-depth. The baseline design criteria in 10 CFR 70.64(a)(9) require that the design provide for criticality control, including adherence to the double contingency principle. This requirement is met by designing processes such that no single credible failure or contingency can result in criticality (GLE, 2011b). This addresses the acceptance criteria of Section 5.4.3.4.2(2) of NUREG-1520 (NRC, 2002) that the applicant commits to the policy, based on 10 CFR 70.61, that no single credible event or failure can result in a criticality accident. Throughout most of the facility, multiple upsets would be required before criticality is possible (GLE, 2011b). The main UF<sub>6</sub> processing areas are designed to preclude the ingress of liquid moderator into uranium-bearing equipment (GLE, 2011b). The use of MCAs is limited to those temporary maintenance activities requiring breaching the confinement barrier, such as opening equipment to perform maintenance or remove deposits (GLE, 2011b). In these cases, local MCAs will be established with engineered barriers (e.g., physical barriers on openings, overhead covers) to prevent the introduction of external source of water from entering the equipment (GLE, 2011b). Administrative controls will also be established as needed to prevent operators from hand carrying moderations into the MCA (GLE, 2011b). Where such engineered barriers cannot prevent moderator from fire suppression from entering the equipment, applicable National Fire Protection Association requirements will be employed to lock out the affected fire suppression system for the duration that the additional moderator controls are needed (GLE, 2011b). Moderator controls relied on to demonstrate compliance with the performance requirements are appropriately designated as IROFS (GLE, 2011b). (Other

moderator controls provide defense-in-depth, but for the purpose of the ISA were presumed to be unavailable (GLE, 2011b.) In addition, other upsets would have to occur before sufficient quantities of fissile material could accumulate and achieve the correct geometry and reflection conditions for criticality to occur (GLE, 2011b). The likelihood of achieving the right combination of geometry, moderation, and reflection to attain criticality provides additional defense-in-depth (GLE, 2011b).

In addition to the double contingency principle, the baseline design criteria in 10 CFR 70.64 require adherence to defense-in-depth practices, including: (1) preference for engineered over administrative controls and (2) features that enhance safety by reducing challenges to IROFS. The principal way in which the design incorporates defense-in-depth practices is through the double contingency principle. The staff determined that in its implementation of double contingency, the design relies to a great extent on the use of passive engineered controls. Challenges to IROFS are minimized by the large safety margins inherent in most facility operations, and by the presence of multiple controls. For example, multiple controls would have to fail before moderator could be introduced into the main UF<sub>6</sub> processing areas, and even if this occurred, substantial safety margin would still remain, such that multiple additional unlikely events would have to occur concurrently before criticality would be possible.

The staff reviewed the information in the ISA Summary (GLE, 2011b) provided to demonstrate compliance with the baseline design and defense-in-depth criteria of 10 CFR 70.64 and finds it is acceptable because it adequately addresses the acceptance criteria in Section 3.4.3.2(4)(d) of NUREG-1520 (NRC, 2002) addressing baseline design criteria applicable to new facilities or new processes at existing facilities, as they relate to NCS.

#### 10 CFR 70.65(b)(6) and (8): IROFS and Sole IROFS

In Section 1.5 of the ISA Summary (GLE, 2011b), the applicant discusses IROFS and sole IROFS. The applicant's ISA Summary (GLE, 2011b) states that there are no sole IROFS related to nuclear criticality safety. The applicant provided a list of IROFS in its ISA Summary (GLE, 2011b) that references the accident sequences where the IROFS applies. Descriptions of IROFS and their role in meeting the performance requirements are included with the accident sequence descriptions.

The staff has reviewed the list of IROFS and sole IROFS in the ISA Summary and finds it is acceptable because it adequately addresses the acceptance criteria in Section 3.4.3.2(6) of NUREG-1520 (NRC, 2002) to provide a descriptive list of all IROFS, as they relate to NCS; and Section 3.4.3.2(8) of NUREG-1520 (NRC, 2002) to provide a list of sole IROFS, as they relate to NCS.

#### 5.3.8.3 ISA Summary Review Conclusions

The staff has reviewed the ISA program and the ISA Summary (GLE, 2011b) based on the acceptance criteria in Section 3.4 of NUREG-1520 (NRC, 2002) for preparing an ISA Summary and 5.4.3.4.6 of NUREG-1520 (NRC, 2002) for meeting the performance requirements in 10 CFR 70.61(b), (c), and (d), and has reasonable assurance that it has conducted an ISA, based upon the current facility design, that:

1. Identified all credible criticality accident scenarios;
2. Identified controls to prevent each credible criticality accident sufficient to meet the performance requirements of 10 CFR 70.61(b) and (d), comply with the double contingency principle in 10 CFR 70.64(a)(9), and provide defense-in-depth as required by 10 CFR 70.64(b);
3. Designated as IROFS, as required by 10 CFR 70.61(e), the controls relied on to meet the performance requirements as they relate to NCS; and
4. Identified management measures which will be applied to NCS related IROFS to ensure they will be available and reliable.

Based upon the review of the ISA commitments in Chapter 3 of the LA (GLE, 2011a), the ISA Summary (GLE, 2011b), and the onsite review of ISA documents, the staff has reasonable assurance that an ISA will be performed and maintained in accordance with 10 CFR 70.62(c) such that the requirements of 10 CFR 70.61, as they relate to NCS, will be met. The staff has reasonable assurance that the ISA program described in Chapter 3 of the LA (GLE, 2011a) is sufficient to identify all credible nuclear criticality accidents and the IROFS necessary to make such events highly unlikely.

#### 5.3.9 FACILITY CHANGES AND CONFIGURATION MANAGEMENT

The review described in this section of the SER was based on Section 5.4.3.4.7 of NUREG-1520 (NRC, 2002), which describes aspects of the NCS Program related to configuration management, change control, and the 10 CFR 70.72 change process. Specifically, this section contains acceptance criteria that pertain to the detection and correction of facility deficiencies, evaluation of facility changes by NCS, records retention, evaluating changes against the criteria of 10 CFR 70.72, and reporting events in accordance with 10 CFR 70.50 and 10 CFR 70, Appendix A.

In Sections 5.1.1, 5.3.3, and 11.1.4 of the LA (GLE, 2011a), the applicant discusses facility changes and the configuration management program as it applies to NCS. This addresses the acceptance criteria in Section 5.4.3.4.7(2) of NUREG-1520 (NRC, 2002) that the applicant commits that NCS evaluations will be made of changes to processes, operating procedures, IROFS, and management measures. As part of configuration management, the applicant must assess whether NRC approval is required before a change is implemented (GLE, 2011a). Changes to the site, structures, processes, systems, equipment, components, computer systems, and activities of personnel may be changed without NRC approval if the criteria in 10 CFR 70.72(c) are met (GLE, 2011a). In Section 1.2.5.5 of the LA (GLE, 2011a), the applicant also requested authorization to make changes to its facility or processes as described in its LA (GLE, 2011a), or conduct tests or activities not presented in its license, without prior approval under specified conditions. This authorization does not change any of the 10 CFR 70.72(c) requirements, but does clarify which changes are authorized or prohibited by license condition. The requested authorization is evaluated in Section 1.2.3.7.2 of this SER.

Section 5.4.3.4.7(3) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the applicant should commit to upgrade the NCS program to reflect changes in the ISA or new NCS methods and to modify operating and maintenance procedures so as to reduce the likelihood of criticality. The staff finds that there is no requirement to improve safety beyond what is found necessary at the time of licensing to comply with the regulations, and therefore a commitment to

upgrade the NCS program as described in the acceptance criteria in Section 5.4.3.4.7(3) of NUREG-1520 as described above is unnecessary.

Section 5.4.3.4.7(4) of NUREG-1520 (NRC, 2002) contains the acceptance criterion that the applicant should commit to retain records of the NCS program and document any corrective actions taken. The applicant has made commitments to these criteria in Sections 5.3.6 and 5.3.7 of the LA (GLE, 2011a).

Sections 5.4.3.4.7(6)(a), (b), and (c) of NUREG-1520 (NRC, 2002) contain acceptance criteria pertinent to the applicant's change control process. Specifically, Section 5.4.3.4.7(6)(a) of NUREG-1520 (NRC, 2002) states that the applicant commits to a change control process that is sufficient to maintain the safety basis over the facility lifetime. The change process should be documented in written procedures and should evaluate the effect of the change on the safety basis of the process, including the effect on bounding process assumptions, the reliability and availability of NCS controls, and the safety of connected processes. Section 5.4.3.4.7(6)(b) of NUREG-1520 (NRC, 2002) states that the change control process should be connected to the configuration management system to ensure that changes to NCS bases are incorporated into procedures, evaluations, postings, drawings, other safety basis documentation, and the ISA Summary. Section 5.4.3.4.7(6)(c) of NUREG-1520 (NRC, 2002) states that the applicant commits to a program to determine whether facility changes require NRC approval under 10 CFR 70.72(c). This program should be documented in written procedures and must involve individuals qualified to determine the incremental effect of changes to the safety basis as documented in the ISA Summary. With regard to NCS changes, in Section 5.1.1 of the LA (GLE, 2011a), the applicant committed to perform NCS reviews for any new or existing processes, or any changes to existing processes, which may have an impact on the established basis for NCS. In Section 5.3.3 of the LA (GLE, 2011a), the applicant committed to consider the effect of any changed CSAs on the ISA and ISA Summary (GLE, 2011b). Section 11.1.4 of the LA (GLE, 2011a) contains detailed commitments with regard to the change control process, for all changes (not just those relating to criticality). These commitments address the acceptance criteria of Section 5.4.3.4.7(6)(a), (b), and (c) of NUREG-1520 (NRC, 2002) as summarized above.

In Section 5.4.1.3.4 of the LA (GLE, 2011a), the applicant discusses commitments related to the MoS. The regulations in 10 CFR 70.61(d) require that the MoS for safety be approved by NRC. In Section 5.4.1.3.4 of the LA (GLE, 2011a), the applicant discusses commitments related to the MoS. The NRC is approving a MoS for safety consisting of an MoS of 0.03 or 0.05, depending on the area of applicability, and the margin due to conservative modeling practices as described in Section 5.4 of the LA (GLE, 2011a). The approved MoS for safety is applicable to the area(s) of applicability as determined in accordance with the applicant's reviewed validation method. The staff, therefore, finds that the applicant's MoS, together with the margin due to conservative technical practices, provides adequate assurance of subcriticality under normal and credible abnormal conditions, when applied to evaluations conducted within the validated area(s) of applicability.

Typically, a licensee must request an amendment under 10 CFR 70.34 to make changes to the license application because it is incorporated into the license by reference. The authorization request described in Section 1.2.5.5 of the LA (GLE, 2011a) would allow some changes to be made without NRC approval (i.e., without an amendment to the license), when a revision to the license application or other licensing basis documents is necessary. The staff determined in Section 1.2.3.7.2 of this SER that the proposed authorization to make changes to the LA (GLE, 2011a) is acceptable because the applicant explicitly commits to not make any change to its

license which would decrease the effectiveness of its commitments without prior NRC approval. The applicant may also make changes to the facility or process described in the license application, or conduct tests or activities not described in the license application, provided they do not degrade the safety commitments or conflict with any specific conditions in the license application.

The staff also reviewed the applicant's commitments for configuration management presented in Sections 5.1.1 and 5.3.3 of the LA (GLE, 2011a) as it relates to NCS and finds that it is acceptable because the applicant has adequately addressed the acceptance criteria in Section 5.4.3.4.7 of NUREG-1520 (NRC, 2002), which describes additional program commitments related to the prompt detection and correction of deficiencies, the performance of NCS determinations of changes, upgrading of the NCS program to reflect changes to the ISA or new NCS methodologies, retention of records, the use of approved methodologies and technical practices to evaluate NCS accident sequences, the change control process as related to NCS, and the reporting requirements of 10 CFR 70.50 and Appendix A.

#### **5.4 EVALUATION FINDINGS**

The staff reviewed the LA (GLE, 2011a), the ISA Summary (GLE, 2011b), the GEMER code validation report (GLE, 2010), and onsite ISA documents as it relates to NCS to satisfy the acceptance criteria in Chapter 5 of NUREG-1520 (NRC, 2002) as described in the previous sections. Based on this review, the staff has reasonable assurance that:

1. The applicant will have a staff of managers, supervisors, engineers, process operators, and other support personnel who are qualified to develop, implement, and maintain the NCS program in accordance with the facility organization and administration and management measures.
2. The applicant's conduct of operations will be based on NCS methods and technical practices, which will ensure that SNM will be possessed, stored, and used safely according to the requirements in 10 CFR Part 70.
3. The applicant will provide an adequate MoS for safety as required by 10 CFR 70.61(d), for evaluations conducted within the validated area(s) of applicability in accordance with the methods and technical practices committed to in its LA.
4. The applicant's safety programs and management measures will ensure that the MoS is maintained such that processes will meet the subcriticality requirements of 10 CFR 70.61(d) and the baseline design criteria requirements in 10 CFR 70.64(a).
5. The applicant will develop, implement, and maintain a CAAS in accordance with the requirements in 10 CFR 70.24 and the facility emergency management program.
6. The requested exemption to the CAAS requirements in 10 CFR 70.24 for the areas specified in the license, and the exemption to the requirement in 10 CFR 70.65(b)(4) to provide information demonstrating compliance with 10 CFR 70.24 in the ISA Summary, will not endanger life or property or the common defense and security, and will be in the public interest.

7. The applicant will perform and maintain an ISA in accordance with 10 CFR 70.62(c) such that the requirements of 10 CFR 70.61, as they relate to NCS, will be met.

This finding is predicated on the applicant's compliance with the following license conditions:

*The licensee shall not make changes to the validation report that decrease the effectiveness of commitments in Section 5.4.1.3 or 5.4.1.4 of the license application, or that degrade the approved margin of subcriticality for safety, without prior NRC approval. Prior NRC approval is required for changes meet one or more of the following criteria: (1) result in an increase in the upper subcritical limit, (2) expand the area of applicability, (3) necessitate extrapolation beyond the area of applicability, (4) employ a statistical method less conservative than that described in Section 5.4.1.3.2 of the license application (including less conservative levels of confidence), or (5) use new codes or calculational methods, or (6) use any other non-conservative change to the validation method or results.*

*The licensee shall provide a minimum 60-day notice to NRC prior to initial customer product withdrawal of licensed material exceeding 5 weight percent <sup>235</sup>U enrichment. This notice shall identify the necessary equipment and operational changes to support customer product shipment for these assays and shall provide the facility documents demonstrating compliance with all criticality safety regulatory requirements. The licensee may not implement the changes in enrichment until NRC approves the changes.*

*No changes shall be made, without prior NRC approval, to Section 5.4 of the License Application that would result in modifying the current values for criticality-based analysis in a less conservative direction, with regard to either validation or criticality evaluation of nuclear processes.*

*The licensee is granted an exemption to the requirements in 10 CFR 70.65(b)(4) to require that the ISA Summary contain information that demonstrates compliance with the criticality monitoring and alarm requirements of 10 CFR 70.24. At least 90 days prior to obtaining licensed material, the licensee shall submit to the NRC for approval Criticality Accident Alarm System design information to demonstrate compliance with 10 CFR 70.65(b)(4) for all areas for which NRC has not granted an exemption to 10 CFR 70.24, and in which special nuclear material is handled, used, stored, or transported (including outdoor transport routes), and include this information in the ISA Summary.*

*The licensee is granted an exemption to the requirements in 10 CFR 70.24, which require the licensee to maintain a criticality accident alarm system in the UF<sub>6</sub> Cylinder Storage Pads, the Trailer Storage Area, and the UF<sub>6</sub> Cylinder Staging Area.*

Based on the above review and proposed license conditions, NRC staff concludes that if the applicant's NCS program will meet the requirements of 10 CFR Part 70 and provide reasonable assurance for the protection of public health and safety, including workers and the environment.

## 5.5 REFERENCES

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## **6.0 CHEMICAL PROCESS SAFETY**

The purpose of the U.S. Nuclear Regulatory Commission's (NRC's) review of the General Electric-Hitachi Global Laser Enrichment LLC (GLE or applicant) chemical safety program and the design of its proposed laser-based uranium enrichment facility is to evaluate whether the applicant will adequately protect workers, the public, and the environment during normal operations against chemical hazards of licensed material and its by-products. The chemical safety program and the facility's design must also protect against credible facility conditions or operator actions that can affect the safety of licensed materials and thus present an increased chemical risk.

### **6.1 REGULATORY REQUIREMENTS**

The regulatory bases for the review are the general and additional contents of an application that addresses chemical process safety, as required by Title 10 of the *Code of Federal Regulations* (10 CFR) 70.22(a)(6), 70.22(a)(7), 70.22(a)(8), 70.23(a)(2), 70.23(a)(3), 70.23(a)(4), and 70.65. In addition, the chemical process safety review should provide reasonable assurance of compliance with 10 CFR 70.61, 70.62, and 70.64.

### **6.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA**

The guidance applicable to NRC's review of chemical process safety for the proposed facility is contained in Chapter 6 of "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," NUREG-1520 (NRC, 2002). This chapter is applicable in its entirety. The staff also used NUREG-1601, "Chemical Process Safety at Fuel Cycle Facilities" (NRC, 1997a), and NUREG-1513, "Integrated Safety Analysis Guidance Document" (NRC, 2001), as guidance documents for this review. The acceptance criteria applicable to this review are contained in Section 6.4.3 of NUREG-1520 (NRC, 2002).

### **6.3 STAFF REVIEW AND ANALYSIS**

NRC staff reviewed the License Application (LA) (GLE, 2011a) and the Integrated Safety Analysis (ISA) Summary (GLE, 2011b) submitted by the applicant and considered the following areas:

1. Process Description;
2. Chemical Accident Sequences;
3. Chemical Accident Consequences;
4. Chemical Process Items Relied on for Safety (IROFS);
5. Management Measures;
6. Emergency Management; and
7. Baseline Design Criteria (BDC).

The staff reviewed the applicant's LA and ISA documents to determine if the facility's design complied with the requirements specified in 10 CFR 70.61(a) and 70.64(b), respectively. Compliance with these regulations is discussed in more detail in Chapter 3 of this Safety Evaluation Report (SER). The staff's evaluation and general information about the proposed facility are summarized in the following sections.

### 6.3.1 PROCESS DESCRIPTION

#### 6.3.1.1 General Process Description

The applicant describes the proposed facility and process systems in Section 1.1 of the LA (GLE, 2011a) and in Chapters 3 and 4 of the ISA Summary (GLE, 2011b). The applicant is proposing to utilize laser-based enrichment technology to enrich natural uranium hexafluoride ( $UF_6$ ) in gaseous form by separating a feed stream containing the naturally occurring proportions of uranium isotopes containing approximately 0.72 weight percent uranium-235 ( $U^{235}$ ) into a product stream enriched in the  $U^{235}$  isotope up to 8 weight percent  $U^{235}$  and a tails stream depleted in the  $U^{235}$  isotope. The proposed facility uses the laser-based enrichment technology within an area of the facility known as the Cascade/Gas Handling Area. The nominal capacity of the facility is six million Separative Work Units per year. The process utilizes lasers tuned to specific frequencies to selectively excite  $UF_6$  gas molecules to enable separation of the  $U^{235}$  isotope in  $UF_6$  feed stock. The result is a  $UF_6$  product stream enriched in the  $U^{235}$  isotope and a  $UF_6$  tails stream in which the fraction of  $U^{235}$  isotope is reduced or depleted. The feed, product, and tails streams are all in the form of  $UF_6$ .

The proposed facility utilizes industry standard  $UF_6$  containers and processes for material handling aspects of enrichment facility operations similar to those utilized at other uranium enrichment facilities. These similar  $UF_6$  handling processes include the movement of uranium feed stock from its solid  $UF_6$  form in cylinders to gaseous form used in the enrichment cascade via vaporization techniques, the filling of  $UF_6$  cylinders with  $UF_6$  gas condensed into solid  $UF_6$  form after the enrichment process, the blending of  $UF_6$  gas of different enrichments to create specific desired product enrichments, and the sampling of  $UF_6$  as a liquid in autoclave pressure vessels.

Technical details of the laser-based enrichment technology are proprietary, are subject to export controls by U.S. laws and regulations, and involve classified information, access to which is further limited by U.S. laws and regulations.

The proposed facility enrichment process consists of the following four major systems and two enrichment support systems:

#### Major Enrichment Process Systems

1.  $UF_6$  Feed and Vaporization
2. Cascade / Gas Handling
3. Product Withdrawal
4. Tail Withdrawal

#### Enrichment Support Systems

1. Blending
2. Sampling

### 6.3.1.2 Chemical Process Inventories

In Section 6.2 of the LA (GLE, 2011a), the applicant stated that the inventories of chemicals will be maintained below the threshold quantities set forth by the Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) standard, 29 CFR 1910.119, and the U.S. Environmental Protection Agency (EPA) Risk Management Program standard, 40 CFR Part 68. An inventory, as well as locations, is listed in the Radiological Contingency and Emergency Plan (RC&EP) (GLE, 2011c) in accordance with the Emergency Planning and Community Right-to-Know Act (EPCRA).

The licensee expects to possess source material and special nuclear material as part of the process and byproduct radioactive materials as calibration sources. The majority of the calibration sources will be sealed and will not constitute a chemical hazard in the facility.

### 6.3.1.3 Chemical Safety Strategy

The applicant's proposed chemical safety strategy and program are discussed in Section 6.2 of the LA (GLE, 2011a). Safety in normal operations will be maintained by the applicant through the implementation of the defense-in-depth engineering philosophy. The main design feature that ensures chemical process safety is robust equipment to contain UF<sub>6</sub> during the enrichment process. Physical barriers include fire walls throughout the facility; glove boxes in the laboratory and decontamination and maintenance areas; isolation and check valves in piping containing UF<sub>6</sub>; siphon breaks in the Radioactive Liquid Effluent Treatment System (RLETS) piping; overflow vessels in the RLETS; and chemical traps for collecting UF<sub>6</sub> vapors during connection and disconnection of cylinders to process lines.

The applicant will also implement a chemical safety strategy through the following:

- Chemical Safety Program – The Chemical Safety Program is applicable to chemicals associated with authorized activities and including UF<sub>6</sub>, hydrogen fluoride (HF), and other hazardous chemicals associated with activities involving licensed material. The Chemical Safety Program provides oversight of the handling, use, and storage of chemicals at the facility. The Chemical Safety Program will be documented in approved written procedures that ensure processes and operations will comply with applicable Federal and State regulations pertaining to chemical safety.
- Chemical Evaluation and Approval – Prior to a new hazardous chemical being brought on site or used in an activity, the applicant will require approval by the Chemical Review Committee. The Chemical Review Committee's approval process will include reviewing the health and safety risks of the chemical, as well as appropriate handling, storage, and disposal information.
- Labeling and Identification – Hazardous materials or conveyance systems will be labeled to meet applicable regulations. Hazardous chemicals will also be identified for personnel through the availability and maintenance of Material Safety Data Sheets (MSDSs).

Inventories of chemicals will be tracked through the procurement process. The facility's RC&EP (GLE, 2011c) will also contain an inventory of bulk chemical quantities and locations, as required by the U.S. Environmental Protection Agency's EPCRA, Section 312, Tier II. The

RC&EP (GLE, 2011c), as well as the MSDSs, are provided to applicable offsite responders. The RC&EP will be updated annually.

#### 6.3.1.4 Hazardous Chemicals and Chemical Interactions

As discussed in Section 6.2.1.1.4 of the LA (GLE, 2011a), the main chemical hazard present in the proposed facility will be  $UF_6$  and its two hydrolysis products, HF and uranyl fluoride ( $UO_2F_2$ ). Any  $UF_6$  that is released will react exothermically with moisture in the air to produce HF and  $UO_2F_2$ . All three compounds are chemically toxic. The most important toxic effect of uranium products ( $UF_6$  and  $UO_2F_2$ ) is damage to the kidneys, due to functional loss. It is also known to induce some damage to liver and muscle tissue. It is also known to induce some damage to liver and muscle tissue. HF exposures to the eye can cause severe burns, as well as marked lowering of serum calcium from a skin exposure, if not treated. High exposures to HF vapor due to inhalation can cause progressive destruction of mucus membranes and swelling of lung tissue, which can be fatal.

Other chemicals expected to be used at the proposed facility include lubricant oil, process gases, and chemical trap media. Lubricant oil primarily comprises a combustible hazard, and the addition of this system is addressed in the fire hazards in Section 7.3.4 of this SER. The applicant will implement industry-recognized standards in the use of these chemicals. Other proprietary chemicals were evaluated and determined to have no significant chemical process hazards.

##### Lubricant Oils

In addition to interaction with moisture,  $UF_6$  can also react exothermically with hydrocarbons. The applicant has committed that it will not use hydrocarbon lubricants in equipment that contacts  $UF_6$ . Where lubricants are needed for equipment that could contact  $UF_6$  gas, the applicant will use lubricants that are compatible with  $UF_6$  and HF. In Chapter 4 of the ISA Summary (GLE, 2011b), the applicant states that it will use Fomblin oil (or its equivalents), which is a trade name for polyfluoropolyether (PFPE). Fomblin oil is an inert, fully fluorinated lubricant that does not react with  $UF_6$  under any operating conditions. It also has minimal flammability and toxicity.

##### Chemical Trap Media

In Section 4.13 of the ISA Summary (GLE, 2011b), "Cylinder Wash," the applicant describes two types of chemical traps, one containing activated alumina designed to absorb HF, and a second type containing sodium fluoride media designed to absorb  $UF_6$ . In addition to normal operating modes, Section 4.13 of the ISA Summary (GLE, 2011b) includes a description of trap evacuation and media replacement. Accident sequences associated with the traps are included in Section 4.13 of the ISA Summary (GLE, 2011b).

##### Materials of Construction

In Section 6.2.1.2.1 of the LA (GLE, 2011a), the applicant committed to utilizing approved materials of construction throughout the process and operations areas that are compatible with  $UF_6$  or are corrosion resistant to  $UF_6$ . These materials of construction will also be compatible with the process operational physical parameters of temperature and pressure.

The applicant states that the cylinders to be used at the proposed facility for transport, processing, and storage of UF<sub>6</sub> will be designed and maintained in accordance with American National Standards Institute (ANSI) ANSI N14.1, "Nuclear Materials: Uranium Hexafluoride – Packaging for Transport," (ANSI, 2001). These containers are appropriate due to the resistance of the materials to corrosion by UF<sub>6</sub>. These cylinders will be painted to resist corrosion from atmospheric conditions, and the cylinders will be inspected on a routine basis to assess corrosion and corrosion rates.

#### 6.3.1.5 Process Description Conclusion

In the LA (GLE, 2011a) and the ISA Summary (GLE, 2011b), the applicant provided process descriptions that are sufficiently detailed to allow an understanding of the chemical process hazards and to allow the development of potential accident scenarios. The information that the applicant provided, as described above, meets the acceptance criteria in Section 6.4.3.1(1) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

The staff finds that the applicant has provided descriptions of the approach employed for adequately maintaining safety in normal operations. The information that the applicant provided, as described above, as well as the hierarchy of policies and procedures discussed in Section 6.3.4.2.2 of this SER, meets the acceptance criteria in Section 6.4.3.2(1) of NUREG-1520 (NRC, 2002), and is therefore, acceptable.

The staff also finds that the applicant has provided a description of the chemical hazards that could result from potential chemical interactions. This information is sufficient to develop potential accident sequences involving chemical hazards. The information provided by the applicant meets the acceptance criteria for the evaluation of potential process chemical interactions in Section 6.4.3.1(1) of NUREG-1520 (NRC, 2002), and is therefore, acceptable.

The ISA Summary (GLE, 2011b) and Chapter 3 of the LA (GLE, 2011a) discuss the screening criteria the applicant employed to identify chemicals for further analysis in the hazard evaluation. The approach used to perform the hazards evaluation phase is also discussed in these chapters. The staff finds that the methods in the LA meet the acceptance criteria in Section 3.4.3.2(4) of NUREG-1520 (NRC, 2002) and provide a basis for reasonable assurance of compliance with the requirements of 10 CFR 70.61.

#### 6.3.2 CHEMICAL ACCIDENT SEQUENCES

In Section 1.2 of the ISA Summary (GLE, 2011b) and Section 3.2.5 of the LA (GLE, 2011a), the applicant discusses the consequence criteria the applicant used to identify chemicals for further analysis in the hazard evaluation. The approach used to perform the hazards evaluation phase is also discussed in these sections.

The applicant has identified the chemical hazards which are produced by the licensed material, could affect the safety of licensed material, or from chemicals which are co-mingled with licensed material, and therefore must meet the requirements of 10 CFR Part 70. Also, the MSDSs for chemicals used in the facility process were reviewed by the applicant for hazards to the workers. Liquid HF solutions were determined to present a potential health hazard. However, the applicant identified no other chemicals as presenting potential serious or long-lasting health hazards as used at the facility.

Chapter 4 of the ISA Summary (GLE, 2011b) includes potential chemical accident sequences associated with each facility area and identifies specific controls that either prevent or mitigate the consequences to an acceptable level. The applicant evaluated the process by systematically breaking down the process system, subsystem, facility area, or operation being studied into well-defined nodes. These nodes established study area boundaries in which the various process systems and supporting systems entering or exiting the node, or activities occurring in the area, can be defined to allow interactions to be studied. The chemical accident sequences covered potential chemical accidents at the following nodes: Node 4200 – Feed and Vaporization (ISA Section 4.3); Node 4300 – Product Withdrawal (ISA Section 4.4); Node 4400 – Tails Withdrawal (ISA Section 4.5); Node 4700 – Blending (ISA Section 4.6); Node 4800 – Sampling (ISA Section 4.7); Node 4900 – Liquid Radioactive Waste (ISA Section 4.8); Node 5200 – Decontamination/Maintenance (ISA Section 4.12); Node 5210 – Cylinder Wash, Valve/Plug Repair, and Trap Shop (ISA Section 4.13); and Node 5400 – Laboratory Operations (ISA Section 4.14). The accident sequences covered the range of events that could result in the loss of confinement of UF<sub>6</sub>, the hazardous chemicals produced from UF<sub>6</sub> (i.e., HF, UO<sub>2</sub>F<sub>2</sub>), and the potential interactions of UF<sub>6</sub> with materials of construction. The accident sequences addressed both intermediate and high consequence events.

#### 6.3.2.1 Review of Selected Accident Sequences

Compliance with the requirements for an ISA of chemical accident sequences is discussed in more detail in Chapter 3 of this SER. As part of the process of evaluating compliance with the ISA requirements, the staff performed a risk-informed vertical slice review of chemical accident sequences. The vertical slice review consists of a detailed evaluation of ISA documentation at the applicant's site of several risk-informed accident sequences. The vertical slice review is further discussed in Section 3.3.17 of this SER. The staff confirmed that the applicant had identified credible accident scenarios and the resulting risk in terms of consequences and likelihood.

#### 6.3.2.2 Chemical Accident Sequences Conclusion

For each of the process systems (nodes), the staff concludes that the applicant has adequately identified credible chemical accident sequences, including appropriate accident likelihoods, based on the applicant's use of a combination of approved hazards analysis methods (What-If/Checklist or Quantitative Risk Analysis) to identify those sequences and the staff's review of selected chemical accident sequences. For each process node in Chapter 4 of the ISA Summary (GLE, 2011b), the applicant provides a description of potential interactions of chemicals and an evaluation of the risks (both consequence and likelihood) as well as a description of controls to minimize the risks and mitigate the consequences of accident scenarios. The information provided by the applicant meets the accident sequence and likelihood acceptance criteria in Section 6.4.3.1(2) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

### 6.3.3 CHEMICAL ACCIDENT CONSEQUENCES

In Section 1.2 of the ISA Summary (GLE, 2011b) and in Section 3.2.5 of the LA (GLE, 2011a), the applicant addresses the chemical quantitative risk levels used in determining the impact of potential accidents on the workers and the public. The applicant chose to use Acute Exposure Guideline Levels (AEGs) to evaluate accidents associated with chemical events involving HF, in a manner consistent with NUREG-1520, Table A-5, "Consequence Severity Categories Based on 10 CFR 70.61," (NRC, 2002). For events involving soluble uranium compounds, the



applicant defined action levels to be in agreement with the performance requirements using the intake of soluble uranium in milligrams. These consequence levels are also discussed in Section 3.3.7 of this SER. The staff finds this approach to be consistent with the acceptance criteria in Section 6.4.3.1(6) of NUREG-1520 (NRC, 2002), which recommends the use of standards such as AEGLs and is, therefore, acceptable.

In Section 3.2.5 of the LA (GLE, 2011a), the applicant describes its approach for evaluating chemical and radiological hazards at the proposed facility. The applicant used a What-If/Checklist Method, for systematically identifying hazards. Using this method, the applicant evaluated a complete spectrum of facility chemical hazards in process components and with facility staff and the public. This method is consistent with recommendations in Section 3.4.3.2(3) of NUREG-1520 (NRC, 2002) and Section 2.3 of NUREG-1513 (NRC, 2001).

The applicant calculated the accident consequences using the 10-minute AEGL values for HF and UF<sub>6</sub> in the case of personnel exposure where a worker would be expected to be in the immediate proximity of a release; and public exposures were estimated to last for a duration of 30 minutes. This is consistent with self-protection criteria for UF<sub>6</sub>/HF plumes listed in NUREG-1140, "A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees," (NRC, 1988).

Liquid HF solutions created during laboratory operations were determined to be 4 percent HF or lower. The effects from a dermal or ocular exposure were evaluated using industry guidance for potential exposures to HF, and determined to not exceed the performance criteria. The applicant committed to a medical treatment program as defense-in-depth, but it is not relied upon to prevent or reduce the likelihood of an event.

The applicant calculated source terms using methods prescribed in NUREG/CR-6410, "Nuclear Fuel Cycle Accident Analysis Handbook" (NRC, 1998), and supporting documents. The specific modeling methods utilized conservative methods for source term determination, release fractions, dispersion factors, and meteorological conditions. For indoor releases, conservative leak path fractions were assumed as recommended by NUREG/CR-6410 (NRC, 1998).

The computer codes used in chemical consequence analyses were RASCAL 3.0.5 from NUREG-1887, "RASCAL 3.0.5: Description of Model and Methods" (NRC, 2007), and ARCON 96, "Code System to Calculate Atmospheric Relative Concentrations in Building Wakes," (NRC, 1997b). Both of these models are widely-accepted by the nuclear industry as appropriate for chemical dispersion modeling.

The staff finds that the applicant has identified and used appropriate techniques and valid assumptions, including source terms, in estimating the consequences from analyzed chemical accident sequences and the consequences have been conservatively estimated. The applicant uses the performance requirements of 10 CFR 70.61(b) and 70.61(c). Source term and dispersion models are wide-accepted by the nuclear industry and consistent with the guidance in NUREG/CR-6481, "Review of Models Used for Determining Consequences of UF<sub>6</sub> Release" (NRC, 1997c). The applicant used models appropriate for their specific application and consequence analyses consistent with NRC guidance in NUREG/CR-6410 (NRC, 1998). The information provided by the applicant meets the acceptance criteria in Sections 6.4.3.1(3), 6.4.3.1(4), and 6.4.3.1(5) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

The staff performed a vertical slice review of a representative sample of potential accident sequences at the proposed facility using the process descriptions and block diagrams provided

in Chapter 4 of the ISA Summary (GLE, 2011b). The accident sequences vary in magnitude, and include those initiated by natural phenomena, operator error, and equipment failure. Analytical results indicate that the accidents pose acceptably low risks. The NRC staff concluded that through a combination of plant design, passive and active engineered controls, and administrative controls, accidents at the facility pose an acceptably low risk to workers, the environment, and the public.

Based on the review of the ISA Summary (GLE, 2011b), onsite visits to evaluate supporting ISA documentation, and the review of selected accident sequences, the staff concludes that the applicant has adequately identified the consequences and likelihoods of the accident sequences involving the chemical hazards of licensed material and hazardous chemicals produced from licensed material. The applicant used a What-If/Checklist approach to evaluating chemical hazards that considered a complete range of chemical interactions with facility components and personnel. As discussed in Section 6.3.5 of this SER, the applicant also provided reasonable assurance that measures to mitigate the consequences of accident sequences identified in the ISA Summary (GLE, 2011b) are consistent with the actions described in the RC&EP (GLE, 2011c). The information the applicant provided meets the acceptance criteria in Section 6.4.3.1(2) of NUREG-1520 (NRC, 2002) for evaluation of potential interactions of process chemicals with facility personnel, and is, therefore, acceptable.

#### 6.3.4 IROFS AND MANAGEMENT MEASURES

##### 6.3.4.1 Chemical Process IROFS

The applicant's ISA Summary (GLE, 2011b) includes chemical accident sequences which describe credible high or intermediate consequence accidents at the following nodes: Node 4200 – Feed and Vaporization (ISA Section 4.3); Node 4300 – Product Withdrawal (ISA Section 4.4); Node 4400 – Tails Withdrawal (ISA Section 4.5); Node 4700 – Blending (ISA Section 4.6); Node 4800 – Sampling (ISA Section 4.7); Node 4900 – Liquid Radioactive Waste (ISA Section 4.8); Node 5200 – Decontamination/Maintenance (ISA Section 4.12); Node 5210 – Cylinder Wash, Valve/Plug Repair, and Trap Shop (ISA Section 4.13); and Node 5400 – Laboratory Operations (ISA Section 4.14).

The accident consequences and the need for IROFS were determined by applying the criteria described in 10 CFR 70.61. IROFS were selected to prevent or mitigate the consequences to the public, workers, and the environment. A table in the section of the ISA Summary (GLE, 2011b) for each facility node lists the identified IROFS and the accident sequences that take credit for each IROFS. The staff reviewed selected chemical accident sequences and their respective process IROFS for the proposed facility. NRC staff reviewed the process descriptions and process flow diagrams provided in Chapter 4 of the ISA Summary (GLE, 2011b) and how the IROFS would function to prevent or mitigate the consequences of the identified accident sequences.

Based on the above reviews and the examination of the ISA documentation during the vertical slice visit, the staff concludes that the applicant adequately identified chemical process administrative and engineered IROFS to prevent or mitigate the consequences of accident sequences involving the chemical hazards of licensed materials and hazardous chemicals produced from licensed material. The information the applicant provided meets the acceptance criteria in Section 6.4.3.2(2) of NUREG-1520 (NRC, 2002) to identify the controls and associated management measures and is, therefore, acceptable.

#### 6.3.4.2 Management Measures

The applicant's commitments regarding management measures are described in Section 6.2.3 and Chapter 11 of the LA (GLE, 2011a). After selecting the IROFS, management measures were selected to ensure that IROFS would be available and reliable to perform their safety function when required. The applicant committed to apply management measures to IROFS on a continuing basis to provide reasonable assurance that IROFS are available and able to perform their intended functions when needed. The applicant will apply management measures in a graded approach based on unmitigated risks as described in the ISA Summary (GLE, 2011b). A Quality Level will be assigned to each IROFS based on the following criteria described in the Quality Assurance Program Description (QAPD) (GLE, 2011d):

- QL-1 A sole IROFS preventing or mitigating a high consequence event
- QL-2 Applies to two or more IROFSs credited with preventing or mitigating a high consequence event or an IROFS preventing or mitigating an intermediate consequence event
- QL-3 Other

The programmatic requirements applied to QL-1 and QL-2 IROFS are discussed in the QAPD (GLE, 2011d). In the QAPD (GLE, 2011d), the applicant commits to ensure that management measures required for the safe design, construction, and operation of the facility through design, procurement, and document control, procedures and drawings, and inspection and testing programs, thus meeting the requirements of 10 CFR 70.64(a)(1).

According to criteria defined in approved written procedures, the relative importance of an IROFS is to be determined using both the severity of consequence and unmitigated likelihood of an initiating event. Based on the assigned importance, the appropriate type and number of management measures will be assigned to assure the IROFS are functional when needed.

#### 6.3.4.2.1 Configuration Management

The applicant's commitments regarding management measures are described in Section 6.2.3 and Chapter 11 of the LA (GLE, 2011a). The Configuration Management (CM) program will address maintenance of facility design information; identification of IROFS; control of information used to operate and maintain the facility; documentation of changes; assurance of adequate safety review of changes; and periodic performance assessment of specific safety controls to ensure conformance to design basis documentation. The CM program will be administered by the CM Manager. During design and construction, the CM Manager will report to the Operations Engineering Manager. During the operational phase, the CM Manager will report to the Operations Manager.

The applicant will perform planned internal and independent assessments to evaluate the application and effectiveness of management measures and implementation of programs related to facility safety. Periodic assessments of the CM Program will be conducted to determine the program's effectiveness and correct any identified deficiencies. The assessments will include review of documentation and system walk downs of the as-built facility. CM assessments will be performed, at a minimum, on an annual basis. The CM Program is further described in Section 11.1 of the LA (GLE, 2011a) and evaluated Section 11.3.1 of this SER.

#### 6.3.4.2.2 Procedures

The applicant's commitments regarding management measures are described in Section 6.2.3 and Chapter 11 of the LA (GLE, 2011a). The applicant will employ a hierarchy of policies, plans, and procedures to document management expectations and commitments as described in Section 11.4 of the LA (GLE, 2011a). Policies and plans are upper tier documents that define and describe senior management expectations and guidelines for safe operation of the proposed facility and compliance with State and Federal regulations, permits, and licenses. Procedures are used to ensure implementation of the requirements set forth in policies and plans. Activities involving licensed material or IROFS will be conducted in accordance with approved written procedures.

Procedures at the proposed facility will be categorized as either management control procedures or operating procedures/instructions. Chemical safety will be addressed in both types of procedures. General chemical process safety will be addressed in management control procedures, while task specific hazards and emergency response will be addressed in specific operating procedures and instructions.

The applicant's safety program design requires the establishment and maintenance of approved written procedures for Environmental Health and Safety (EHS) limitations and requirements to govern the safety aspects of operations. Requirements for procedure control and approval authorities will be documented.

#### 6.3.4.2.3 Training and Qualification

The applicant's commitments regarding management measures are described in Section 6.2.3 and Chapter 11 of the LA (GLE, 2011a). Training and qualification are described in Section 11.3 of the LA (GLE, 2011a). The objective of the training program is to ensure safe and efficient operation of the facility and ensure compliance with applicable regulatory requirements. Training requirements will be applicable to, but not restricted to, those personnel who have a direct relationship to the operation, maintenance, testing, or other technical aspects of plant operations. The responsibility for training will be shared between the ESH disciplines and line management.

Facility personnel will be trained to recognize and overcome safety hazards, such as chemical hazards, that may be encountered in the facility under normal or abnormal conditions. The odor threshold for HF is less than 1 part per million, and the irritating effects of HF are intolerable at concentrations well below those that could cause permanent injury or which could produce escape-impairing symptoms. Therefore, the facility will also adopt the "See and Flee" policy. This policy specifies that personnel immediately move away from the release area to a safe location. Facility employees will be trained in proper actions to take in response to a release.

Continuing or periodic retraining will be established, when applicable, to ensure personnel remain proficient. Periodic training will be conducted to ensure retention of knowledge and skills important to operations. The training may consist of periodic retraining exercises, instructions, or review of subjects as appropriate to maintain the proficiency of personnel assigned to the facility. Retraining is required due to facility modifications, procedure changes, and Quality Assurance (QA) Program changes resulting in new or changed information. The results of the retraining will be documented.

Training records will be maintained to support management information needs associated with personnel training, job performance, and qualifications. Training records will be retained in accordance with approved written record management procedures.

#### 6.3.4.2.4 Maintenance and Inspection

The applicant's commitments regarding management measures are described in Section 6.2.3 and Chapter 11 of the LA (GLE, 2011a). Maintenance is described in Section 11.2 of the LA (GLE, 2011a). The maintenance program will cover:

- Corrective Maintenance - Corrective maintenance refers to situations where repairs, replacements, or major adjustments, such as re-calibration occur. The applicant commits to promptly perform corrective actions to remediate unacceptable performance deficiencies in IROFS.
- Preventive Maintenance (PM) - PM will be performed on a periodic basis to prevent failures, facilitate performance, and maintain or extend the life of equipment. PM helps ensure IROFS are available and reliable. The bases for PM tasks will be developed through a review of manufacturer recommendations, available industry standards, and historical operating information, where available.
- Surveillance and Monitoring - The Surveillance and Monitoring Program provides a periodic check of the ability of IROFS to perform their design safety function when called upon to do so. Surveillances are in the form of performance checks, calibrations, tests, and inspections.
- Functional Testing - Functional testing of IROFS will be performed as appropriate, following initial installation, as part of periodic surveillance testing, and after corrective maintenance, PM, or calibration to ensure that the item is capable of performing the designed safety function when required. The applicant commits to perform functional tests in accordance with approved written procedures that define the method for the test and the required acceptable results. The results of the tests will be recorded and maintained.
- Preoperational Testing - The major objective of preoperational testing is to verify that IROFS, essential to the safe operation of the facility, are capable of performing their intended function. Initial startup testing will be performed beginning with the introduction of UF6 and ending with the startup. The purpose of initial startup testing is to ensure safe and orderly UF6 feeding, and to verify parameters assumed in the ISA.
- Post-Maintenance Testing (PMT) – PMT provides assurance that IROFS will perform their intended function following maintenance activities. PMT will be performed, with acceptable results, prior to returning the equipment to service.

The maintenance function will utilize a systems-based program to plan, schedule, track, and maintain records for maintenance activities. Maintenance procedures and instructions are described in Section 11.4 of the LA (GLE, 2011a). Key maintenance requirements for safety controls, such as calibration, functional testing, and replacement of specified components, are derived from the analyses described in the ISA Summary (GLE, 2011b).

#### 6.3.4.2.5 Chemical Process Safety Records

The applicant's commitments regarding management measures are described in Section 6.2.3 and Chapter 11 of the LA (GLE, 2011a). Records Management (RM) is described in Section 11.7 of the LA (GLE, 2011a). The Quality Assurance and Infrastructure Program Manager will be responsible for the RM Program during the design and construction phases of the project. The Infrastructure Program Manager will be responsible for the RM Program during the operations phase. The RM Program functions include directing the development, implementation, and maintenance of methods and procedures encompassing a RM Program, and assuring the laws, codes, standards, regulations, and company procedures pertaining to recordkeeping requirements are met.

The following are examples of chemical safety records that will be maintained by the applicant's RM Program:

- Chemical process safety procedures, plans, diagrams, charts, and drawings;
- Records pertaining to chemical process inspections, audits, investigations, and assessments;
- Records pertaining to chemical process incidents, unusual occurrences, or accidents;
- Chemical process safety reports and analyses; and
- Chemical process safety training.

#### 6.3.4.2.6 Audits and Assessments

The applicant's commitments regarding management measures are described in Section 6.2.3 and Chapter 11 of the LA (GLE, 2011a). Audits and Assessments are described in Section 11.5 of the LA (GLE, 2011a). Qualified facility personnel will perform periodic audits and assessments to verify safety during operations. Management performs assessments to verify the effective implementation of the safety program elements (chemical safety, radiation protection, nuclear criticality safety, industrial safety, security and emergency preparedness, and environmental protection), management measures, and QA Program elements. The applicant also commits to perform independent assessments of its safety program elements. The assessment scope includes compliance to procedures, conformance to regulations, and the overall adequacy of the safety program.

Formal scheduled safety audits of uranium enrichment and process support areas will be performed in accordance with approved written procedures. These audits will be performed to determine if operations conform to chemical safety, nuclear criticality safety, radiation protection, and industrial safety requirements. Industrial safety audits will be performed under the direction of the Industrial Safety Manager. The applicant will make provisions for reporting and corrective actions, where warranted, in accordance with the Corrective Action Program.

#### 6.3.4.2.7 Incident Investigation

The applicant's commitments regarding management measures are described in Section 6.2.3 and Chapter 11 of the LA (GLE, 2011a). Conduct of incident investigations is described in

Section 11.6 of the LA (GLE, 2011a). The applicant commits to maintain a system to identify, track, investigate, and implement corrective actions for abnormal events (unusual incidents). This system will be employed to investigate abnormal events that may occur during operation of the facility, determine the specific or generic root causes and generic implications, recommend corrective actions, and report to NRC as required by 10 CFR 70.50 and 10 CFR 70.74.

Incident investigations will be performed to assure that upset conditions are understood and appropriate corrective actions are identified and implemented to prevent recurrence. Management Measures will include documenting upset conditions in unusual incident reports (UIRs). UIRs are documented and the associated corrective actions tracked to completion.

Investigations will commence within 48 hours of an unusual event, or sooner, depending upon the safety significance of the event. The investigators are independent from the function involved in the investigation. Qualified internal or external investigators will be appointed to serve on investigating teams when required. The teams will include at least one process expert and at least one team member trained in root cause analysis.

The incident investigation process will contain a step in which proper closure documentation for the incident and corrective actions is provided to the licensing organization for distribution to the appropriate regulatory agencies, e.g., NRC, State of North Carolina, etc.

#### 6.3.4.3 IROFS and Management Measures Conclusion

The staff finds that for each process area or node in the ISA Summary (GLE, 2011b), the applicant has adequately identified the administrative and engineered controls and IROFS to prevent or mitigate chemical process risks at the proposed facility. Safety grading is described in the QAPD (GLE, 2011d). In the ISA Summary (GLE, 2011b), all IROFS and their safety grade are summarized at the end of each process area or node. The information the applicant provided, as described above, meets the acceptance criteria in Section 6.4.3.2(2) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

In the QAPD (GLE, 2011d), the applicant provided a detailed description of the graded approach to implement the performance requirements of each type of control for high and intermediate consequence events, as well as the management measures associated with each level. The staff finds that the applicant has provided a sufficient description of how IROFS and management measures will be graded and how such grading is commensurate with the reduction in risk that the IROFS are designed to achieve. The information that the applicant provided, as described above and in Chapter 11 of this SER, meets the acceptance criteria in Sections 3.4.3.2(2) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

In Section 6.2.3 of the LA (GLE, 2011a), the applicant committed to written procedures to ensure worker actions and other administrative controls provide the level of safety described in the safety basis. Detailed descriptions of each sub process are provided in the ISA Summary (GLE, 2011b). The staff finds that the applicant has provided a sufficient description of its procedures to ensure the reliable operation of engineered controls and administrative controls will be correctly implemented. The information the applicant provided, as described above and in Chapter 11 of this SER, meets the acceptance criteria in Section 6.4.3.2(3) of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

### 6.3.5 EMERGENCY MANAGEMENT

The applicant's emergency management program is discussed in more detail in Chapter 8 of this SER and in the applicant's RC&EP (GLE, 2011c). In Chapter 8 of the LA (GLE, 2011a), the applicant commits to developing the RC&EP (GLE, 2011c) in accordance with 10 CFR 70.22(i)(3) and 10 CFR 40.31(j), which meets the criteria in Chapter 8 of NUREG-1520 (NRC, 2002). Emergency management is further discussed in Chapter 8 of this SER.

The applicant maintains Memoranda of Understanding (MOUs) with offsite support organizations identified in the RC&EP (GLE, 2011c). The applicant will provide information to responding fire departments, that include the type of event (fire, chemical, spill, explosion, etc.) location, and hazard, in addition to any safety-related items (e.g., from the MSDS sheets). These organizations, in addition to the State of North Carolina Division of Emergency Management and the State of North Carolina Division of Environment and Natural Resources Radioactive Materials Section, reviewed the RC&EP (GLE, 2011c) pursuant to the requirement in 10 CFR 70.22(i)(4) and 10 CFR 40.31(j)(4).

UF<sub>6</sub> process systems in the proposed facility will generally operate at sub-atmospheric pressure. Exceptions will utilize systems designed per applicable pressure vessel codes and standards. This design feature is key to containment controls and preventing UF<sub>6</sub> leakage. Active pressure and temperature instrumentation monitors the integrity of appropriate systems and vessels. Chemical/toxic hazard detection includes process gas leak monitors and associated pressure instrumentation. If a process leak were to occur, air in-leakage would initially result causing a system pressure increase, which may typically be sensed by instrumentation and initiate applicable alarms, system isolation, and enable automated or manual shutdown of effected systems. Because UF<sub>6</sub> reacts with moisture in air to form UO<sub>2</sub>F<sub>2</sub> and HF, process gas leak monitors consist of HF detectors to sense HF concentrations and initiate alarms. With a UF<sub>6</sub> release outside the facility, personnel are trained in hazard recognition ("See and Flee" policy) and would detect the release because the resultant UO<sub>2</sub>F<sub>2</sub> would be visible and the presence of HF would easily be detected due to its strong odor even below hazardous concentrations. The staff reviewed the ISA Summary (GLE, 2011b) and determined that these actions are consistent with the accident sequences and mitigating IROFS identified in the ISA Summary (GLE, 2011b) and are consistent with the actions described in Chapter 8 of NUREG-1520 (NRC, 2002).

The staff finds that the applicant has provided reasonable assurance that measures to mitigate the consequences of accident sequences identified in the ISA Summary (GLE, 2011b) are consistent with actions described in Chapter 8 of NUREG-1520 (NRC, 2002). The information the applicant provided, including interaction of chemicals with the atmosphere as described above, meets the acceptance criteria in Section 6.4.3.1(2) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable.

### 6.3.6 BASELINE DESIGN CRITERIA

In Section 3.2.4.4 of the LA (GLE, 2011a), the applicant commits to the BDC in 10 CFR 70.64, and provides design basis information for chemical process safety IROFS in the LA (GLE, 2011a) and ISA Summary (GLE, 2011b). The regulations in 10 CFR 70.64(a)(5) state the following, with respect to chemical protection:

"Chemical protection. The design must provide for adequate protection against chemical risks produced from licensed material, facility conditions which affect the safety of licensed material, and hazardous chemicals produced from licensed material."



The main chemicals of concern at the proposed facility will be UF<sub>6</sub> and its reaction products formed when it reacts with water (see Section 6.3.1.3 of this SER). Descriptions of the design and safety features can be found in Chapters 1 and 6 of the LA (GLE, 2011a) and Chapter 4 of the ISA Summary (GLE, 2011b). The applicant will have IROFS in place to prevent various high and intermediate consequence accidents and to mitigate consequences to the public and workers. The applicant further identified additional safety controls that will constitute defense-in-depth in the facility's design. In describing the application of the chemical protection to the BDC, the applicant proposed no facility-specific relaxations or additions to the BDC.

The staff reviewed the applicant's design of the proposed facility contained in the ISA Summary (GLE, 2011b) and Chapters 1 and 6 of the LA (GLE, 2011a). The uranium enrichment process is a physical separations process that separates the U<sup>235</sup> isotope from the U<sup>238</sup> isotope based on mass difference. The specific uranium enrichment process utilized by the proposed facility utilizes lasers tuned to specific frequencies to selectively excite UF<sub>6</sub> gas molecules to enable separation of the U<sup>235</sup> isotope in UF<sub>6</sub> feed stock. The process is generally performed at sub-atmospheric pressure. Therefore, any process leak would result in the in-leakage of air into the system as the system pressure increased to atmospheric pressure. Under normal process temperatures, the gaseous UF<sub>6</sub> will desublime directly into the solid phase as the system approaches atmospheric pressure. The physical behavior of UF<sub>6</sub> and its reaction products are such that the majority of the uranium bearing material is likely to accumulate near the process breach. Furthermore, the applicant will have IROFS in place and implement defense-in-depth practices as part of the design of the facility. Based on the operational mode of the laser enrichment system and the applicant's proposed safety strategy, the staff concludes that the proposed design basis will provide adequate protection against chemical risks.

The applicant will use internationally recognized codes and standards as part of the design of the proposed facility. The licensed material will be stored and transported in cylinders compliant with ANSI N14.1 (ANSI, 2001). These cylinders serve as the primary containment for UF<sub>6</sub>. Licensed material in the liquid state will be contained in autoclaves and piping. The autoclaves will be designed to the American Society of Mechanical Engineers (ASME) standard, "Boiler and Pressure Vessels Code, Section VIII," (ASME, 2004a) and will act as secondary containment. All process piping will meet the appropriate ASME code (i.e., ASME B31.3, "Process Piping," 2004 (ASME, 2004b)). The applicant committed to using materials of construction that are compatible with UF<sub>6</sub> and HF to ensure structural integrity of process equipment.

In Section 3.2.4.4 of the LA (GLE, 2011a), the applicant commits to the BDC in 10 CFR 70.64, and provides design basis information for chemical process safety IROFS in the LA (GLE, 2011a) and ISA Summary (GLE, 2011b). In the ISA Summary (GLE, 2011b), the applicant describes its preference for passive controls over engineered and administrative controls, as well as good engineering and defense-in-depth practices designed to reduce the hazards from chemical inventories. The applicant provided a comprehensive evaluation of the high and intermediate consequence accident scenarios in Chapter 4 of the ISA Summary (GLE, 2011b). No relaxations of the BDC were requested. The applicant also described how the chemical process safety BDC were applied in establishing design principles, features, and control systems. Based on the above, the staff concludes that the information that the applicant provided and the applicant's proposed design meets the acceptance criteria in Sections 6.4.3.3(1), (2), and (3) of NUREG-1520 (NRC, 2002), provides for adequate protection against chemical risks produced from licensed material, facility conditions that affect the safety of licensed material, and hazardous chemicals produced from licensed materials, and meets the requirements of 10 CFR 70.64(a)(5).

## 6.4 EVALUATION FINDINGS

The staff evaluated the application using the criteria in NUREG-1520 (NRC, 2002) and NUREG-1513 (NRC, 2001). Based upon review of Chapter 6 of the LA (GLE, 2011a) and ISA Summary (GLE, 2011b), NRC staff concludes that the applicant has described and assessed accident consequences that can result from the handling, storage, or processing of licensed materials that can potentially have significant chemical consequences and effects. In its ISA, the applicant prepared a hazard analysis that identifies and evaluates those chemical process hazards and potential accidents and established safety controls providing reasonable assurance of safe facility operations. To ensure that the performance requirements of 10 CFR 70, Subpart H, are met, the applicant provided controls to ensure that IROFS are maintained available and reliable to perform their safety-related functions when needed. As part of the review, the staff reviewed a representative sample for the safety controls and the applicant's plan for managing chemical process safety. The staff finds reasonable assurance that the applicant identified chemical hazards and accident sequences and credited IROFS sufficient to meet the performance requirements of 10 CFR 70.61, Subpart H, consistent with the acceptance criteria in Section 6.4 of NUREG-1520 (NRC, 2002).

The staff concludes that the applicant's plan for managing chemical process safety and chemical process safety controls meet the requirements of 10 CFR 70 and provides reasonable assurance that the public health and safety, and the environment, will be protected.

## 6.5 REFERENCES

(ANSI, 2001) American National Standards Institute (ANSI). ANSI N14.1, "Nuclear Materials: Uranium Hexafluoride – Packaging for Transport," 2001.

(ASME, 2004a) American Society of Mechanical Engineers (ASME). ASME Boiler and Pressure Vessels Code, Section VIII, "Pressure Vessels," 2004.

(ASME, 2004b) American Society of Mechanical Engineers (ASME). ASME B31.3, "Process Piping," 2004.

(GLE, 2011a) General Electric-Hitachi Global Laser Enrichment (GLE). "GE-Hitachi Global Laser Enrichment, LLC Commercial Facility License Application," Revision 6. 2011.

(GLE, 2011b) General Electric-Hitachi Global Laser Enrichment (GLE). "Integrated Safety Analysis Summary for the GE-Hitachi Global Laser Enrichment, LLC Commercial Facility," Revision 4. 2011.

(GLE, 2011c) General Electric-Hitachi Global Laser Enrichment (GLE). "Radiological Contingency and Emergency Plan for the GE-Hitachi Global Laser Enrichment, LLC Commercial Facility," Revision 3. 2011.

(GLE, 2011d) General Electric-Hitachi Global Laser Enrichment (GLE). "Quality Assurance Program Description for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility," Revision 7. 2011.

(NRC, 1988) U.S. Nuclear Regulatory Commission (NRC). NUREG-1140, "A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees," 1988.

(NRC, 1997a) U.S. Nuclear Regulatory Commission (NRC). NUREG-1601, "Chemical Process Safety at Fuel Cycle Facilities." 1997.

(NRC, 1997b) U.S. Nuclear Regulatory Commission (NRC). NUREG/CR-6331, "Atmospheric Relative Concentrations in Building Wakes," Revision 1. 1997.

(NRC, 1997c) U.S. Nuclear Regulatory Commission (NRC). NUREG/CR-6481, "Review of Models Used for Determining Consequences of UF<sub>6</sub> Release," Revision 1, 1997.

(NRC, 1998) U.S. Nuclear Regulatory Commission (NRC). NUREG/CR-6410, "Nuclear Fuel Cycle Accident Analysis Handbook." 1998.

(NRC, 2001) U.S. Nuclear Regulatory Commission (NRC). NUREG-1513, "Integrated Safety Analysis Guidance Document." 2001

(NRC, 2002) U.S. Nuclear Regulatory Commission (NRC). NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility." 2002.

(NRC, 2007) U.S. Nuclear Regulatory Commission (NRC). NUREG-1887, "RASCAL 3.0.5: Description of Model and Methods," 2007.



## **7.0 FIRE SAFETY**

The purpose of this review is to determine with reasonable assurance that General Electric-Hitachi Global Laser Enrichment LLC (GLE or the applicant) has designed a facility that provides adequate protection against fires and explosions that could affect the safety of licensed material and hazardous chemicals and thus present an increased health risk to facility workers and the public. The review should also establish that the application has considered radiological and chemical consequences of fires and will institute suitable safety controls to protect workers, the public, and the environment.

### **7.1 REGULATORY REQUIREMENTS**

The regulatory basis for the fire safety review is the general and additional contents of application as required by Title 10 *Code of Federal Regulations* (CFR) 30.33, 40.32, 70.22 and 70.65. In addition, the fire safety review should focus on providing reasonable assurance that the operation of the facility will be in compliance with 10 CFR 70.61, 70.62, and 70.64, as applicable. The regulations in 10 CFR 70.61, 70.62, and 70.64 describe performance requirements for fuel cycle facilities, the development of a safety program based on an integrated safety analysis (ISA), and requirements for new facilities.

### **7.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA**

The acceptance criteria the U.S. Nuclear Regulatory Commission (NRC) uses for review of fire safety are outlined in Sections 7.4.3.1 through 7.4.3.5 of the "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," NUREG-1520 (NRC, 2002). All of Chapter 7 of NUREG-1520 (NRC, 2002) is applicable to the License Application (LA) (GLE, 2011a) and ISA Summary (GLE, 2011b) review of the proposed facility. The following section, "Staff Review and Analysis," in this Safety Evaluation Report (SER) provides details on the acceptance criteria and describes how the applicant satisfies them.

### **7.3 STAFF REVIEW AND ANALYSIS**

This section addresses the staff's review of the facility fire protection, including fire safety management measures, fire hazards analysis (FHA), facility fire protection, process fire safety, and fire safety and emergency response, as presented in the LA (GLE, 2011a), the ISA Summary (GLE, 2011b), and the applicant's Fire Hazard Analysis (FHA) (GLE, 2010a).

The proposed facility and its fire safety program were reviewed to determine applicability and level of compliance with the National Fire Protection Association (NFPA) standard NFPA 801, "Standard for Fire Protection for Facilities Handling Radioactive Materials" (NFPA, 2008a), and the applicable standards referenced within. The staff finds that the use of these consensus codes and standard to be in accordance with the guidance in Section 7.4.3 of NUREG-1520 (NRC, 2002) in regard to the use of nationally recognized codes and standards that may be used to measure reasonable assurance of fire safety. Therefore, the staff considers the use of

the above codes and standards appropriate to satisfy the requirements of 10 CFR 70.64(a), Baseline Design Criterion 3, "Fire Protection."

### 7.3.1 FIRE SAFETY MANAGEMENT MEASURES

Fire safety management measures are described by the applicant in Section 7.1 of the LA (GLE, 2011a). These measures include a reference to fire protection Items Relied on for Safety (IROFS) defined in the ISA Summary (GLE, 2011b), responsibilities for management policy and direction and the various aspects of the fire protection program including:

- Fire Prevention Program;
- Inspection, Testing, and Maintenance;
- Control of Impairments;
- Onsite Emergency Response Organizations;
- Offsite Emergency Response Organizations; and
- Pre-incident Planning.

#### 7.3.1.1 Fire Safety Management and Direction

In Section 7.1.2 of the LA (GLE, 2011a), the applicant described the management policy and direction for the proposed facility. The primary responsibility for fire protection resides with the Environmental, Health, and Safety (EHS) Organization. The EHS Manager is assisted by the Fire Safety Manager in accordance with the fire safety program. The Fire Safety Manager position is described in Section 2.2.9.7 of the LA (GLE, 2011a) as administratively independent of Operations and as having the authority to shut down operations when imminent hazardous fire safety conditions are identified. Designated responsibilities of the Fire Safety Manager are also listed. The Fire Safety Manager shall have as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years experience in fire protection. Engineering support staff available to the Fire Safety Manager shall include a licensed fire protection engineer with a minimum of seven years fire protection related experience.

The Facility Safety Review Committee (FSRC) reviews issues affecting the safety of the proposed facility operations, including fire safety.

#### 7.3.1.2 Fire Protection Program

In Section 7.1.3 of the LA (GLE, 2011a), the applicant described the fire protection program for the proposed facility. The fire protection program complies with the criteria in NFPA 801 (NFPA, 2008a) to ensure fire protection requirements of applicable NFPA codes or other nationally recognized codes and standards are adequately implemented. The fire protection program includes the following elements:

- Administrative controls for changes in processes, equipment, or facilities as well as fire protection and management review of planned activities and modifications to ensure that building design and operating features are maintained in an analyzed condition.
- A fire prevention program which includes requirements for conducting documented facility inspections; description of general housekeeping practices and control of transient combustibles; control of flammable and combustible liquids, gases, and oxidizers in accordance with applicable NFPA codes and standards; control of ignition sources, including hot work in accordance with NFPA 51B, “Standard for Fire Prevention During Welding, Cutting, and Other Hot Work” (NFPA, 2009a); fire reports including investigations and corrective actions in accordance with NFPA 901, “Standard Classifications for Incident Reporting and Fire Protection Data” (NFPA, 2006a); fire prevention surveillance in accordance with NFPA 601, “Standard for Security Services in Fire Loss Prevention” (NFPA, 2005a); restriction of smoking to designated areas; and protecting construction, demolition and renovating activities in accordance with NFPA 241, “Standard for Safeguarding Construction, Alteration, and Demolition Operations” (NFPA, 2004a).
- Inspection, testing, and maintenance activities are performed in accordance with applicable codes and standards such as NFPA 25, “Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems” (NFPA, 2008b) for water based systems.
- Fire protection impairment procedures include identification, tagging, and tracking of impaired equipment; identification of personnel to be notified; and determination of needed compensatory fire protection and fire prevention measures. Section 7.1.3.5 of the LA (GLE, 2011a) lists four different types of impairments (sprinkler system, fire alarm, fire barrier, and water supply) and the potential compensatory measures that may be applied to each type of impairment.
- Pre-fire plans are developed in accordance with NFPA 801 (2008a) and NFPA 1620, “Recommended Practice for Pre-Incident Planning” (NFPA, 2003). Once developed, these plans will be provided to onsite and offsite emergency response organizations.

### 7.3.1.3 Fire Protection Quality Assurance Measures

All engineered fire protection IROFS will be provided under Appendix A of the applicant’s Quality Assurance Program Description (QAPD) (GLE, 2011c) as an alternative to the quality assurance measures used for other IROFS. These alternative quality assurance measures are necessary as fire protection equipment is not reasonably available under the proposed management measures used for other IROFS. Quality assurance measures are further discussed in Chapter 11 of this SER and Appendix A to Chapter 11 of this SER. Appendix A to the QAPD (GLE, 2011c) prescribes design, procurement, installation, acceptance, inspections, testing and maintenance to be in accordance with applicable NFPA or other national and international codes and standards. These codes and standards are consensus standards widely accepted by industry and government to provide an acceptable level of fire safety to ensure that IROFS will be reliable and available when needed. These codes and standards also require key fire protection system components to be listed or approved by a nationally recognized testing laboratory such as Underwriters Laboratories (UL) or Factory Mutual Research Corporation (FMRC). These testing laboratories are accredited by the Nationally

Recognized Testing Laboratories Program under the Occupational Safety and Health Administration. Manufacturers that are certified by UL or FMRC are capable of supplying products that meet UL or FMRC established testing criteria for attributes that are important to component functionality and reliability. Based on the performance history of certified components, the NRC staff considers such components to be of adequate quality to be used in fire protection systems for nuclear fuel cycle facilities.

The use of UL and FMRC approved and/or listed components is consistent with fire protection practices for commercial nuclear power reactors licensed under 10 CFR 50 and the guidance in Regulatory Guide 1.189, "Fire Protection for Nuclear Power Plants" (NRC, 2009), which specifically exempts fire protection systems from the scope of 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," unless the licensee has committed to include such systems under the plant's Appendix B program.

Fire protection IROFS will also be in conformance with all applicable management measures and the reporting requirements of 10 CFR Parts 70 and 21.

#### 7.3.1.4 Fire Safety Management Measures Conclusions

Based on the information above, the staff concludes that the application is consistent with the acceptance criteria in Section 7.4.3.1 of NUREG-1520 (NRC, 2002) because the LA (GLE, 2011a) reflects a commitment to ensure that IROFS as identified in the ISA Summary (GLE, 2011b) are available and reliable. In addition, the facility maintains fire safety awareness among employees, controls transient ignition sources and combustibles, and maintains a readiness to extinguish or limit the consequences of fire. The LA (GLE, 2011a) identifies a senior-level manager who has the authority and staff to ensure that fire safety receives appropriate priority. The LA (GLE, 2011a) documents the fire safety management measures in sufficient detail to identify their relationship to and functions for, normal operations; anticipated events; and accident safety. Therefore, the staff concludes that the facility meets the requirements of 10 CFR 70.22, 70.61, 70.62, 70.64, and 70.65 as they pertain to fire safety management measures and is, therefore, acceptable.

### 7.3.2 FIRE HAZARDS ANALYSIS

In Section 7.2 of the LA (GLE, 2011a), the applicant described the FHA (GLE, 2010a) conducted for the proposed facility. An FHA (GLE, 2010a) was performed at the beginning of the facility design process and is revised as necessary when significant changes are made to ensure that the fire prevention and protection requirements have been evaluated per NFPA 801 (NFPA, 2008a). The FHA (GLE, 2010a) evaluation considers:

- Facility specific design, layout, and operating needs;
- Acceptable means for separation and control of hazards;
- The control or elimination of ignition sources;
- Suppression of fires; and
- Storage and use of radioactive materials under fire or explosion conditions.



The FHA (GLE, 2010a) is a part of the ISA and evaluates credible fire scenarios to establish the radiological and toxic chemical consequences of an unmitigated fire. From these scenarios, the

FHA (GLE, 2010a) and ISA also describe and evaluate preventive and mitigative controls from which the fire protection IROFS are selected.

The FHA (GLE, 2010a) was prepared in accordance with the guidance provided in Annex B of NFPA 801 (NFPA, 2008a).

Fire hazards at the operational/process level are analyzed with respect to potential accident sequences, likelihoods, consequences, and resultant risk. Fire/explosion-related accident sequences with the potential to create high or intermediate consequences as defined in 10 CFR 70.61 are controlled by the application of IROFS.

Sections of the FHA (GLE, 2010a) that support the ISA Summary (GLE, 2011b) are evaluated in Section 7.3.4 of the non-public Safety Evaluation Report (SER).

Based on the above, the staff concludes that the application is consistent with the guidance in Section 7.4.3.2 of NUREG-1520 (NRC, 2002) because the applicant, in its FHA (GLE, 2010a), developed bounding credible fire scenarios for each fire area containing significant fire loading, and then assessed the consequences of an unmitigated fire. The FHA (GLE, 2010a) includes a description, by fire area, of the fuel loading, fire scenarios, methods of consequence analysis, the potential consequences, and a description of the mitigative controls. The FHA (GLE, 2010a) was used to identify possible fire initiators and accident sequences leading to radiological and chemical consequences resulting from interaction with special nuclear material. Therefore, the staff concludes that the facility meets the requirements of 10 CFR 70.22, 70.61, 70.62, 70.64, and 70.65 as they pertain to fire hazards analysis and is, therefore, acceptable.

### 7.3.3 FACILITY DESIGN

In Section 7.3 of the LA (GLE, 2011a), the applicant described the fire protection design for the proposed facility. The Operations Building is constructed of non-combustible materials meeting the requirements of Type IA or IB as described in Chapter 6 of the "International Building Code" (IBC) (ICC, 2006). The Operations Building is a mixed occupancy of Factory Industrial (F-1) and High Hazard (H-3) as classified by Chapter 3 of the IBC (ICC, 2006). The High Hazard H-3 fire areas will be of NFPA 220, "Standard on Types of Building Construction" (NFPA, 2009b) Type I (442 or 332).

Type IA construction requires structural frame and exterior and interior bearing wall elements to meet the requirements for 3-hour fire rated construction. Type IB construction requires the structural frame and exterior and interior bearing walls to meet the requirements of 2-hour fire-rated construction.

The Operations Building is subdivided into separate fire areas as determined by the FHA (GLE, 2010a). The fire barriers meet the minimum requirements of the IBC (ICC, 2006) for sprinklered and unsprinklered occupancy categories. The minimum fire resistance of sprinklered and unsprinklered bearing walls is 3-hours. Openings and penetrations within the envelope of each fire area are sealed with protective assemblies consistent with the designated fire rating in accordance with NFPA 221, "Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls" (NFPA, 2009c). Door openings are protected with fire rated doors, frames, and

hardware in accordance with NFPA 80, "Fire Door Openings and Other Opening Protectives" (NFPA, 2007a). Fire dampers are provided where ventilation ductwork penetrates fire rated barriers in accordance with NFPA 90A, "Installation of Air-Conditioning and Ventilating Systems" (NFPA, 2009d).

The interior surface of the Operations Building is designed to meet the requirements of Sections 5.8.1 and 5.8.2 of NFPA 801 (NFPA, 2008a). The interior surface finish of walls and ceilings in process and storage areas are Class A in accordance with NFPA 255, "Surface Method of Test of Surface Burning Characteristics of Building Materials" (NFPA, 2006b). The floor finish is Class I in accordance with NFPA 253, "Standard method of Test of Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source," (NFPA, 2006c).

The Solid Waste Storage Buildings (SWSBs) are used for storage of solid, radioactive, or industrial waste, generated and packaged for transport at the Operations Building. The SWSBs are constructed of noncombustible materials meeting the requirements of NFPA 801 (NFPA, 2008a) for fire resistant or noncombustible construction, typically NFPA 220 (NFPA, 2009b) Type I or Type II. The SWSBs are not subdivided into separate fire areas. Each building is considered a separate fire area. The interior surface finish of walls and ceilings in process and storage areas are Class A in accordance NFPA 255 (NFPA, 2006b). The floor finish is Class I in accordance with NFPA 253 (NFPA, 2006c).

Electrical systems in the Operations Building and in the SWSBs are designed in accordance with NFPA 70, "National Electric Code" (NFPA, 2008c). Switchgear, motor control centers, panel boards, uninterruptible power supply systems, and control panels are mounted in metallic enclosures and contain only small amounts of combustible material. Cable trays and conduits are metallic and the cables in cable trays meet the requirements of UL 1277, "Electrical Power and Control Tray Cables with Optional Optical-Fiber Members" (UL, 2001).

In the Operations Building and the SWSBs, life safety features (such as occupancy separation, means of egress, illumination and exit marking and signage, etc.) meet the requirements of NFPA 101, "Life Safety Code" (NFPA, 2009e) and the IBC (ICC, 2006). Rated fire barriers (in the Operations Building) are in accordance with NFPA 101 (NFPA, 2009e) and the FHA (GLE, 2010a) and are provided to prevent unacceptable fire propagation. Security requirements will not prevent safe means of emergency egress as required by NFPA 101 (2009e) and the IBC (ICC, 2006). The applicant's Physical Security Plan (GLE, 2010b) addresses the establishment of permanent and temporary controlled access areas.

In the Operations Building, ductwork, accessories, and support systems for ventilation, filtration, and containment are designed and tested in accordance with NFPA 801 (NFPA 2008a); NFPA 90A (NFPA, 2009d); NFPA 90B, "Installation of Warm Air Heating and Air-conditioning Systems" (NFPA, 2009f); and NFPA 91, "Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids" (NFPA, 2004b). Where shutdown of the ventilation system is not appropriate, fire/smoke dampers are not required for ventilation duct penetrations. Alternative means of protecting against fire propagation include fire-rated construction wrapping or encasing the duct for 3.05 meters (10 feet) on either side of the rated barrier. The rated construction encasing the duct will match the rating of the fire barrier penetrated. High-efficiency particulate air (HEPA) filtration systems and high-efficiency gas absorption systems are part of the confinement function of the monitored central exhaust system. HEPA filters meet the requirements of UL 900, "Test performance of Air Filter Units" (UL, 2004); and UL 586, "High-Efficiency Particulate Air Filter Units" (UL, 2009). The HEPA filters also meet the spot flame resistance of American Society of Mechanical Engineers

(ASME) AG-1, "Code on Nuclear Air and Gas Treatment" (ASME, 2009). Smoke control systems are designed in accordance with the IBC (ICC, 2006).

Operations Building control, computer, and telecommunications rooms meet the applicable requirements of NFPA 75, "Standard for the Protection of Information Technology Equipment" (NFPA, 2009g).

Water that may discharge from the firewater system or from firefighting activities (water runoff) that could be contaminated with radioactive materials will be confined in accordance with NFPA 801 (NFPA, 2008a) and will be stored, sampled, and treated, if necessary. Water runoff from the Uranium Hexafluoride (UF<sub>6</sub>) Cylinder Pads will be collected in the monitored retention basin.

Where water-based fire suppression is undesirable due to nuclear criticality safety concerns, redundant fire protection features are provided to ensure effective mitigation, including clean agent suppression, automatic detection, fire barriers, ignition controls, combustible loading controls, and emergency response activities. When called upon, the fire brigade or responding offsite fire departments typically extinguish fire in these areas with the use of portable and wheeled dry chemical fire extinguishers.

The lightning protection system for the facility is in accordance with applicable portions of NFPA 780, "Standard for the Installation of Lightning Protection Systems" (NFPA, 2008d) or other nationally recognized codes and standards.

Wildland fire protection was assessed in the FHA (GLE, 2010a) in accordance with applicable portions of NFPA 1143, "Standard for Wildland Fire Management" (NFPA, 2009h) and NFPA 1144, "Standard for Reducing Structure Ignition Hazards from Wildfire" (NFPA, 2008e). The FHA (GLE, 2010a) determined that the wildland fire threat for the GLE site is a moderate hazard and that additional fire protection measures are not required. In addition, the applicant performed an exposure analysis of the Operations Building and the two SWSBs in the FHA (GLE, 2010a) and determined that there were no wildland areas that could threaten either type of building.

Fire risk from a buried natural gas line was also assessed in the FHA (GLE, 2010a) and is evaluated by the staff in Section 7.3.4 of the (non-public) SER.

Based on the above, the staff concludes that the application is consistent with the guidance in Section 7.4.3.3 of NUREG-1520 (NRC, 2002) because the application documents the fire safety considerations used in the general design of facility features. These features include building construction, fire area determination, electrical installation, fire safety, ventilation, drainage and lightning protection. Also considered in the application in regard to fire protection design were criticality concerns, environmental concerns, physical security concerns, compliance with the baseline design criteria (through compliance with NFPA 801 (NFPA, 2008a) and other appropriate fire codes), and defense-in-depth. Therefore, the staff concludes that the facility meets the requirements of 10 CFR 70.22, 70.61, 70.62, 70.64, and 70.65 as they pertain to facility design in regard to fire protection and is, therefore, acceptable.

#### 7.3.4 PROCESS FIRE SAFETY

Process hazards as related to fire safety are described in Section 7.4 of the LA (GLE, 2011a). Event descriptions are described in the ISA Summary (GLE, 2011b) and the FHA (GLE, 2010a). The major process material of concern is UF<sub>6</sub> which can react with hydrocarbon-based

lubricating oils at high temperatures. UF<sub>6</sub> is not flammable or combustible, but can be released if UF<sub>6</sub> cylinders are exposed to heat or fire such as from an external cylinder transporter fire.

A major interior fire hazard of concern is from flammable process gases. Hydrogen is generated at battery charging stations throughout the facility. Natural or mechanical ventilation will be provided in the charging stations to ensure that hydrogen and process gas concentrations do not exceed 25 percent of the Lower Explosive Limit.

A fire hazard both internal and external is transient combustibles such as trash, construction materials, and personal protective equipment (PPE). Such transient combustible fires could threaten UF<sub>6</sub> cylinders as well as dispersible radioactive materials.

Fire related process hazards are evaluated in more detail by the staff in the non-public section of this SER.

The staff concludes that the LA (GLE, 2011a) is consistent with the acceptance criteria in Section 7.4.3.4 of NUREG-1520 (NRC, 2002) in regard to process fire safety because, in areas that have fire hazards that may threaten licensed material, the applicant identified the hazardous chemicals, processes, and design standards used to ensure fire safety. These fire-related process hazards are evaluated in more detail in the non-public section of the SER. Therefore, the staff concludes that the facility meets the requirements of 10 CFR 70.22, 70.61, 70.62, 70.64, and 70.65 as they pertain to facility fire protection design and is, therefore, acceptable.

### 7.3.5 FIRE PROTECTION AND EMERGENCY RESPONSE

#### 7.3.5.1 Fire Protection Systems

##### 7.3.5.1.1 Firewater Supply System

The existing site firewater supply and distribution system consists of a 1.14 million liter (300,000 gallon (gal)) (379,000 liters (100,000 gal) devoted to fire)) water storage tank and a water reservoir containing about 2.55 million liters (675,000 gal). The water is distributed throughout an underground 25-centimeter (cm) (10-inch) looped gridded firewater distribution system, supplying water to existing facilities and hydrants, via 5680 liters per minute (lpm) (1,500 gallons per minute (gpm) electric and diesel fire pumps.

The fire water supply system for the proposed facility is installed, in accordance with NFPA 801 (NFPA, 2008a), Section 6.2, with fire pump arrangement and installation meeting the requirements of NFPA 20, "Installation of Stationary Pumps for Fire Protection" (NFPA, 2007b). The minimum firewater flow and volume required is 5680 lpm (1,500 gpm) for four hours (1.36 million liters (360,000 gal)).

##### 7.3.5.1.2 Fire Detection and Alarm Systems

Automatic fire detection is provided for fire areas in accordance with the requirements of the IBC (ICC, 2006), Section 907; NFPA 101 (NFPA, 2009e), Section 40.3.4.1; and NFPA 801 (NFPA, 2008a), Section 6.8. The fire alarm system is designed and installed per the requirements of NFPA 72, "National Fire Alarm Code" (NFPA, 2007c).

Manual pull stations are located at exits and throughout the facility to allow occupants to initiate an alarm. Area detection is provided as well as detection for automatic closing doors, fire/smoke damper operation, and air handler shutdown. Suppression system activation is also monitored by the fire alarm system.

#### 7.3.5.1.3 Automatic Suppression Systems

Automatic sprinkler protection will be provided in the Operations Building and the SWSBs. The sprinkler systems are designed as ordinary hazard, Group 2 systems and have a design density of 6.11 lpm per meter<sup>2</sup> (m<sup>2</sup>) (0.15 gpm per foot<sup>2</sup> (ft<sup>2</sup>)) over the most hydraulically remote 372 m<sup>2</sup> (4,000 ft<sup>2</sup>) area as per NFPA 13, "Installation of Sprinkler Systems" (NFPA, 2007d).

In those areas where automatic sprinkler systems are not provided, other systems will be considered. These systems are identified in the non-public portion of Section 7.4 of this SER.

#### 7.3.5.1.4 Standpipes

Class I standpipe systems are installed in the Operations Building in accordance with NFPA 14, "Standard for the Installation of Standpipe and Hose Systems" (NFPA, 2007e) in each required exit stairway. Hose connections for use by emergency personnel are located at each intermediate landing.

#### 7.3.5.1.5 Portable Extinguishers

Fire extinguishers are provided throughout the Operations Building in accordance with NFPA 10, "Portable Fire Extinguishers" (NFPA, 2007f). In areas where moderator control is considered, carbon dioxide and dry chemical extinguishers are provided so that an uncontrolled moderator source is not created.

#### 7.3.5.2 Emergency Response Capability

The facility will have an onsite fire brigade which meets the NFPA 600, "Standard on Industrial Fire Brigades" (NFPA, 2005b) requirements for interior structural fire fighting. Documented training and drills will be conducted. Appropriate equipment, including portable communications, lighting, thermal protective clothing and protective equipment is available in sufficient quantities and sizes to fit each fire brigade member expected to enter hot or warm fire zones. The fire brigade will have at least five staff members available at all times.

For fires that propagate beyond the incipient stage, response agreements are in place to request emergency offsite assistance, when needed. The New Hanover County Fire Department is a fully equipped fire department incorporating nearby volunteer companies, which would respond with pumper engines and adequate resources, if requested. The travel time from the site to the nearest responding station is about 5 minutes (ESCI, 2009).

#### 7.3.5.3 Fire Protection and Emergency Response Conclusion

Based on the above, the staff concludes that the application is consistent with the acceptance criteria in Section 7.4.3.5 of NUREG-1520 (NRC, 2002) because the application describes the NFPA codes and standards used for the design of the fire water system and the detection and alarm systems. The application also describes the onsite manual fire suppression capabilities including an onsite fire brigade and offsite fire departments capable of prompt response. Also

described are the facility standpipe system and portable fire extinguishers. The identification of IROFS in the ISA Summary (GLE, 2011b) is evaluated in Section 7.3.4 of the non-public SER. Therefore, the staff concludes that the facility meets the requirements of 10 CFR 70.22, 70.61, 70.62, 70.64, and 70.65 as they pertain to fire protection and emergency response and is, therefore, acceptable.

## **7.4 EVALUATION FINDINGS**

The staff's review has verified that the applicant: (1) provides sufficient information to satisfy the intent of 10 CFR Part 70 requirements related to the overall safety program; and (2) is consistent with the fire safety criteria of NUREG-1520 (NRC, 2002). The staff concludes that:

- The applicant has established a fire protection function meeting the acceptance criteria in Chapter 7 of NUREG-1520 (NRC, 2002). The function includes a Facility Safety Review Committee responsible for integrating modifications to the facility and a fire safety manager responsible for day-to-day program implementation. Fire prevention, inspection, testing, and maintenance of fire protection systems and the qualification, drills, and training of facility personnel are in accordance with applicable NFPA codes and standards.
- The applicant has conducted risk analyses in accordance with NFPA 801 (2008a). The FHA (GLE, 2010a) identified credible fire scenarios that bound the fire risk. The ISA used these scenarios and identified fire protection IROFS (in particular, automatic fire suppression in process areas, combustible material controls, and fuel limits for cylinder transporters). A memorandum of understanding with the fire department documents the required assistance and the annual exercises. Procedures are in place to allow the fire department efficient access to process areas during fire emergencies. Worker egress is designed and maintained in accordance with NFPA 101 (NFPA, 2009e).
- The applicant has demonstrated that it incorporated appropriate fire safety considerations in the design of its facilities. The applicant has also demonstrated that the facility has appropriate active fire protection systems.
- The staff concludes that the applicant's submittals provide sufficient information in accordance with requirements of 10 CFR 30.33 and 10 CFR 40.32, both entitled "General Requirements for Issuance of Specific Licenses," and those of 10 CFR 70.22 and 10 CFR 70.65 on potential fire hazards, consequences, and required controls for the proposed processes. The NRC staff determined that the applicant demonstrated compliance with the performance requirements of 10 CFR 70.61 for fire protection related to postulated accident scenarios. The design that the applicant proposes also satisfies the requirements of 10 CFR 70.64(a)(3) and the defense-in-depth requirements of 10 CFR 70.64(b) (as required).

## **7.5 REFERENCES**

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(NFPA, 2007b) National Fire Protection Association (NFPA). NFPA 20, "Installation of Stationary Pumps for Fire Protection," 2007.

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(NFPA, 2007f) National Fire Protection Association (NFPA). NFPA 10, "Portable Fire Extinguishers," 2007.

(NFPA, 2008a) National Fire Protection Association (NFPA). NFPA 801, "Standard for Fire Protection for Facilities Handling Radioactive Materials", 2008.

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(NFPA, 2008d) National Fire Protection Association (NFPA). NFPA 780, "Standard for the Installation of Lightning Protection Systems, 2008.

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## **8.0 EMERGENCY MANAGEMENT**

### **8.1 INTRODUCTION**

The purpose of reviewing the General Electric-Hitachi Global Laser Enrichment LLC (GLE) Radiological Contingency and Emergency Plan (RC&EP) (GLE, 2011) is to determine if the RC&EP (GLE, 2011) has established adequate emergency management facilities and procedures to protect workers, the public, and the environment. The Nuclear Regulatory Commission staff's review of the RC&EP contains Proprietary, Security-Related, and Export Control Information and is addressed in the non-public version of this Safety Evaluation Report.

The Global Nuclear Fuel-Americas (GNF-A) and the applicant have established an emergency plan for responding to the radiological hazards resulting from a release of radioactive material or hazardous chemicals relating to the processing of licensed material in accordance with 10 CFR 30.32(i)(1)(ii), 10 CFR 40.31(j)(1)(ii), and 10 CFR 70.22(i)(1)(ii). As part of the license application, an integrated RC&EP for both the GNF-A fuel fabrication facility and the GLE laser-based enrichment facility was provided. This plan provides emergency planning for both the GNF-A facility and the proposed GLE commercial enrichment facility. Emergency planning for the GNF-A facility was originally reviewed and included under License Condition 13 in the GNF-A license (Special Nuclear Material (SNM) License SNM-1097) issued by the U.S. Nuclear Regulatory Commission (NRC) on April 23, 1979. The GNF-A emergency plan was later reviewed as part of the GNF-A license renewal and found adequate to meet the requirements of 10 CFR 70.23(a)(11) in the "Safety Evaluation Report for the Renewal of SNM-1097 Global Nuclear Fuel – Americas Wilmington, North Carolina" (NRC, 2009).

### **8.2 EVALUATION FINDINGS**

The NRC staff reviewed the RC&EP (GLE, 2011a) with respect to 10 CFR 30.32(i)(1)(ii), 10 CFR 40.31(j)(1)(ii), 10 CFR 70.22(i)(1)(ii), 10 CFR 70.22(i)(3), and the acceptance criteria in Section 8.4.3.1 of NUREG-1520 (NRC, 2002). The NRC staff concluded that the RC&EP (GLE, 2011) is adequate to demonstrate compliance with the regulatory requirements, in that: (1) the facilities are properly configured to limit releases of radioactive materials in the event of an accident; (2) a capability exists for measuring and assessing the significance of accidental releases of radioactive materials; (3) appropriate emergency equipment and procedures are provided onsite to protect workers against radiation and other chemical hazards that might be encountered after an accident; (4) a system has been established to notify Federal, State and local government agencies, and to recommend appropriate protective actions to protect members of the public; and (5) necessary recovery actions are established to return the facility to a safe condition after an accident.

### **8.3 REFERENCES**

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## 9.0 ENVIRONMENTAL PROTECTION

The purpose of the U.S. Nuclear Regulatory Commission's (NRC's) review of the applicant's environmental protection plan for its proposed GE-Hitachi Global Laser Enrichment (GLE) facility is to determine whether the applicant's proposed environmental protection measures are adequate to protect the environment, and the health and safety of the public, as required by Title 10 *Code of Regulations* (CFR) Parts 20, 30, 40, 51, and 70.

### 9.1 REGULATORY REQUIREMENTS

To be considered acceptable, the applicant must satisfy the following regulatory requirements regarding environmental protection:

1. The regulations in 10 CFR Part 20 specify the effluent control and treatment measures necessary to meet dose limits and dose constraints for members of the public specified in Subparts B, D, and F; the waste minimization requirements in 10 CFR 20.1406; the survey requirements of Subpart F; the waste disposal requirements of Subpart K; the records requirements of Subpart L; and the reporting requirements of Subpart M.
2. The regulations in 10 CFR 30.33 specify in part that an application for the possession and use of byproduct material will be granted provided that, among other things, the applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property, and that the applicant is qualified by training and experience to use the byproduct material for the purpose requested in such a manner as to protect health and minimize danger to life and property.
3. The regulations in 10 CFR 40.31(k) state that, "A license application for a uranium enrichment facility must be accompanied by an Environmental Report required under subpart A of Part 51 of this chapter."
4. The regulations in 10 CFR 40.32(b) specify that the applicant must be qualified by reason of training and experience to use the source material for the purpose requested in such manner as to protect health and minimize danger to life or property.
5. The regulations in 10 CFR 40.32(e) state that, "In the case of an application for a license for a uranium enrichment facility, or for a license to possess and use source and byproduct material for uranium milling, production of uranium hexafluoride, or for the conduct of any other activity which the Commission determines will significantly affect the quality of the environment, the Director, Office of Federal and State Materials and Environmental Management Programs or his designee, before commencement of construction of the plant or facility in which the activity will be conducted, on the basis of information filed and evaluations made pursuant to subpart A of part 51 of this chapter, has concluded, after weighing the environmental, economic, technical and other benefits against environmental costs and considering available alternatives, that the action called for is the issuance of the proposed license, with any appropriate conditions to protect environmental values. Commencement of construction prior to this conclusion is

grounds for denial of a license to possess and use source and byproduct material in the plant or facility. As used in this paragraph, the term 'commencement of construction' means any clearing of land, excavation, or other substantial action that would adversely affect the environment of a site. The term does not mean site exploration, roads necessary for site exploration, borings to determine foundation conditions, or other preconstruction monitoring or testing to establish background information related to the suitability of the site or the protection of environmental values."

6. The regulations in 10 CFR 51.60(b)(1)(vii) specify that the applicant must submit an environmental report (ER) for construction and operation of a uranium enrichment facility.
7. The regulations in 10 CFR 70.22(a)(7) specify that the applicant must provide a description of the equipment and facilities which will be used by the applicant to protect health and minimize danger to life or property.
8. The regulations in 10 CFR 70.23(a)(2) specify that the applicant must be qualified by reason of training and experience to use the material for the purpose requested.
9. The regulations in 10 CFR 70.59 outline the radiological effluent monitoring reporting requirements for a 10 CFR Part 70 licensee.
10. The regulations in 10 CFR 70.65(b) specify that an applicant for a facility must provide an "Integrated Safety Analysis (ISA) Summary" that includes a list of the Items Relied on for Safety (IROFS) established by the applicant.

## **9.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA**

The acceptance criteria for the NRC's review of the applicant's environmental protection program are outlined in Section 9.4.3.2 of the "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," NUREG-1520 (NRC, 2002). Other acceptance criteria in Chapter 9 of NUREG-1520 (NRC, 2002) relating to environmental documents developed pursuant to the National Environmental Policy Act (NEPA) are not applicable to this review. These NEPA-related acceptance criteria apply to evaluating the adequacy of the applicant's ER and to determining whether the staff should prepare an environmental assessment (EA) or an environmental impact statement (EIS) pursuant to regulatory requirements found in 10 CFR Part 51.

## **9.3 STAFF REVIEW AND ANALYSIS**

### **9.3.1 TRAINING AND QUALIFICATIONS**

The regulations in 10 CFR 30.33, 40.32(b), and 70.23(a)(2) require that the applicant be qualified by reason of training and experience to use the material for the purpose requested. The acceptance criteria in Section 9.4.3.2 of NUREG-1520 (NRC, 2002) indicate that the applicant's environmental protection measures will be acceptable if it provides for qualified and trained staff associated with environmental protection. This will include the qualification and training of managers, supervisors, technical staff, operators, technicians, and maintenance

personnel whose levels of knowledge are important to the environment and protect the health and safety of the public. In addition, managers and staff will be expected to have levels of education and experience commensurate with the responsibilities of their positions.

Personnel training and qualification requirements are established and implemented in accordance with approved written procedures. The applicant's training program is described in Section 11.3 of its License Application (LA) (GLE, 2011a); its qualification requirements for key management positions are described in Section 2.2 of its LA (GLE, 2011a).

#### 9.3.1.1 Personnel Training

As noted in Section 11.3 of its LA (GLE, 2011a), the applicant indicates that training programs are provided through shared responsibility of the environmental, health, and safety (EHS) disciplines and line management, and its programs are designed primarily to ensure that personnel who perform activities relied on for safety have the appropriate skills to design, operate, and maintain the facility in a safe manner. Training requirements are applicable primarily to those personnel who have a direct relationship to various aspects of IROFS. In addition to its safety focus, the training program also is designed to ensure that assigned personnel are trained and tested as necessary to perform their responsibilities important to the protection of the environment.

As discussed in Section 11.3.2.4 of the LA (GLE, 2011a), technical training consists of initial, on-the-job, continuing, and special training, as applicable to assist personnel to gain an understanding of specific assigned technical duties. Professional development, which uses internal or external professionals via formal workshops, tutorials, and selected training programs, assists personnel in gaining additional understanding of technical practices common to their assigned job functions. Job-specific training is performance-based. Lesson plans that are developed are based on job performance requirements, and are reviewed by line management and by the responsible organization for the subject matter. Under its training program, the applicant also provides continuing or periodic retraining to assure personnel remain proficient and retain important knowledge and skills. Retraining may be required as a result of facility modifications or changes in procedures or in the Quality Assurance (QA) program which would result in new or changed information. As discussed in Section 11.3.8 of the LA (GLE, 2011a), the applicant evaluates trainee understanding and proficiency through observation, demonstration, or examinations, and training results are documented.

The applicant also performs periodic evaluations of its training program to assess program effectiveness. These evaluations identify program strengths and weaknesses. The evaluations are also used to help determine whether training content matches current job needs and whether corrective actions are needed to improve training program effectiveness. In addition, the applicant may also perform independent audits to evaluate the overall training program effectiveness.

#### 9.3.1.2 Personnel Qualifications

In Section 2.2 of the LA (GLE, 2011a), the applicant identifies key management and supervisory positions, hierarchy and functions, including personnel qualifications for each key position. In Figure 2-2 of the LA (GLE, 2011a), the applicant provides an overview of those management positions and functions. In Section 2.2 of its LA (GLE, 2011a), the applicant provides a

description of those key management positions and qualifications that relate to, among other things, Environmental Protection, including the following:

- The Facility Manager, who reports to the GLE President and Chief Executive Officer (CEO), provides for safety, control of operations, and protection of the environment by delegating and assigning responsibility to qualified line management and to area managers. The Facility Manager is required to have, as a minimum, a bachelor's degree in an engineering or scientific field and four years of experience in nuclear facility operations.
- The Operations Manager, who reports to the GLE President and CEO during the design and construction phases and to the Facilities Manager during operations, has the responsibility of directing the day-to-day operation of the facility, which includes responsibility for activities related to UF-6 processes and handling, as well as for the identification and mitigation of any off-normal operating conditions. The Operations Manager is required to have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years of experience in nuclear facility operations.
- Area Managers, who report to the Operations Manager, are the designated individuals responsible for ensuring that activities necessary for safe operations and protection of the environment are conducted properly within their assigned area(s) of the facility in which uranium materials are possessed, handled, or stored. They are also required to be knowledgeable of the safety program procedures, including, among other things, Environmental Protection. Area Managers are required to have, as a minimum, a bachelor's degree (or equivalent) in a technical field and two years of experience in operations, one of which is in fuel cycle facility operations. Alternatively, Area Managers are required to have a high school diploma and five years of operations experience, two of which are in fuel cycle facility operations.
- Shift Supervisors, who report to the Operations Manager, are the interface between management and facility operators. Shift Managers are required to be knowledgeable of the safety program procedures, including, among other things, Environmental Protection. Shift Supervisors are required to have, as a minimum, a high school diploma and three years of experience in a technical field.
- The Training Manager is responsible for establishing and maintaining the training program described above. The Training Manager is also responsible for conducting training and maintaining training records for personnel at the facility. The Training Manager is required to have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years of related experience.
- The EHS Manager, who reports to the Facility Manager, has the authority and responsibility to contact the GLE President and CEO with any EHS concerns. The EHS Manager has the overall responsibility to establish and manage, among other things, Environmental Protection and Radiation Protection Programs to ensure compliance with applicable federal, state, and local regulations and laws. This position is independent from other management positions at the facility in order to ensure the ability to conduct objective EHS audit, review, and control activities. The EHS Manager is required to have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and five years of management experience in assignments involving regulatory



activities. In addition, the EHS Manager is required to have experience in the understanding and management of nuclear criticality safety, environmental protection, and industrial safety programs.

- The Environmental Protection Manager, who reports to the EHS Manager, is administratively independent of Operations and has the authority to shut down operations having potentially adverse environmental impacts. Environmental Protection responsibilities are identified in Section 2.2.9.5 of the LA (GLE, 2011a). The Environmental Protection Manager is required to have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and two years of experience in assignments involving regulatory activities (or equivalent); or a high school diploma and eight years of experience in assignments involving regulatory activities.

The staff conducted a review of the applicant's training program identified in Section 11.3 of the LA (GLE, 2011a) and of the applicant's personnel qualifications identified in Section 2.2 of the LA (GLE, 2011a), which includes the qualification and training of managers, supervisors and technical staff who are associated with environmental protection. Because the applicant identified specific training areas and provides that managers and staff have levels of education and experience commensurate with the responsibilities of their positions, the staff finds that the applicant has established that its training, testing and qualification of these personnel meets the regulatory requirements found in 10 CFR 70.22(a)(6) and the acceptance criteria found in Section 9.4.3.2 of NUREG-1520 (NRC, 2002) and Sections 11.3.3(1) through (10) of NUREG-1520 (NRC, 2002).

### 9.3.2 RADIATION SAFETY

#### 9.3.2.1 As Low As Reasonably Achievable Goals for Air and Liquid Effluent Control

The regulations in 10 CFR 20.1101 require each licensee to implement a radiation protection program. This environmental review of the applicant's radiation protection program focuses on the applicant's proposed methods to maintain public doses As Low As Reasonably Achievable (ALARA) in accordance with 10 CFR 20.1101. Acceptance criteria are found in Section 9.4.3.2.1(1), (2), and (3) of NUREG-1520 (NRC, 2002). The applicant's proposed ALARA program will be found acceptable if the applicant's program is consistent with Regulatory Guide 8.37, "ALARA Levels for Effluents from Materials Facilities" (NRC, 1993). In addition, the applicant's ALARA goals should be established at a modest fraction (10 to 20 percent) of the values in 10 CFR Part 20, Appendix B, Table 2, Columns 1 and 2, and Table 3 and the external exposure limit in 10 CFR 20.1302(b)(2)(ii), or the dose limit for members of the public, if the applicant proposes to demonstrate compliance with 10 CFR 20.1301. The applicant's constraint approach is acceptable if it is consistent with the guidance in Regulatory Guide 4.20, "Constraint on Releases of Airborne Radioactive Material to the Environment for Licensees Other Than Power Reactors" (NRC, 1996) and provides sufficient detail to demonstrate specific application of the guidance to proposed routine and non-routine operation, including anticipated events. The applicant also needs to describe its proposed effluent controls to maintain public doses ALARA and demonstrate a commitment to reduce unnecessary exposure to members of the public and releases to the environment. The applicant also needs to commit to annual reviews of the content and implementation of the radiation protection program, which includes the ALARA program. The review needs to consider analysis of trends in release concentrations, environmental monitoring data, and radionuclide usage; determinations of whether operational changes are needed, and evaluations of designs for system installations or modifications. In

addition, the results of the annual review should be reported to senior management, along with recommendations for changes to facilities or procedures that are necessary to achieve ALARA goals.

The applicant's ALARA and Radiation Protection Program are described in Chapter 4 of the applicant's LA (GLE, 2011a) and Section 4.12.2.2 of its ER (GLE, 2008). The applicant stated that it will maintain and use gaseous and liquid treatment systems, as appropriate, to maintain releases of radioactive material to unrestricted areas below the limits specified in 10 CFR 20.1301 and in accordance with ALARA policy. The applicant maintains an Environmental Protection Program for the proposed GLE facility which builds on the existing Wilmington Site Nuclear Safety Program. In Section 9.2 of the LA (GLE, 2011a), the applicant states that the primary purpose of this program is to ensure that exposure of the workers, public and environment to radioactive materials used in facility operations is kept ALARA. As discussed in Chapter 6 of the applicant's ER (GLE, 2008), compliance with the ALARA concept is a part of the applicant's Environmental Protection Program. Air and liquid effluent controls are used to maintain public doses ALARA.

The applicant's approach is sufficiently detailed to demonstrate that the applicant is in compliance with regulatory dose limits found in 10 CFR 20.1301, that air and liquid dose constraints meets the acceptance criteria in Section 9.4.3.2.1(1) of NUREG-1520 (NRC, 2002), and that the applicant's ALARA program for controlling gaseous and liquid effluents is within the guidance found in NRC Regulatory Guide 8.37, "ALARA Levels for Effluents From Materials Facilities" (NRC, 1993).

#### Air Effluent ALARA Goal

For radiological ALARA goals for air effluent control, the applicant proposes an ALARA goal of being within the 10 CFR 20.1101 constraint of 0.1 milliSievert per year (mSv/yr) (10 milliRem per year (mrem/yr)) total effective dose equivalent (TEDE) for the maximally exposed member of the public. The applicant's proposal satisfies the 0.1 mSv/yr (10 mrem/yr) ALARA goal recommended in NRC Regulatory Guide 8.37, Regulatory Position C.1.2, "ALARA Goals" (NRC, 1993), meets the acceptance criterion found at 9.4.3.2.1(1) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### Liquid Effluent ALARA Goal

As noted in Section 4.2 of the applicant's LA (GLE, 2011a), liquid effluent does not provide a significant pathway for radiological exposure to the general public. Liquid radioactive wastes and process wastewaters are treated to remove uranium and fluoride. The remaining radioactive material is then packaged and disposed of as a solid, dry, Class A low-level radioactive waste (LLRW). The treated wastewaters are then discharged ultimately to the Northeast Cape Fear River. Average annual release concentrations of liquid effluents will be in compliance with limits in 10 CFR 20.1302, and will not exceed the values in 10 CFR Part 20, Appendix B. There will be negligible increases to the environmental or public radiological exposures resulting from liquid effluents. ALARA levels for liquid effluents will be consistent with guidance described in NRC Regulatory Guide 8.37 (NRC, 1993). Radiation Program procedures incorporate the ALARA philosophy into facility operations and ensure exposures are below 10 CFR 20.1101(d) limits. For the proposed facility, the level of radioactivity from liquid effluents to the public and the environment would be within the regulatory goal of 0.1 mSv/yr (10 mrem/yr) recommended in NRC Regulatory Guide 8.37 (NRC, 1993), meets the acceptance

criteria found in Section 9.4.3.2.1(1) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

### 9.3.2.2 Air Effluent Controls to Maintain Public Doses ALARA

Small amounts of radiation and radiological materials may be released from routine operations to the environment via gaseous emissions, liquid effluent, and direct radiation. In Section 1.1.6.2 of its LA (GLE, 2011a) and Section 4.12.2.2.2 of its ER (GLE, 2008), the applicant identifies the route of exposure for the general public as being by way of gaseous emissions to the atmosphere through a rooftop vent stack (the Operations Building stack). As noted in Section 4.6 of the LA (GLE, 2011a), control of the release of radiation or radioactive materials is a fundamental requirement for facility and equipment design for areas in which uranium and other sources of radiation are handled, processed, or used in processes.

The containment of uranium hexafluoride ( $UF_6$ ), and therefore the concentration of radioactive material in air, is accomplished through several engineered controls, including containment and ventilation systems. Process systems are operated at consistent sub-atmospheric pressure so that any leaks would be into the system as opposed to into work areas. Process system components that are equipped with removable covers or hatch openings are equipped with seals and mechanical closure devices to ensure containment of the  $UF_6$ .

$UF_6$  is processed in the  $UF_6$  Feed and Vaporization, Product Withdrawal, Tails Withdrawal, and Cascade and Gas Handling Areas. As noted in Section 4.6.1 of the LA (GLE, 2011a) and Section 4.6.2.2.1 of the ER (GLE, 2008), some short-term gaseous releases potentially could occur inside the Operations Building during activities associated with operations of the enrichment process. An example would be the connection and disconnection of the  $UF_6$  cylinders to process equipment, as well as during equipment maintenance activities. These gaseous releases would be contained within the Operations Building process areas and routed through the ventilation system containing high-efficiency particulate air (HEPA) and high-efficiency gas absorption (HEGA) filter media. In addition, pre-filters are provided where necessary to treat effluents before filtration to ensure that filter effectiveness is maintained. The ventilation system would be designed to remove over 99 percent of particulates and gaseous pollutants from the air stream. The ventilation system exhausts to the environment through the Operations Building stack.

Constraints on atmospheric releases are established so that no member of the public is expected to receive a TEDE in excess of 0.1 mSv/yr (10 mrem/yr) from these releases. The applicant will use the guidance in Regulatory Guide 4.20 (NRC, 1996) to determine compliance with dose limits to members of the public. The applicant estimated the cumulative radiological impact of uranium emissions from both the proposed GLE facility and its existing General Electric-Hitachi Global Nuclear Fuels – Americas (GNF-A) fuel manufacturing facility as being representative of the most realistic scenario for gaseous releases from the proposed facility. Section 4.12.2.2.2.1 of the ER (GLE, 2008) indicates that because there are no publically available source test data for quantifying the level of air emissions from the laser-enrichment process, the applicant used 2006 air monitoring data for a subset of the fuel manufacturing facility process vents as a reasonable surrogate for the proposed facility. This is because the applicant expects emissions from the fuel manufacturing facility to be greater than the emissions from the proposed laser enrichment facility (GLE, 2008). A more detailed basis for the applicant's use of the fuel manufacturing facility data is found in Section 4.6.2.2.1.1 of the ER (GLE, 2008).

As noted in Section 4.12.2.2.2 of the ER (GLE, 2008), the applicant estimated offsite radiological impacts to key receptors from routine effluent releases using the GENII model (Version 2.06). In addition, Appendix S of the ER (GLE, 2008) describes the assumptions and results of air emissions dispersion modeling for the proposed facility. Table S-2 of the ER (GLE, 2008) provides total uranium and uranium isotope emission rates for ambient air dispersion modeling.

### Staff Evaluation of Air Effluent Controls

The staff evaluated the air effluent controls and effects described in Sections 4.6.1, 9.2.1.1 and 9.2.1.2 of the applicant's LA (GLE, 2011a) and Sections 4.6.2.2.1 and 4.12.2.2 of the ER (GLE, 2008). The Committed Effective Dose Equivalent (CEDE) for the adult Maximally Exposed Individual (MEI) (which is the highest calculated CEDE) from the combined existing fuel fabrication facility and proposed enrichment facility emissions was calculated to be 9.2E-6 mSv/yr (9.2E-4 mrem/yr) per year. Dose equivalents for the MEI from gaseous effluents for the total body in adults, teens, children, and infants are presented in Tables 4.12-1 and 4.12-2 of the ER (GLE, 2008). These doses are well below (orders of magnitude) the U.S Environmental Protection Agency (EPA) 0.1 mSv/yr (10 mrem/yr) standard in 40 CFR Part 190. This estimated maximum public dose is also well below the 0.1 millSievert (mSv) (10 milliRem (mrem)) ALARA constraint on air emissions described in 10 CFR 20.1101. Because public receptors at other sites of interest are more distant than the MEI, their doses would be even lower because of dispersion of uranium at the more distant locations.

The staff finds that the applicant's controls will ensure that radiation levels to the public will remain well below regulatory limits and ALARA air effluent goals, that the applicant's approach to effluent controls meets the acceptance criteria found in Section 9.4.3.2.1(2) of NUREG-1520 (NRC, 2002), and are, therefore, acceptable to the staff. Therefore, the staff finds that the applicant has demonstrated that its air effluent controls will reduce releases to provide adequate protection of the environment and of the health and safety of the public.

### 9.3.2.3 Liquid Effluent Controls to Maintain Public Doses ALARA

As noted in Section 4.13.2.2.1.1 of the applicant's ER (GLE, 2008), uranium-enrichment operations inside the Operations Building would generate process wastewater streams from the collective drain water resulting from decontamination, cleaning, and laboratory activities. The liquid radioactive waste would be collected in closed-drain systems that discharge to an accumulator tank. The liquid would then be treated to remove uranium through precipitation and to remove fluoride through evaporation. The resulting solids would be dried and disposed as LLRW.

In the liquid effluent treatment process described in Section 4.13.2.2.1.1 of the ER (GLE, 2008), a caustic solution is added to the wastewater in the accumulator tank, which increases the pH of the solution and results in the precipitation of uranium from the solution. The uranium-containing slurry would be pumped to a centrifuge. The solids collected from the centrifuge would be oven-dried, sampled, and packaged for disposal as a solid LLRW. The solution from the centrifuge would be sampled to evaluate the residual uranium concentration to determine whether further treatment of the solution would be required to precipitate uranium. Once the concentration is determined to be acceptably low (i.e., within concentrations and corresponding release limits in 10 CFR Part 20, Appendix B), it would ultimately be discharged from the liquid

effluent treatment system via a National Pollutant Discharge Elimination System (NPDES) permitted Outfall 001 to the Wilmington site effluent channel where it mixes with stormwater discharging groundwater and treated sanitary wastewater effluent. The effluent channel flows into Unnamed Tributary #1 and to the Northeast Cape Fear River.

Stormwater runoff collected from the UF<sub>6</sub> storage pads will be routed to a holding pond that will be monitored to ensure that no unanticipated radiological discharge occurs to the stormwater wet detention basin. Should unanticipated radioactivity be detected in the holding pond, it will be allowed to settle and precipitate. The liquid would then be pumped from the holding pond and, if necessary, routed to the effluent treatment system. The contaminated portions of the contained solids will be disposed of as LLRW. In Section 4.13.2.2.1.4 of the ER (GLE, 2008), the applicant indicates that no more than trace levels of radiological contamination will be released from the UF<sub>6</sub> storage pads area stormwater holding pond and these releases will be within the effluent release requirements in 10 CFR Part 20, Appendix B.

#### Staff Evaluation of Liquid Effluent Controls

As noted above and in Section 9.2.1.2 of the LA (GLE, 2011a), liquid effluents from facility operations will be treated to remove uranium and fluoride prior to being released to the environment. Uranium will be precipitated from wastewater streams and disposed as LLRW. In addition, stormwater runoff will contain only trace levels of radiological contamination and these releases will be within the effluent release requirements in 10 CFR Part 20, Appendix B.

The staff finds that these trace levels and any resulting doses would be much less than the regulatory limit, and well within the ALARA goal for liquid effluents described above. In addition, the staff finds that the applicant's approach to liquid effluent controls meets the acceptance criteria found in Section 9.4.3.2.1(2) of NUREG-1520 (NRC, 2002). Thus, the applicant's controls and approach to the controls are acceptable to the staff. Therefore, the staff finds that the applicant has demonstrated that it will reduce liquid effluents to provide adequate protection of the environment and of health and safety of the public.

#### 9.3.2.4 ALARA Reviews and Reports to Management

In Section 4.2 of the LA (GLE, 2011a), the applicant describes an ALARA program for the proposed facility. The ALARA program is also described in Section 4.3.2 of this Safety Evaluation Report (SER). The ALARA program provides for an annual review of the content and implementation of the radiation protection (RP) program, including the effluent control program. The Facility Safety Review Committee (FSRC) is responsible for conducting annual ALARA reviews. The FSRC is an independent advisory committee that reports directly to the Facility Manager. In conducting its ALARA review, the FSRC considers the following:

- Programs and projects undertaken by the RP Manager and the Radiation Safety Committee (RSC);
- Performance including trends in airborne concentrations of radioactivity, personnel exposures, and environmental monitoring results; and
- Programs for improving the effectiveness of equipment and procedures used for effluent and exposure control.

As discussed in Sections 4.1.2.3 and 4.3.3 of the LA (GLE, 2011a), the RP Manager is responsible for the overall implementation of the RP program and has direct access to the Facility Manager who, in turn, has the overall responsibility for safety and activities conducted at the proposed facility.

As discussed in Section 4.2.4 of the LA (GLE, 2011a), the RSC is composed of the Chairperson and representatives from the RP, Environmental Protection, Operations, Engineering and Maintenance programs. The RSC provides oversight of the RP program and functions as the ALARA Committee (GLE, 2011a). The RP Manager chairs the RSC and compiles and maintains related records and distributes monthly meeting summaries to the Facility Manager as well as to line and area managers (GLE, 2011a). Results of the ALARA review are reported to senior management, along with recommendations for changes in facilities or procedures that are necessary to achieve ALARA goals (GLE, 2011a). Reports are retained for at least three years (GLE, 2011a). As described in Section 4.3.2 of this SER, the ALARA program will be implemented in accordance with 10 CFR 20.1101 through approved written procedures and policies (GLE, 2011a). The approach described above meets the acceptance criteria found in 9.4.3.2.1(3) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### 9.3.2.5 Waste Minimization

The requirements in 10 CFR 20.1406 require an applicant for a license to describe how the facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate decommissioning, and minimize, to the extent practicable, the generation of radioactive waste. Acceptance criteria are addressed in Section 9.4.3.2.1(4) of NUREG-1520 (NRC, 2002). The applicant's program for waste minimization will be acceptable if the applicant describes how the facility's design procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate decommissioning, and minimize, to the extent practicable, the generation of radioactive waste. In addition, the program needs to have senior management support; provide methods to characterize waste generation and waste management costs; provide for periodic waste minimization assessments; provide provisions for technology transfer to seek and exchange technical information on waste minimization; and provide methods to implement and evaluate waste minimization recommendations.

In Section 4.7.8 of the LA (GLE, 2011a) and in Section 4.13.3 of the ER (GLE, 2008), the applicant commits to design and operate its facility to meet waste minimization requirement in 10 CFR 20.1406. The applicant describes its Waste Minimization Plan (WMP) to: (1) reduce the quantity of waste generated by a source; (2) recycle or reprocess the material so that it can be reused; (3) treat the waste to remove hazard constituents; or 4) reduce the waste volume. The goal of the WMP is to reduce targeted waste activities to the technically feasible and economically practicable minimum by implementing projects and work practices identified in the plan. In Section 4.13.3 of its ER (GLE, 2008), the applicant states that it would work toward achieving its goals by a combination of waste reduction assessments, procedural improvements, equipment and manufacturing process improvements, material substitution, and employee training, as applicable. The WMP would contain the following elements:

- Policy statement with senior management commitment;
- Plan scope and objectives;
- Waste Minimization Committee;
- Waste stream assessments;

- Waste minimization project identification and selection;
- Selected waste minimization projects implementation;
- Results measurement and progress evaluation; and
- Periodic plan review procedures.

As described in Section 3.12 of the applicant's ER (GLE, 2008), minimization practices include reclamation, recycle, reuse, compaction, and design features or procedures to avoid or reduce the generation of wastes. Examples of current waste minimization efforts at the Wilmington Site that the applicant expects to carry over to the proposed facility include: (1) changes in manufacturing processes that resulted in the elimination of most of the process wastewater streams discharged into the drain system; (2) concentration of aqueous HF and transferred to a chemical company for industrial and industrial uses; (3) use of treated sanitary wastewater effluent as makeup water in cooling towers; and (4) various solid wastes such as packaging materials, worn-out equipment, spent process chemicals and used oils are reduced in volume or separated for recycling, recoverable materials are salvaged, and other materials, such as combustible uranium-contaminated maintenance items (LLRW) are disposed in an onsite incinerator.

In Section 1.1.4.1 of the LA (GLE, 2011a), the applicant described its solid waste management program at the proposed facility for industrial (nonhazardous), radioactive, and hazardous wastes. Solid waste will be grouped into one of these waste categories. The applicant may send wastes that are candidates for volume reduction, recycling, or treatment to licensed treatment facilities that have the ability to reduce the volume of most Class A LLRW. The applicant proposes to dispose of all solid radioactive wastes as Class A LLRW. Industrial waste, including miscellaneous trash, vehicle air filters, empty cutting oil cans, miscellaneous scrap metal, and paper will be shipped offsite for disposal at a permitted waste landfill.

The WMP meets the requirements specified in 10 CFR 20.1406, "Minimization of Contamination," which provides in part that the applicant will provide procedures that will minimize the generation of radioactive waste. The WMP also will be consistent with the guidance provided in NRC Information Notice 94-23, "Guidance to Hazardous, Radioactive, and Mixed-Waste Generators on the Elements of a Waste Minimization Program" (NRC, 1994) and in Regulatory Guide 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning" (NRC, 2008); and meets Section 9.4.3.2.1(4) of NUREG-1520 (NRC, 2002). The applicant's proposed waste minimization program is, therefore, acceptable to the staff. The staff finds that the applicant's implementation of its program for management of solid radiological and non-radiological wastes related to facility operation, including its volume reduction and recycling programs, will reduce unnecessary exposures to these wastes and assure adequate protection of public health and safety and the environment.

### 9.3.3 EFFLUENT AND ENVIRONMENTAL MONITORING

The regulations in 10 CFR 20.1302 require a licensee to make or cause to be made, as appropriate, surveys of radiation levels in unrestricted and controlled areas and radioactive material in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits for individual members of the public in 10 CFR 20.1301.

Acceptance criteria for effluent monitoring are addressed in Section 9.4.3.2.2(1)(a) through (n) of NUREG-1520 (NRC, 2002). An applicant's effluent monitoring program will be found

acceptable if known or expected concentrations of radioactive materials in airborne and liquid effluents are ALARA and are below the limits specified in Table 2 of Appendix B to 10 CFR Part 20, or site-specific limits are established in accordance with 10 CFR 20.1302(c). In addition, if the applicant proposes to demonstrate compliance with 10 CFR 20.1301 by using calculations of the TEDE, the applicant needs to perform pathway analyses using appropriate models, codes, and assumptions. The applicant also needs to identify and monitor all liquid and airborne effluent discharge locations and continuously sample airborne effluents from all routine and non-routine operations, unless periodic sampling or other means has been justified (NRC, 2002). Sample collection and analysis methods and frequencies need to be appropriate for the effluent medium and the radionuclides being sampled. Radionuclide-specific analyses need to be performed using appropriate samples using justified methods. In addition, the minimum detectable concentration (MDC) for sample analysis needs to be adequate (sufficiently sensitive) for comparison to the concentration limits in 10 CFR Part 20, Appendix B, and laboratory quality control procedures need to be adequate to validate the analytical results. The applicant also needs to establish action levels and proposed action if action levels are exceeded. In addition, the applicant needs to completely and accurately describe all applicable Federal or State discharge limits for gaseous and liquid effluents applicable to the proposed facility. Leakage detection systems also need to be in-place to detect leaks from tanks, ponds, or lagoons that could affect ground water, surface water, and soils. The applicant needs to control and maintain releases to sewer systems to meet the requirements of 10 CFR 20.2003. The applicant also needs to have reporting procedures that comply with 10 CFR 70.59 and the guidance in Regulatory Guide 4.16, "Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants" (NRC, 1985). In addition, the applicant's procedures and facilities for solid and liquid waste handling, storage, and monitoring need to result in safe storage and timely disposition of the material.

Acceptance criteria for environmental monitoring are found in Section 9.4.3.2.2(a) through (i) in NUREG-1520 (NRC, 2002). An applicant's environmental monitoring program will be found acceptable if it is commensurate with the scope of activities at the facility and the expected impacts from operations as identified in the ER. In addition, the program needs to include the establishment of background and baseline radionuclide concentrations in environmental media. Monitoring needs to include sampling and analyses for air, surface water, ground water, soil, sediments, and vegetation, as appropriate, and identify adequate and appropriate sampling locations and frequencies for each environmental medium and the analyses to be performed for each medium. Monitoring procedures need to employ acceptable analytical methods and instrumentation and instrumentation needs to be appropriately maintained and calibrated. If the applicant proposes to use its own laboratory for environmental sample analyses, the applicant needs to commit to providing third-party verification of its methods such as a round-robin measurement program. In addition, the applicant needs to identify appropriate action levels and actions to be taken if action levels are exceeded for each environmental medium and radionuclide. Action levels should be selected based on pathway analyses that demonstrate that below those concentrations, doses meet the ALARA and 10 CFR Part 20, Subpart B limits. The applicant also needs to specify MDCs for sample analyses at least as low as those selected for effluent monitoring in air and water consistent with the selected action levels. Data analysis methods and criteria need to be provided for evaluating and reporting the results of environmental sampling and indicate when an action level is being approached in time to take corrective actions. The applicant also needs to provide a description of the status of all licenses, permits, and other approvals for facility operation that is complete and accurate. In addition, the program needs to be adequate to assess environmental impacts from potential



radioactive and non-radioactive material releases as identified in high and intermediate consequence events in the ISA.

The applicant describes its effluent and environmental monitoring programs for radiological and non-radiological effluents released from the proposed facility in Section 9.2.2 of its LA (GLE, 2011a) and in Chapter 6 of its ER (GLE, 2008). In its introduction to Chapter 6, the applicant commits to perform measurements and monitoring necessary to demonstrate that the amount of radioactive material present in effluent from the proposed facility will be kept ALARA in compliance with 10 CFR Part 20. The applicant also identifies guidance in Regulatory Guide 4.16 (NRC, 1985) to assure that it will adhere to the ALARA principle such that there will be no undue risk to the public health or safety at or beyond the Wilmington site boundary. Monitoring during decommissioning and closure is discussed briefly in Section 4.12.3 of the ER (GLE, 2008).

### 9.3.3.1 Air Effluent Monitoring

#### Expected Concentrations

Expected concentrations of radioactive materials in airborne and liquid effluents are addressed in Section 9.2.2.1 of the applicant's LA (GLE, 2011a) and in Section 4.12.2.2.2 of its ER (GLE, 2008), in which concentrations were estimated using conservative assumptions. As described in Section 9.3.2.1 of this SER, the staff finds that the expected concentrations of radioactive materials in airborne effluents would be well below the regulatory limits specified in 10 CFR 20.1302(c). The applicant demonstrated compliance with air effluent limits by calculation of the TEDE to the individual who is likely to receive the highest dose in accordance with 10 CFR 20.1302(b)(1).

The staff finds that the applicant's control of these concentrations is ALARA and below limits specified in 10 CFR 20, Appendix B, Table 2, meets the acceptance criteria found in Section 9.4.3.2.2(1)(a) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### TEDE

The applicant established constraints on atmospheric releases for the proposed facility such that no member of the public is expected to receive a TEDE in excess of 0.1 mSv/yr (10 mem/yr) from these releases. Written procedures approved by applicant management dictate atmospheric releases to be monitored and measured. In Section 4.12.2.2.2.2 of the ER (GLE, 2008), the applicant provides a detailed description of the calculation of the TEDE to the individual who is likely to receive the highest dose, which includes a pathway analysis and an analysis of the dose contribution from the existing GNF-A fuel fabrication facility, using GENII (version 2.06), which implements dosimetry models recommended by the International Commission on Radiological Protection. In Tables 4.12-1 and 4.12-2 of its ER (GLE, 2008), the applicant provides calculated dose equivalents for the MEI and nearest resident to the proposed facility, which dose equivalents are well below (by orders of magnitude) the regulatory limit in 10 CFR 20 and well within the EPA regulatory standard in 40 CFR 190. The staff finds that the applicant's approach is in accordance with requirements in 10 CFR 20.1302(b)(1), meets the acceptance criteria found in Section 9.4.3.2.2(1)(b) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

## Locations, Continuous Sampling, and Analysis Methods of Airborne Effluents

The applicant's air effluent monitoring program is described in Sections 9.2.2.1 and 1.1.6.2 of the LA (GLE, 2011a), and in Section 6.1.2 of the ER (GLE, 2008). The source of air emissions from the proposed facility is the Operations Building stack, which is identified in Section 9, Figure 9-1, of the applicant's LA (GLE, 2011a). The air monitoring locations are identified in Chapter 6, Figure 6-1, of the applicant's ER (GLE, 2008).

As noted above in Section 9.3.2.2 of this SER, the ventilation system air stream will pass through a series of HEPA and HEGA filters before being vented to the atmosphere through the Operations Building stack and being monitored for uranium and hydrogen fluoride (HF). Initially, the stack will be sampled continuously to measure radioactivity of the exhausted air, and the collection filter in the sample system will be analyzed daily for gross alpha activity. Sampling frequency will depend upon the results, and will decrease to weekly if the results are continuously low during normal operations. Radionuclide analyses are performed more frequently whenever there is a significant non-routine, unexplained increase in gross radioactivity in effluents (gaseous or liquid) or whenever a process change or other circumstance change may cause a significant variation in the radionuclide composition.

As indicated in Section 6.1.2 of the applicant's ER (GLE, 2008), in addition to stack monitoring, ambient air is also monitored for activities from UF<sub>6</sub> cylinder pads. Active air monitors are used for analysis of gross alpha activity and concentrations of uranium isotopes. These monitors are placed around the restricted area fence line of the site of the proposed facility and are based on predominant wind directions. These monitors are placed in various locations near the UF<sub>6</sub> cylinder pads to measure levels of radioactive material from storage pads and the stack; one is placed at the site boundary near the point of highest potential impact from the Operations Building stack. The sampling program includes analysis of a weekly composite sample for gross alpha activity and concentrations of uranium isotopes.

Trends in gaseous emissions and liquid effluent monitoring data are to be reviewed annually by the applicant to evaluate whether changes are needed in systems or practices to achieve ALARA effluent goals. The Expanded Monitoring Program would be revised as appropriate to maintain the Program's effectiveness as changes are noted, such as those related to operations or other factors identified in Chapter 6 of the ER (GLE, 2008).

In Section 6.2 of its ER (GLE, 2008), the applicant states that HF would be collected continuously on particulate filters in vent stacks and analyzed weekly. Also, as noted in Section 6.1.2 of its ER (GLE, 2008) and in Section 9.2.2.1.4 of the LA (GLE, 2011a), uranium isotopes would also be collected continuously on particulate filters in air samplers located around the proposed facility and initially would be analyzed daily. However, the applicant expects the periodicity for uranium sampling to decrease to weekly if results are continually low during normal operations (GLE, 2008).

The staff finds that the applicant has identified and will monitor all airborne effluent discharge locations to determine contributions to dose limits in accordance with requirements in 10 CFR Part 20, and that the applicant's effluent monitoring meets the acceptance criteria found in Section 9.4.3.2.2(1)(c) of NUREG-1520 (NRC, 2002), which is applicable to both airborne and liquid effluents. The staff also finds that the applicant will monitor continuously samples of airborne effluents from all routine and non-routine operations in a manner that meets the acceptance criteria found in Section 9.4.3.2.2(1)(d) of NUREG-1520 (NRC, 2002), and will

assure that the air sample collection and analysis methods and frequencies described in the applicant's radiological monitoring program are appropriate to meet the acceptance criteria found in Section 9.4.3.2.2(1)(e) of NUREG-1520 (NRC, 2002), which is applicable to both airborne and liquid effluent discharges. Therefore, the staff finds the applicant's airborne effluent monitoring and analysis program to be acceptable.

#### Radionuclide-Specific Analyses

Radionuclide-specific analyses will be performed on selected composite samples. Sample locations, types and other information are provided in Table 9-1 of the applicant's LA (GLE, 2011a). Monitoring reports in which the quantities of individual radionuclides are estimated on the basis of methods other than direct measurement would include an explanation and justification of how the results were obtained. In Section 9.2.2.1.13 of the LA (GLE, 2011a), the applicant states that it will submit to the NRC a single semiannual report for the Wilmington Site that would include the proposed facility would be submitted to the NRC. The report would include the concentrations of principal radionuclides released in the unrestricted area as well as other information necessary to evaluate the radiation doses from effluent releases to the public in liquid and gaseous effluents. The report also would include the MDC for analysis and the error for each data point.

The staff finds that the applicant's proposed radionuclide-specific analyses and reporting will comply with the regulatory requirements of 10 CFR 70.59 and the guidance specified in NRC Regulatory Guide 4.16 (NRC, 1985), meets the acceptance criteria found in Section 9.4.3.2.2(1)(f) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### Minimum Detectable Concentrations

MDCs for effluent and environmental samples are listed in Table 9.2 of the applicant's LA (GLE, 2011a) and in Table 6.2 of the applicant's ER (GLE, 2008). The listed MDCs are consistent with the analytical methods employed as established in the existing Wilmington Site Monitoring Program. The staff finds that the MDCs for various listed media would be sufficiently low to meet action level, regulatory, and permit requirements, as well as the requirements of environmental media monitoring programs, is consistent with acceptance criteria found in Section 9.4.3.2.2(1)(g) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### Laboratory Quality Control

Laboratory quality control (QC) is addressed in Section 9.2.2.1.8 of the LA (GLE, 2011a) and in Chapter 6 of its ER (GLE, 2008). Laboratory procedures include the use of established standards such as those used by the National Institute of Standards and Technology (NIST), as well as standard analytical procedures such as those established by the National Environmental Laboratory Accreditation Conference (NELAC).

The applicant's Extended Monitoring Program would fall under the oversight of the QA Program and would be subject to periodic audits performed by QA personnel. Written procedures would be used to ensure that sampling and monitoring equipment is properly maintained, calibrated, and is in good working condition. Samples would be analyzed onsite for facility-related radiological constituents and may be shipped to a qualified independent laboratory for analyses. Laboratories would participate in third-party comparison studies to validate their performance. All radiological and non-radiological laboratory vendors will be certified by the National

Environmental Laboratory Accreditation Program (NELAP) or an equivalent state laboratory accreditation agency.

The staff finds that the laboratory QC procedures are adequate to validate the analytical results produced by the Environmental Monitoring Program to assure compliance with the monitoring requirements in 10 CFR Part 20, meet the acceptance criteria in Section 9.4.3.2.2(1)(h) of NUREG-1520 (NRC, 2002), and are, therefore, acceptable to the staff.

#### Action Levels

The action level for environmental measurements is the concentration (or mass) of an analyte that indicates that some action needs to be taken, such as initiating an investigation or, if the level is sufficiently high, shutting down operations. Action levels established below compliance levels will be specified in approved written procedures according to the type of sample and the specific analysis. A program of corrective actions will be implemented to ensure that the cause for the action level exceedance can be identified and corrected, applicable regulatory agencies are notified, if required, lessons learned are communicated to appropriate personnel, and applicable operational procedures are revised accordingly, if needed. Action levels provide guidance in ensuring that concentrations of radioactivity are within 10 CFR Part 20, Appendix B, limits.

The applicant's proposed development of action levels and related actions meets the regulatory requirements of 10 CFR Part 20, Appendix B, meets the acceptance criteria found in Section 9.4.3.2.2(1)(i) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### Federal and State Permits

As described in Section 1.3 of the LA (GLE, 2011a), in addition to meeting NRC requirements, the applicant will also comply with requirements provided in applicable Federal permits as well as those specified in the North Carolina Department of Air Quality permit for the monitoring of fluorides. For example, the applicant has been issued an air permit from the North Carolina Division of Air Quality that contains the regulatory requirements for the emission of fluoride from the Operations Building stack. The air permit also contains the requirements for the operation of the diesel back-up generators. The staff finds that the applicant adequately describes Federal or State standards for discharges as well as any permits issued by Federal, State, or local governments for gaseous and liquid effluents as documented in Section 1.4 of the ER (GLE, 2008), which meets the acceptance criteria found in Section 9.4.3.2.2(1)(j) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### Air Effluent Monitoring Summary Evaluation

Based on the staff review of the applicant's LA (GLE, 2011a) and ER (GLE, 2008) described in Section 9.3.3.1 of this SER, above, the staff finds that the air effluent monitoring program during operation of the proposed facility will detect and measure concentrations of radioactivity in air effluent to demonstrate that air effluent concentrations are below the regulatory limits in 10 CFR Part 20, Appendix B, meets the acceptance criteria found in Section 9.4.3.2.2(1) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

### 9.3.3.2 Liquid Effluent Monitoring

The applicant's liquid effluent monitoring program is described in Section 9.2.2 of its LA (GLE, 2011a) and in Sections 3.4.2 and 6.1 of its ER (GLE, 2008). Figure 9-2 of the LA (GLE, 2011a), which identifies outfalls, effluent channel, and process lagoons, shows the location of the liquid effluent discharges. In addition, Table 6-1 of the applicant's ER (GLE, 2008) identifies media (e.g., surface water, groundwater, and treated wastewater), sample locations, and sample type for liquid effluent monitoring. The Expanded Monitoring Program will maintain the current surface water monitoring activities in the effluent channel and in the Northeast Cape Fear River. Figure 6-2 of the ER (GLE, 2008) identifies groundwater monitoring locations for the proposed facility. The sources and estimated quantities of wastewater generated by facility operations are summarized in Section 1, Tables 1-3 and 1-4, of the applicant's LA (GLE, 2011a).

Uranium enrichment operations performed inside the Operations Building generate process wastewater from decontamination, cleaning wash water, and laboratory wastes (GLE, 2011a). Liquid radioactive wastes would be collected in closed drain systems that discharge to an accumulator tank (GLE, 2011a). The liquid would then be treated to remove uranium through precipitation (GLE, 2011a). The resulting solids would be dried and disposed of as LLRW (GLE, 2011a). The liquid also would be treated to remove fluoride through evaporation (GLE, 2011a). Treated wastewaters from the Radioactive Liquid Effluent Treatment System (RLETS) would be monitored and discharged to the existing Final Process Lagoon Treatment Facility, and then discharged via NPDES-permitted Outfall 001 to the Wilmington Site effluent channel (GLE, 2011a). This treated effluent then would be combined with stormwater, discharging groundwater, and treated sanitary effluent (GLE, 2011a). The effluent channel flows to the unnamed Tributary No. 1 to the Northeast Cape Fear River (GLE, 2011a).

#### Detection of Leaks to Groundwater, Surface Water, or Soil

The liquid is monitored to ensure compliance with 10 CFR Part 20, Appendix B, limits and for compliance with NPDES permit levels for fluoride and other constituents specified in the permit. Thus, as described in Section 9.3.2.3 of this SER, any discharges of liquid effluents to the Wilmington Site effluent channel are expected to be within regulatory limits of 10 CFR Part 20, Appendix B.

As part of the applicant's Expanded Monitoring Program, leak detection systems will be operated and maintained in areas where liquid effluents are processed, which includes leak detection on tanks, pipes, sumps, and drains to prevent unplanned releases to groundwater, surface water, and soil. As noted above, surface water monitors are currently located in the effluent channel and downstream of the Wilmington Site. Thirteen additional monitoring wells will be added to the existing groundwater monitoring wells located at different depths across the Wilmington site. Finally, soil samples will continue to be taken at various existing locations identified in Figure 9-4 of the applicant's LA (GLE, 2011a).

The staff finds that the systems for detecting leaks are adequate to assure liquid effluents will be in compliance with 10 CFR Part 20, Appendix B, limits, meet the acceptance criteria found in Section 9.4.3.2.2(1)(k) of NUREG-1520 (NRC, 2002), and are, therefore, acceptable to the staff.

### Releases to Sewer Systems

As noted by the applicant in Section 9.2.2.1.12 of its LA (GLE, 2011a), there will be no releases of liquid effluents to the sewer system. Drains from showers and hand wash stations in contaminated area change rooms would be routed to the RLETS and ultimately discharged to unnamed Tributary No. 1 to the Northeast Cape Fear River, as discussed above. In Section 4.12.2.1.2.2 of the ER (GLE, 2008), the applicant indicated that sanitary effluents from the proposed facility (e.g., originating from washrooms) would be pumped to the Wilmington Site Sanitary Wastewater Treatment Facility for treatment and for industrial reuse as process water.

Because there will be no radiological liquid effluent releases to the sewer system and no radiological releases from the sewer system to the environment, the staff finds that the releases to the sewer systems are controlled and maintained to meet the regulatory requirements of 10 CFR 20.2003, and meet the acceptance criteria found in Section 9.4.3.2.2(1)(l) of NUREG-1520 (NRC, 2002), and are, therefore, acceptable to the staff.

### Reporting Procedures

In Section 9.2.2.1.13 of its LA (GLE, 2011a), the applicant committed to comply with reporting procedure requirements of 10 CFR 70.59 and the guidance specified in Regulatory Guide 4.16 (NRC, 1985). As noted in the discussion of radionuclide-specific analyses in Section 9.3.3.1 of this SER, above, it is expected that the applicant will submit to the NRC a single semiannual report for the Wilmington Site that would include the proposed facility. The report would include the concentrations of principal radionuclides released in the unrestricted area as well as other information necessary to evaluate the radiation doses from effluent releases to the public in liquid and gaseous effluents. The report also would include the MDC for analysis and the error for each data point.

The staff finds that the applicant has committed to reporting procedures that will comply with the regulatory requirements of 10 CFR 70.59 and the guidance specified in NRC Regulatory Guide 4.16 (NRC, 1985), the procedures meet the acceptance criteria found in Section 9.4.3.2.2(1)(m) of NUREG-1520 (NRC, 2002), and are, therefore, acceptable to the staff.

### Liquid and Solid Waste Handling

The applicant addresses liquid and solid waste management in Section 3.12 of its ER (GLE, 2008) and in Section 9.2.2.1.14 of its LA (GLE, 2011a). As discussed in Sections 9.3.2.3 and 9.3.2.5 of this SER, above, liquid effluents will be treated to remove uranium through precipitation and remove fluoride through evaporation prior to release of liquid effluents to the environment. Discharges from the RLETS will be monitored and controlled to ensure that the uranium and fluoride concentrations in the effluents are in compliance with concentrations and mass limits in the NPDES permit and in 10 CFR 20.1301 and 20.1302. Many liquid and semi-solid wastes, such as uranium sludges, at the Wilmington Site will be temporarily stored and managed onsite in containers, and shipped to a licensed LLRW disposal facility.

Solid waste management facilities, with sufficient capability to enable preparation, packaging, storage, and transfers to licensed disposal sites in accordance with applicable regulations, will be provided and maintained in proper operating condition to support the operation of the proposed facility. Solid waste will be grouped into industrial (nonhazardous), radioactive, mixed, and hazardous wastes. Radioactive and mixed waste will be further segregated according to

the quantity of liquid that is not readily separable from the solid material. The applicant may send wastes that are candidates for volume reduction, recycling, or treatment to licensed treatment facilities that have the ability to reduce the volume of most Class A LLRW and to process contaminated oils. The applicant proposes to dispose of all solid radioactive wastes as Class A LLRW. Industrial waste, including miscellaneous trash, vehicle air filters, empty cutting oil cans, miscellaneous scrap metal, and paper will be shipped offsite for minimization and then sent to a permitted waste landfill.

Depleted uranium from the proposed facility operations will be stored temporarily in 48-inch cylinders before being shipped offsite to a depleted uranium deconversion facility. The Tails Pad is designed to provide storage capacity for approximately 9,000 of the cylinders, which is equivalent to about ten years of facility operation. Work practices to manage the Tails Pad include periodic inspections and radiological surveys to ensure cylinder integrity. Operators are trained in safe cylinder handling and maintenance procedures. There will be no onsite disposal of depleted uranium at the Wilmington Site. The applicant indicated that it will use the U.S. Department of Energy's (DOE's) depleted uranium disposition path under Section 3113 of the United States Enrichment Corporation Privatization Act, which directs DOE to accept depleted uranium for disposal at the request of an NRC-licensed uranium enrichment facility.

The staff finds that the applicant's program for management of liquid and solid wastes will reduce unnecessary exposures per 10 CFR Part 20 ALARA requirements, meets the waste handling acceptance criteria found in Section 9.4.3.2.2(1)(n) of NUREG-1529 (NRC, 2002), and is, therefore, acceptable to the staff.

#### Liquid Effluent Monitoring Summary Evaluation

Based on the staff review of the applicant's LA (GLE, 2011a) and ER (GLE, 2008) described in Section 9.3.2.2 of this SER, above, the staff finds that the liquid effluent monitoring program during operation of the proposed facility will detect and measure concentrations of radioactivity in liquid effluent to demonstrate that liquid effluent concentrations will be below the regulatory limits in 10 CFR Part 20, meets the acceptance criteria found in Section 9.4.3.2.2(1) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### 9.3.3.3 Environmental Monitoring

Section 9.2.2.2 of the applicant's LA (GLE, 2011a) and Section 6 of its ER (GLE, 2008) describe the applicant's environmental monitoring program. Table 9-1 of the LA (GLE, 2011a) provides a summary of the applicant's environmental monitoring program, including air and water monitoring. Table 6.1 of the ER (GLE, 2008) also provides a summary, in which the medium (e.g., air, water, soil), sample locations, sample type, parameter (e.g., gross alpha, gamma, beta) and frequency, is presented. Environmental monitoring during facility operation is also discussed in Section 4.12.2.2 of the ER (GLE, 2008).

#### Background and Baseline Radionuclide Concentrations

As stated above, the GLE Environmental Monitoring Program was developed using the existing Global Nuclear Fuel-Americas (GNF-A) Environmental Monitoring Program, which was expanded where needed to include the requirements of the proposed facility. This expanded program, which meets the needs of both facilities, is referred to as the Expanded Monitoring Program.

As noted in Section 9.2.2.2.1 of the applicant's LA (GLE, 2011a), the existing GNF-A Environmental Monitoring Program has established historical radiological and non-radiological data to provide information about the site environs. In addition, as discussed more fully below, soil and groundwater samples were collected from the proposed facility location and air and water samples are collected from remote locations and analyzed to determine a baseline to be used in evaluating changes in potential environmental conditions that could be caused by the proposed facility operation. Section 9.2.2.2 of the applicant's LA (GLE, 2011a) and Section 6.1 of the applicant's ER (GLE, 2008) describe operational radiological monitoring under its Expanded Monitoring Program.

The staff finds that the applicant has established background and baseline concentrations of radionuclides in environmental media through sampling and analyses under the Expanded Monitoring Program for the proposed facility. These data will be used as part of its radiation protection program and trending analyses to ensure that doses to individual members of the public will be within the dose limits identified in 10 CFR Part 20, Subpart D, and the provisions of the EPA's generally applicable environmental radiation standards in 40 CFR Part 190. In addition, the Expanded Monitoring Program meets the acceptance criteria in Section 9.4.3.2.2(a) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### Sampling and Analyses for Monitoring

Table 9-1 of the LA (GLE, 2011a) and Table 6.1 of the ER (GLE, 2008) provide summaries of the Expanded Monitoring Program, including the medium sampled, sampling locations, sample type (e.g., thermal luminescent dosimeters, grab samples), and analyte/parameter frequency (e.g., total uranium sampled quarterly).

As noted in Section 9.3.3.1 of this SER, above, air monitoring would include continuous sampling of the stack of the main process building as well as weekly composite samples for gross alpha activity and concentrations of uranium isotopes from eleven active air monitors placed around the restricted area fenceline as indicated in Figure 9-1 of the LA (GLE, 2011a) and Figure 6-1 of the applicant's ER (GLE, 2008). The applicant would conduct periodic surveys in and around outdoor storage areas and use dosimeters at the fenceline to ensure direct radiation doses are maintained ALARA.

Wastewater effluent and surface water monitoring would include collection of continuous proportional samples of treated process wastewater effluent and analysis of a weekly composite of the daily samples for gross alpha activity and gross beta activity. Surface water would continue to be monitored for gross alpha activity, gross beta activity, and uranium concentrations. Stormwater runoff from the UF<sub>6</sub> storage area would be routed to a holding pond to be analyzed for uranium and gross alpha and beta activity before the stormwater is released to the proposed facility stormwater wet detention basin.

The groundwater monitoring program would include continued analysis of existing wells and of thirteen additional wells around the proposed facility at varying depths to monitor uranium for gross alpha and gross beta activity. Initially, sampling would be conducted quarterly and would begin prior to commencement of operations to further establish baseline groundwater conditions and continue throughout operations and decommissioning. Proposed facility groundwater sampling locations are identified in Figure 9-3 of the LA (GLE, 2011a) and Figure 6.2 of the ER (GLE, 2008).



The soil monitoring program would include existing on and offsite soil sample locations as well as two additional pairs of locations specific to the proposed facility. These locations are identified on Figure 9-4 of the LA (GLE, 2011a) and Figure 6-3 of the applicant's ER (GLE, 2008). Soil samples would be analyzed for uranium concentrations. Semi-annual sampling would begin prior to commencement of operations to establish baseline conditions and would continue through decommissioning. Sediment monitoring includes collection of samples in the effluent channel downstream from the final process basins to be analyzed for uranium.

As described in Section 6.1.8 of the ER (GLE, 2008), the North Carolina Division of Radiation Protection currently conducts an area surveillance program that would be expanded to include the proposed facility. The program includes sampling and analysis of vegetation, sediment, soil, surface water, and groundwater. The program also has low-volume air samplers that operate continuously.

The staff finds that the applicant's monitoring includes sampling and analyses for monitoring air, surface water, groundwater, soil, sediments, and vegetation meets the acceptance criteria in Section 9.4.3.2.2(2)(b) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff. The staff also finds that the applicant's description in Section 9.2.2 (GLE, 2011a), together with Table 9-1, of its LA (GLE, 2011a), adequately identifies sample media, locations, types, and sampling frequencies is consistent with guidance found in Section 9.4.3.2.2(2)(c) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### Monitoring Procedures

As noted in the staff's discussion of laboratory QC in Section 9.3.2.1, above, the applicant will use written procedures to ensure that sampling and monitoring equipment would be properly maintained, calibrated at regular intervals, which would include functional testing and routine checks, and in good working condition. Samples would be analyzed onsite for facility-related radiological constituents and may be shipped to a qualified independent laboratory for analyses. Laboratories would participate in third-party comparison studies to validate their performance. Sections 11.7 and 11.8 of the applicant's LA (GLE, 2011a) also address, in part, aspects of the QA Program related to maintaining monitoring-related records, as well as developing and implementing monitoring-related procedures.

The staff finds that the applicant's monitoring procedures would employ acceptable analytical methods, instrumentation, laboratory validation methods, and laboratory procedures that are adequate to validate analytical results and meet the acceptance criteria in Section 9.4.3.2.2(2)(d) of NUREG-1520 (NRC, 2002).

#### Action Levels

An action level is the concentration (or mass) of an analyte that indicates that some action needs to be taken, such as an investigation or if the level is high enough, shutting down operations. Action levels are specified in procedures according to the type of samples and the specific analysis. Action levels for monitored environmental parameters will be included in documented procedures as appropriate to provide guidance to assure compliance within appropriate regulatory limits specified in 10 CFR Part 20, Subpart B. The action levels will be consulted on an ongoing basis to initiate internal review and adjustments of operations and other procedures. Response actions for elevated measurements would be set in documented

procedures at increasing levels of priority, ranging from (1) increasing monitoring frequency, (2) to adjusting operations, and (3) performing corrective actions to prevent exceedances of regulatory compliance levels.

The staff finds that the applicant's use of parameter action levels will ensure that concentrations of radioactivity will be below the regulatory limits in 10 CFR Part 20, meets the acceptance criteria in Section 9.4.3.2.2(2)(e) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### Minimum Detectable Concentrations

MDCs for both effluent and environmental samples are listed in Table 9-2 of the LA (GLE, 2011a), and identify the medium (e.g., surface water), activity (e.g., gross alpha, gross beta, total uranium), and typical MDCs (e.g., pCi/L, ppm). The MDCs are typical for the analytical methods employed as previously established for the existing Wilmington Site Monitoring Program.

The staff finds that the MDCs would be sufficient to meet action level, regulatory, and permit requirements, as well as the requirements of environmental media monitoring programs, meet the acceptance criteria in Section 9.4.3.2.2(2)(f) of NUREG-1520 (NRC, 2002), and are, therefore, acceptable to the staff.

#### Data Analysis

Field and laboratory analytical procedures address the collection of representative samples, use of appropriate sampling methods and equipment, proper location of sampling points, and proper handling and analysis of samples.

The staff finds that data analysis methods and criteria to be used in evaluating and reporting environmental sampling results would indicate when an action level is being approached in time to take corrective actions to assure concentrations will be within regulatory limits in 10 CFR Part 20, Appendix B, meets the acceptance criteria in Section 9.4.3.2.2(2)(g) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### Federal, State, and Local Requirements

Section 1.4 of the applicant's ER (GLE, 2008) contains a complete description of required licenses, permits, and other approvals that are required by the Federal government, as well as agencies of the State of North Carolina and New Hanover County, and Table 1-6 also provides the status of each of these requirements. The applicant commits to follow applicable requirements for effluent monitoring activities described in Section 9.2.2.1 of the LA (GLE, 2011a).

Based on the information in Table 1-6 of the ER (GLE, 2008), the staff finds that the information provided satisfies the acceptance criteria in Section 9.4.3.2.2(2)(h) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

## Measurement of Accidental Radioactive and Non-Radioactive Releases to the Environment

In Section 3 of the LA (GLE, 2011a), the applicant describes its ISA, which evaluates potential risks and radiological and non-radiological (e.g., chemical) hazards from postulated unmitigated accident scenarios that could result in injuries to workers and the public or in significant environmental impacts. Assessments of these accidents are documented in the applicant's ISA Summary (GLE, 2011b). The ISA Summary (GLE, 2011b) also identifies engineered or administrative IROFS that would prevent or mitigate the likelihood and consequences of those accident scenarios to acceptable levels. In Section 3.2.5.2 of the LA (GLE, 2011a), the applicant identifies two hazards of concern for the proposed facility. The first is related to a release of UF<sub>6</sub>, which, when exposed to moisture in the air, would form HF as a byproduct that is highly toxic and that could be transported beyond the site boundary. The second hazard is the occurrence of a criticality event that would result in the release of radiation and airborne fission products that, in turn, could result in direct radiation exposure and chemical/radiological inhalation exposure to workers and the public. Table 3-2 of the applicant's LA (GLE, 2011a) identifies, among other things, consequence descriptions to the offsite public and the environment for high and intermediate severity accidents. Table 3-3 identifies EPA Acute Exposure Guideline Levels for UF<sub>6</sub>, HF, and soluble uranium. The applicant also addresses radiological and non-radiological accident analyses, including mitigation measures to attenuate releases to the environment, in Sections 4.12.2.1.2.3 and 4.12.2.2.2.3 of its ER (GLE, 2008). As noted above, the staff's evaluation of these two hazards is found in Chapter 3 of this SER.

As noted above in Sections 9.3.3.1, 9.3.3.2, and 9.3.3.3 of this SER, the Expanded Monitoring Program provides for effluent and environmental monitoring of airborne and liquid releases of uranium, UF<sub>6</sub>, and HF. For example, air emissions from the Operations Building stack are monitored continuously for uranium and HF. In addition ambient air is monitored for activities from the UF<sub>6</sub> cylinder pads. Active air monitors (dosimeters) are also placed around the restricted area fence line for analysis of gross alpha activity and concentrations of uranium isotopes.

The staff finds that the applicant's environmental monitoring is adequate to assess impacts to the environment from potential radioactive and nonradioactive releases, as identified in high and intermediate consequence accident sequences identified in the ISA, adequately addresses related performance requirements in 10 CFR 70.61 for individuals located outside the controlled area, and meets the acceptance criteria in Section 9.4.3.2.2(2)(i) of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

### 9.3.4 ISA SUMMARY

In Chapter 3 of this SER, the staff provides its evaluation of the ISA Summary, and documents its conclusion that the ISA Summary (GLE, 2011b) is complete, provides reasonable estimates of the likelihood and consequences of each accident sequence, and provides sufficient information to determine whether adequate engineering or administrative controls are identified for each accident sequence. Chapter 11 of this SER contains the staff's evaluation of management measures used to ensure that IROFS will satisfactorily perform their intended safety functions. The staff verified that environmental release limits would be met using existing IROFS. Therefore, no additional IROFS are identified for the proposed facility for reducing the environmental risks of natural phenomena and potential accidents.

Under 10 CFR Part 70, Subpart H (paragraphs 70.60 through 70.76), an applicant is to assure, among other things, compliance with various performance requirements. The regulations in 10 CFR 70.61(c)(3) identify the environmental performance requirement that the applicant apply controls such that a credible intermediate consequence event is unlikely to occur or that the consequence of such an event will not exceed a 24-hour averaged release of radioactive material outside the restricted area in concentrations 5000 times the values in Table 2 of Appendix B to 10 CFR Part 20.

In its ISA Summary (GLE, 2008c), the applicant identified various sequences for radiological and non-radiological accidents which were evaluated to assure adequate protection of worker health and safety. By assuring that all credible high-consequence events are rendered highly unlikely and that all intermediate-consequence events are unlikely, the applicant also assured that the environmental performance requirements of 10 CFR 70.61(c)(3) will be met. The staff determined that environmental consequences could occur only if uncontrolled, intermediate or high consequences to workers were also present. The staff did not identify any accident sequence that would fail to meet the environmental performance requirements of 10 CFR 70.61(c)(3).

The applicant's approach to risk reduction is to be accomplished through a combination of preventive and mitigative measures, with an emphasis on preventive measures. A more complete discussion is found in Chapter 3 of the SER, which addresses accident sequences for high and intermediate consequence events. It also addresses preventive and mitigative measures.

The staff finds that the applicant's ISA Summary complies with 10 CFR Part 70, meets the acceptance criteria in section 9.4.3.2.3 of NUREG-1520 (NRC, 2002), and is, therefore, acceptable to the staff.

#### **9.4 EVALUATION FINDINGS**

The applicant has developed a program to implement adequate environmental protection measures during operation. These measures include: (1) environmental and effluent monitoring and (2) effluent controls to maintain public doses ALARA as part of the radiation protection program. The NRC staff concludes that the applicant's program, as described in its application, is adequate to protect the environment and the health and safety of the public, and complies with regulatory requirements imposed by the Commission in 10 CFR Parts 20, 30, 40, 51, and 70.

The NRC staff will issue a Final EIS as part of this licensing action, as required by 10 CFR 51.20. The Final EIS will consider the environmental impacts of the proposed construction, operation, and decommissioning of the proposed facility and compare alternatives to inform the NRC staff recommendation concerning the license application for the proposed facility.

#### **9.5 REFERENCES**

(GLE, 2008) General Electric-Hitachi Global Laser Enrichment (GLE). "Environmental Report for the GLE Commercial Facility," 2008.

(GLE, 2011a) General Electric-Hitachi Global Laser Enrichment (GLE). "GE-Hitachi Global Laser Enrichment LLC Commercial Facility License Application," Revision 6, 2011.

(GLE, 2011b) General Electric-Hitachi Global Laser Enrichment (GLE). "Integrated Safety Analysis Summary for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility," Revision 4. 2011.

(NRC, 1985) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 4.16, "Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants," Revision 1, 1985.

(NRC, 1993) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 8.37, "ALARA Levels for Effluents From Materials Facilities," 1993.

(NRC, 1994) U.S. Nuclear Regulatory Commission (NRC). Information Notice 94-23, "Guidance to Hazardous, Radioactive, and Mixed-Waste Generators on the Elements of a Waste Minimization Program," 1994.

(NRC, 1996) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 4.20, "Constraint on Releases of Airborne Radioactive Material to the Environment for Licensees Other Than Power Reactors," 1996.

(NRC, 2002) U.S. Nuclear Regulatory Commission (NRC). NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility." 2002.

(NRC, 2008) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning." 2008.



## 10.0 DECOMMISSIONING

The purpose of the U.S. Nuclear Regulatory Commission's (NRC's) review of General Electric-Hitachi Global Laser Enrichment LLC's (GLE's) decommissioning approach is to evaluate whether the application provides for decommissioning the facility safely and in accordance with U.S. Nuclear Regulatory Commission (NRC) requirements.

At the time of the initial license application (LA) for a uranium enrichment facility, the applicant is required to submit a decommissioning funding plan (DFP). The purpose of NRC's review of the DFP is to determine whether the applicant has considered decommissioning activities that may be needed in the future, has performed a credible site-specific cost estimate for those activities, and has presented NRC with financial assurance to cover the cost of those activities in the future. The DFP, therefore, should contain an overview of the applicant's proposed decommissioning activities, the methods used to determine the cost estimate, and the financial assurance mechanism. This overview should contain sufficient detail to enable the reviewer to determine whether the decommissioning cost estimate is reasonably accurate. In its LA, the applicant submitted both public and non-public, proprietary versions of its DFP (GLE, 2010a).

### 10.1 REGULATORY REQUIREMENTS

The following NRC regulations require planning, financial assurance, and recordkeeping for decommissioning, as well as procedures and activities to minimize waste and contamination:

- 10 CFR 20.1401-1406 "Radiological Criteria for License Termination"
- 10 CFR 30.35 "Financial Assurance and Recordkeeping for Decommissioning"
- 10 CFR 30.36 "Expiration and Termination of Licenses and Decommissioning of Sites and Separate Buildings or Outdoor Areas"
- 10 CFR 40.14 "Specific Exemptions"
- 10 CFR 40.36 "Financial Assurance and Recordkeeping for Decommissioning"
- 10 CFR 40.42 "Expiration and Termination of Licenses and Decommissioning of Sites and Separate Buildings or Outdoor Areas"
- 10 CFR 70.17 "Specific Exemptions"
- 10 CFR 70.22(a)(9) "Contents of Application" (Proposed Decommissioning Funding Plan)
- 10 CFR 70.25 "Financial Assurance and Recordkeeping for Decommissioning"
- 10 CFR 70.38 "Expiration and Termination of Licenses and Decommissioning of Sites and Separate Buildings or Outdoor Areas"

## **10.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA**

The guidance applicable to NRC's review of the decommissioning section of the LA (GLE, 2011) is contained in Chapter 10 of "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," NUREG-1520 (NRC, 2002a) and in Volume 3 of "Consolidated NMSS Decommissioning Guidance," NUREG-1757 (NRC, 2006). Chapter 10 of NUREG-1520 (NRC, 2002a) is applicable to the proposed facility, except that the review used NUREG-1757 (NRC, 2006), which is the updated version of NUREG-1727, "NMSS Decommissioning Standard Review Plan" (NRC, 2000a), referenced in NUREG-1520 (NRC, 2002a). The acceptance criteria applicable to this review are contained in Section 10.4 of NUREG-1520 (NRC, 2002a).

NUREG-1757 (NRC, 2006), Volumes 1 and 2, provides guidance for developing final decommissioning plans required under 10 CFR 30.36(g), 10 CFR 40.42(g), and 10 CFR 70.38(g). A final decommissioning plan will be provided at the time of decommissioning. At the time of initial licensing and for license renewals, Section 10.1 of NUREG-1520 (NRC, 2002a) describes an overview of the proposed decommissioning activities needed to develop the DFP. This overview is a more generalized discussion of the detailed information that would be needed for the final decommissioning plan described in NUREG-1757 (NRC, 2006), Volumes 1 and 2. Section 10.5.2 of NUREG-1520 (NRC, 2002a) indicates that the decommissioning safety review should ensure that the proposed decommissioning approach, principal remediation activities, and worker and environmental radiation protection programs are acceptable.

In the Commission's January 7, 2010, Order initiating the GLE license proceeding (NRC, 2010), the Commission provided criteria for addressing the treatment of depleted uranium produced from the proposed facility. In the Order, the Commission stated that unless GLE demonstrates a use for uranium in the depleted tails, the depleted tails will be considered waste. The Commission previously concluded that depleted uranium from an enrichment facility is appropriately classified as low-level radioactive waste. See Louisiana Energy Services (National Enrichment Facility) CLI-05-05, 61 NRC 22, 36 (NRC, 2005). An approach for disposition of tails that is consistent with the USEC Privatization Act, such as transfer to the U.S. Department of Energy (DOE) for disposal, constitutes a "plausible strategy" for disposition for GLE depleted tails. Consequently, depleted uranium generated in the operation of the proposed facility is considered as a potential decommissioning obligation in the DFP.

## **10.3 STAFF REVIEW AND ANALYSIS**

NRC's staff review of the DFP (GLE, 2010a) focused on the applicant's conceptual decommissioning activities for the proposed facility, the decommissioning cost estimates, and the financial assurance for decommissioning activities. In Chapter 10 of the LA (GLE, 2011), the applicant identified the decommissioning activities that may be needed in the future for decommissioning and presented site-specific estimates of decommissioning costs for those activities. The applicant submitted to the NRC public and non-public, proprietary versions of the DFP (GLE, 2010a). The non-public version provides a proprietary estimate of the cost to decommission the facility and dispose of the depleted tails. The DFP (GLE, 2010a) also contains a draft financial assurance instrument that will be used to cover the decommissioning cost estimate.

The following subsections describe the applicant's proposed decommissioning program, and NRC staff's assessment of the applicant's proposed decommissioning plan, cost estimate, and funding plan. Before license termination, the applicant will provide a detailed decommissioning



plan that will include specific activities which will be used to protect workers, the public, and the environment.

### 10.3.1 CONCEPTUAL DECONTAMINATION AND DECOMMISSIONING PLAN

#### 10.3.1.1 Decommissioning Strategy

Section 10.1 of NUREG-1520 (NRC, 2002a) states that the DFP needs to contain an overview of the proposed decommissioning activities. This section of this Safety Evaluation Report (SER) describes the staff's review of the overview of the decommissioning activities used to develop the site-specific cost estimate in the DFP. A detailed decommissioning plan will be provided at the time of decommissioning in accordance with 10 CFR 30.36(g), 10 CFR 40.42(g), and 10 CFR 70.38(g).

In Section 10.1.1 of the LA (GLE, 2011), the applicant stated that it would decommission the proposed facility after facility shutdown to reduce the level of radioactivity remaining in the facility to residual levels acceptable for release of the facility for unrestricted use and for NRC license termination pursuant to 10 CFR 20.1401 and 10 CFR 20.1402. Prior to decommissioning, an assessment of the radiological status of the proposed facility will be made. Decommissioning and closure activities will include the cleaning and removal of radioactive and hazardous waste contamination that may be present on materials, equipment, and structures.

In Section 10.1.1 of the LA (GLE, 2011), the applicant stated that decommissioning of the proposed facility will require longer than 24 months. The regulations in 10 CFR 30.36(h)(1), 40.42(h)(1), and 70.38(h)(1) state that licensees shall complete decommissioning of the site or separate building or outdoor area as soon as practicable but no later than 24 months following the initiation of decommissioning, except as provided in paragraphs 30.36(i), 40.42(i), and 70.38(i). The regulations in 10 CFR 30.36(i), 40.42(i), and 70.38(i) state that the Commission may approve a request for an alternate schedule for completion of decommissioning of the site or separate building or outdoor area, and license termination if appropriate, if the Commission determines that the alternative is warranted by consideration of five factors, including whether it is technically feasible to complete decommissioning within the allotted 24-month period. Therefore, the applicant requested an alternate schedule in accordance with 10 CFR 30.36(i), 40.42(i), and 70.38(i). The reason for the project taking longer than 24 months is due to the complexity and scope of the project. Therefore, it is not technically feasible to complete decommissioning within the allotted 24-month period. Overall, decommissioning is estimated to require approximately 3.5 years from facility shutdown to completion of the final status survey of radiological conditions. The decommissioning schedule is presented in Figure 10-1 of the LA (GLE, 2011).

Section 2.6 of NUREG-1757 (NRC, 2006), Volume 3, provides review criteria related to decommissioning timeliness. As described above, the applicant plans to initiate decommissioning at the time of facility shutdown, but requested an extension of the 24-month decommissioning schedule because of the technical complexity of decommissioning the proposed facility. The applicant proposed a 3.5-year decommissioning schedule. The NRC staff reviewed the applicant's justification for requesting an alternate schedule for decommissioning and agree that decommissioning of the facility is technically complex. NRC staff considers that the size of the facility and the complexities of dispositioning classified equipment justify an extended decommissioning schedule. In addition, the facility has a radiation protection program in place described in Chapter 4 of the LA (GLE, 2011) that will ensure that an adequate health and safety program is conducted to protect workers and the

public. Therefore, a longer period of time to decommission the facility is reasonable and will not endanger health and safety. Based on the considerations in 10 CFR 30.36(i), 40.42(i), and 70.38(i), the staff finds that the applicant's proposed alternative 3.5-year schedule is acceptable.

In Sections 10.1.1.1 and 10.1.1.2 of the LA (GLE, 2011), the applicant describes in accordance with 10 CFR 20.1406 that the proposed facility will be designed and operated in such a way to minimize contamination, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste. As a result, worker exposure to radiation and radioactive waste volumes during operations and decommissioning are maintained as low as reasonably achievable (ALARA).

Section 10.5.2 of NUREG-1520 (NRC, 2002a) indicates that the decommissioning safety review should ensure that the proposed decommissioning approach, principal remediation activities, and worker and environmental radiation protection programs are acceptable. Section 4 of NUREG-1757 (NRC, 2006), Volume 3, indicates that a DFP outlines the scope of work needed to decommission the facility. As described above, the applicant is proposing to decommission the facility to the unrestricted release standard in 10 CFR 20.1402. The NRC staff reviewed the applicant's proposed decommissioning strategy and determined that it contains adequate commitments to meet the radiological criteria for unrestricted use contained in 10 CFR 20.1402, and to be timely, in accordance with the alternative schedule approved in accordance with 10 CFR 30.36(i), 40.42(i), and 70.38(i). The applicant's commitments also meet the evaluation criteria in Section 10.5.2 of NUREG-1520 (NRC, 2002a) and Section 4 of NUREG-1757 (NRC, 2006), Volume 3, and are, therefore, acceptable, because the applicant proposed an acceptable decommissioning strategy and scope of work for decommissioning the facility.

#### 10.3.1.2 Decommissioning Steps

In Section 10.1.2 of the LA (GLE, 2011), the applicant describes the decommissioning methods to be employed at the proposed facility, and Section 10.1.8 of the LA (GLE, 2011a) addresses the decontamination process. NRC's review of the applicant's decontamination process is explained in Section 10.3.1.8 of this SER.

Decommissioning activities will generally include: (1) shutdown and purging/draining of process systems; (2) dismantling and removal of equipment; (3) decontamination and destruction of classified material in accordance with 10 CFR Part 95; (4) sales of salvaged materials (sale of salvaged materials is not included in the decommissioning cost estimate); (5) waste disposal; and (6) completion of a final radiation survey.

Installation of new facilities will not be required for decontamination of facility components and structures. The applicant will use existing facilities in the Decontamination/Maintenance Area in the Operations Building for these activities. This area is capable of accommodating the cleaning of equipment and maintenance/cleaning of large components.

In Section 10.1.2.7 of the LA (GLE, 2011), the applicant stated that a final radiation survey must be performed to verify proper decontamination to allow the site to be released for unrestricted use. The evaluation of the final radiation survey is based in part on an initial radiation survey performed prior to initial operation. The applicant will perform an initial survey to determine the natural background radiation of the area prior to site preparation and construction. These measurements will be used to determine any increase in levels of radioactivity during facility operations. The applicant will follow the guidance in the following documents to perform the initial survey:

- NUREG-1505, “A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys,” Section 2.2.5 (NRC, 1998);
- NUREG-1575, “Multi-Agency Radiation Survey and Site Investigation Manual,” Section 4.5 (NRC, 2000b); and
- NUREG-1757, “Consolidated Decommissioning Guidance,” Volume 2, “Characterization, Survey, and Determination of Radiological Criteria” (NRC, 2006).

The final survey will be a systematic measurement of radioactivity over the entire site. The number of survey points will vary depending on the location and levels of radioactivity. The survey will be conducted in accordance with current NRC guidance. The results will be evaluated to demonstrate that the site can be released for unrestricted use. If data show that radioactivity is above allowable residual radioactivity limits, further decontamination will be performed.

Section 10.5.2 of NUREG-1520 (NRC, 2002a) indicates that the decommissioning safety review should ensure that the proposed decommissioning approach, principal remediation activities, and worker and environmental radiation protection programs are acceptable. The evaluation criteria in Section 4.1 of NUREG-1757 (NRC, 2006), Volume 3, indicate that the decommissioning planning information used in the decommissioning cost estimate should be sufficient to allow NRC staff to determine if the applicant’s cost estimate is adequate. NRC staff reviewed the applicant’s proposed decommissioning steps and determined that it has the essential steps needed to decommission the facility to meet the restricted release criteria in 10 CFR 20.1402. In addition, the proposed decommissioning steps provide reasonable assurance that the decommissioning process can be performed in a manner that will minimize the generation of radioactive and hazardous wastes and protect the health and safety of workers and the public. NRC staff determined that the applicant’s commitment to following the specified NRC guidance for conducting initial and final radiation surveys provides reasonable assurance that the final survey will be adequate to demonstrate that the site can be released for unrestricted use in accordance with 10 CFR 20.1402 and the evaluation criteria in Section 10.5.2 of NUREG-1520 (NRC, 2002a) and Section 4.1 of NUREG-1757 (NRC, 2006), Volume 3. The proposed decommissioning steps are, therefore, acceptable.

#### 10.3.1.3 Management and Organization

In Section 10.1.3 of the LA (GLE, 2011), the applicant stated that an appropriate organization structure will be used for the decommissioning operations. The organizational structure will ensure that appropriate resources are available to perform the technical and administrative tasks required for decommissioning, including experienced and knowledgeable staff. The organizational structure and decommissioning capabilities would be presented in the decommissioning plan submitted at the time of decommissioning.

The applicant will conduct proper training and prepare applicable procedures to ensure worker health and safety. The decommissioning program will emphasize the minimization of wastes and worker exposures to hazardous or radioactive materials. Qualified decommissioning contractors will meet facility security and training requirements and work under facility procedural controls.

Section 10.5.2 of NUREG-1520 (NRC, 2002a) indicates that the decommissioning safety review should ensure that the proposed decommissioning approach, principal remediation activities, and worker and environmental radiation protection programs are acceptable. NRC staff has determined that the applicant's commitment to develop a management organization to support the decommissioning program will provide reasonable assurance that the applicant will be able to execute the proposed decommissioning strategy described in Sections 10.3.1.1 and 10.3.1.2 of this SER. This commitment meets the evaluation criteria in Section 10.5.2 of NUREG-1520 (NRC, 2002a), and is acceptable.

#### 10.3.1.4 Health and Safety

In Section 10.1.4 of the LA (GLE, 2011), the applicant provides commitments to keep individual and collective occupational radiation exposures ALARA, and to maintain the radiation protection program and the nuclear criticality safety function during decommissioning. The Radiation Protection Program, described in Section 4.1 of the LA (GLE, 2011), establishes a program for worker protection and for use of survey and monitoring instruments. The ALARA program is described in Section 4.2 of the LA (GLE, 2011) and provides a program for meeting facility ALARA goals. The Nuclear Criticality Safety function, described in Chapter 5 of the LA (GLE, 2011), ensures that special nuclear material (SNM) is safely processed, packaged, and stored to prevent inadvertent criticalities. The applicant will use the change process identified in Section 11.1.4 of the LA (GLE, 2011) for their removal.

Section 10.5.2 of NUREG-1520 (NRC, 2002a) indicates that the decommissioning safety review should ensure that the proposed decommissioning approach, principal remediation activities and worker and environmental radiation protection programs are acceptable. NRC staff has determined that the applicant's commitment to maintain radiation protection, and nuclear criticality safety during decommissioning provides reasonable assurance that health and safety will be protected during decommissioning in accordance with 10 CFR 20, Subpart C and, therefore, the evaluation criteria in Section 10.5.2 of NUREG-1520 (NRC, 2002a), and is acceptable.

#### 10.3.1.5 Waste Management

In Sections 9.2.2.1.14 and 10.1.5 of the LA (GLE, 2011), the applicant states that radioactive and hazardous wastes generated in the facility decommissioning will be collected, handled, and disposed of in accordance with requirements applicable to the proposed facility at the time of decommissioning. Waste management procedures are expected to be similar to those for wastes produced during facility operations. These wastes will be disposed of in licensed radioactive or hazardous waste disposal facilities. Non-hazardous and non-radioactive wastes generated during decommissioning will be disposed of consistent with standard industrial practice and in accordance with applicable requirements.

Under Section 3113 of the USEC Privatization Act of 1996 (Title 42 U.S.C. 2297h), DOE is required to accept depleted uranium tails from NRC-licensed uranium enrichment plants, if the depleted uranium tails are low-level radioactive wastes, and if requested by the enrichment facility. In addition, the generator of the waste must reimburse DOE for the disposal of the depleted uranium in an amount equal to DOE's costs, including a pro rata share of any capital costs. In Section 10.2.2 of the LA (GLE, 2011), the applicant stated that depending on future technical advances and the existence of facilities, depleted uranium may be marketable for further enrichment or other commercial uses. However, for the purposes of estimating dispositioning costs, it is assuming that the total quantity of depleted uranium tails generated at

the proposed facility would be dispositioned by DOE under the provisions of the USEC Privatization Act. Therefore, the applicant's proposed approach for dispositioning depleted uranium tails would constitute a "plausible strategy" for depleted uranium tails in accordance with the Commission Order, dated January 7, 2010 (NRC, 2010). As discussed in Section 10.3.2.1 of this SER, the applicant provided a cost estimate from DOE for tails disposition.

Section 10.5.2 of NUREG-1520 (NRC, 2002a) indicates that the decommissioning safety review should ensure that the proposed decommissioning approach, principal remediation activities, and worker and environmental radiation protection programs are acceptable. NRC staff has reviewed the applicant's commitments to manage depleted uranium tails and wastes generated during decommissioning activities and has determined that they are consistent with the applicable NRC regulations in 10 CFR 20, Subpart K, the Commission Order of January 7, 2010 (NRC, 2010), the evaluation criteria in Section 10.5.2 of NUREG-1520 (NRC, 2002a), and are, therefore, acceptable.

#### 10.3.1.6 Security and Nuclear Material Control

In Section 10.1.6 of the LA (GLE, 2011), the applicant states that it will maintain its physical security program and nuclear material control and accountability (MC&A) program during decommissioning in a manner similar to the programs in force during facility operation. For operations, the physical security program is described in the Physical Security Plan (PSP) (GLE, 2010b) and the Nuclear Material Transportation Security Plan (NMTSP) (GLE, 2010c). The MC&A program is described in the Fundamental Nuclear Material Control Plan (FNMCP) (GLE, 2010d). The PSP (GLE, 2010b) is evaluated in Chapter 13 of the SER, the NMTSP (GLE, 2010c) is evaluated in Chapter 14 of this SER, and the FNMCP (GLE, 2010d) is evaluated in Chapter 12 of this SER. The applicant will propose any changes to these programs in the Decommissioning Plan (DP) to be submitted near the end of plant life.

Section 10.5.2 of NUREG-1520 (NRC, 2002) indicates that the decommissioning safety review should ensure that the proposed decommissioning approach, principal remediation activities, and worker and environmental radiation protection programs are acceptable. NRC staff has reviewed the applicant's commitment to maintain physical security and MC&A requirements during decommissioning and determined that they provide reasonable assurance that the applicant will meet the regulatory requirements in 10 CFR 70.23(a)(6) and (a)(10) and 10 CFR Parts 73 and 74. As described above, these commitments are, therefore, acceptable.

#### 10.3.1.7 Recordkeeping

In Section 10.1.7 of the LA (GLE, 2011), the applicant states that records important for safe and effective decommissioning of the proposed facility will be maintained in accordance with the Records Management procedural requirements and the regulatory requirements of 10 CFR 30.35(g), 40.36(f), and 70.25(g). Under this decommissioning recordkeeping program, the applicant will maintain records of spills and unusual occurrences involving the spread of radioactive contamination; as built drawings, including modification of structures and equipment where radioactive contamination could exist; a list contained in a single document updated biennially of areas that contain, are designated to contain, or formerly contained radioactive materials; and records associated with decommissioning cost estimates.

Records management is further discussed in Section 11.7.1 of the LA (GLE, 2011). Decommissioning records are maintained in this program as stated in Section 11.7.3.4 of the LA (GLE, 2011). Under the records management program, records are maintained in specific

locations designated to contain records, will be legible, maintained in organized files, stored in steel cabinets, and controlled by procedure and access requirements. Procedures will be in place to avoid loss or tampering of records and to enable record auditing with clearly designated management responsibilities. The applicant will use those procedures for reviewing, approving, handling, identifying, updating, retention, retrieval, and maintenance of records.

Section 3.1 of NUREG-1757 (NRC, 2006), Volume 3, provides guidance on implementing the decommissioning recordkeeping requirements during licensed operations. As described above, the applicant proposed a decommissioning recordkeeping program that requires record storage in defined locations, use of records management procedures, verification of legibility, protection against loss or tampering, provisions for updating, efficient retrieval, clear responsibility of management, and management review and audits. The applicant committed to maintaining records of spills and unusual circumstances resulting in radioactive contamination and records of facility, equipment, and site drawings useful for decommissioning. The NRC staff has reviewed the applicant's commitments to maintain decommissioning records and determined that they are in accordance with NRC regulations in 10 CFR 30.35(g), 40.36(f), and 70.25(g), and Section 3.1 of NUREG-1757 (NRC, 2006), Volume 3, and, therefore, are acceptable.

#### 10.3.1.8 Decontamination Process

In Section 10.1.8 of the LA (GLE, 2011), the applicant provides an overview of the proposed decontamination methods.

The methods to be used to decontaminate and decommission the proposed facility will be developed based upon the site characterization survey performed during that phase of decommissioning planning. These methods will be described in detail in the DP to be submitted to the NRC prior to commencing decommissioning activities. The applicant will use past experience and lessons learned from previous decommissioning efforts in selecting the methods to be used. Typical decommissioning steps include removing surface contamination on equipment and building internals and purging lines to remove licensed material internal to piping systems and components.

Some of the equipment, most of the buildings, and the outdoor areas are expected to be acceptable for release for unrestricted use in accordance with 10 CFR 20.1402 without the need for extensive decontamination. If these areas were inadvertently contaminated during enrichment operations, these areas will likely have been remediated when the contamination was discovered.

Decontamination is expected to be performed in the existing Decontamination/Maintenance Area. This area will be used for decontamination of large and small components and for packaging prior to temporary storage and shipping of radioactive wastes to a licensed disposal facility.

The applicant will develop and use procedures for decontamination operations. These procedures will be approved by facility management in accordance with the management measures described in Section 11.4 of the LA (GLE, 2011). These procedures will be developed to minimize worker exposure and waste volumes, and to ensure work is carried out safely.

Section 10.5.2 of NUREG-1520 (NRC, 2002) indicates that the decommissioning safety review should ensure that the proposed decommissioning approach, principal remediation activities,

and worker and environmental radiation protection programs are acceptable. As stated in Section 4 of NUREG-1757 (NRC, 2006), Volume 3, for an applicant submitting a DFP at the time of license application, NRC staff will review the accuracy and appropriateness of the methods used by the licensee to estimate the costs of decommissioning. NRC staff has reviewed the applicant's conceptual decontamination methods and has determined that the proposed methods are appropriate and that the applicant will be able to develop a detailed decommissioning plan at the time of decommissioning that will meet applicable NRC regulations and guidance. The proposed decommissioning methods are, therefore, acceptable.

### 10.3.2 DECOMMISSIONING COSTS AND FINANCIAL ASSURANCE

#### 10.3.2.1 Decommissioning Costs

In Section 10.2.1 of the LA (GLE, 2011), the applicant described the Decommissioning Cost Estimate (DCE) for the proposed facility. The applicant also submitted both a public and proprietary DFP (GLE, 2010a) to meet the requirements in 10 CFR 30.35, 10 CFR 40.36, and 10 CFR 70.25. The DFP was intended to be consistent with the recommendations in NUREG-1757 (NRC, 2006), Volume 3, "Consolidated NMSS Decommissioning Guidance - Financial Assurance, Recordkeeping, and Timeliness." The DFP (GLE, 2010a) includes a DCE for the proposed facility and a cost estimate prepared by DOE for providing depleted uranium hexafluoride (UF<sub>6</sub>) conversion and disposal services to the applicant. The applicant presented a detailed facility description and the number and dimensions of facility components to be decommissioned in Tables C3.4 and C3.5 of the DFP (GLE, 2010a); estimates of labor required by decommissioning activity and labor category in Tables C3.6 to C3.12; and its DCE breakdown in Tables C3.13 through C3.19 of the DFP and in Tables 1 through 4 of the DOE cost estimate. Decommissioning cost information includes labor costs by labor category, proposed decontamination methods and unit costs, radioactive waste packaging, shipping, and disposal costs, final survey costs, and costs for dispositioning depleted uranium tails. Restoration of contaminated areas on facility grounds is not expected to be required because routine surveys will detect contamination and the contamination will be removed. The applicant plans decommissioning such that the facilities can be released for unrestricted use; therefore, site stabilization and long-term surveillance are not necessary.

The specific details of the cost estimate for decommissioning the Operations Building, which includes the process, support, and waste storage areas are proprietary. The staff reviewed the proprietary information to evaluate the completeness of the estimate, the level of detail presented, and the reasonableness of the estimate (i.e., the accuracy and magnitude of the estimated costs), as identified in NUREG-1757, Volume 3, Appendix A, Section A.3.1 (NRC, 2006). The staff confirmed that the DCE included detailed estimates for the costs of planning and preparation, descriptions of the number and dimensions of facility components, estimates for the costs of decontamination or dismantling of radioactive facility components, and the final radiation survey. The staff reviewed the estimates for the necessary labor categories and labor-hours to decontaminate the operations, the proposed decontamination and decommissioning activities, the estimated volumes and types of materials resulting from decommissioning these operations, and packaging, shipping and disposal costs for radioactive wastes, and confirmed that they were reasonable. The basis for the staff's conclusion was that the applicant developed its DCE using the format and addressing the topics at the level of detail recommended in NUREG-1757, Volume 3, Appendix A, Tables A.3.4 through A.3.18 (NRC, 2006).

The applicant based its labor estimates on the cost, including overhead and profit, of independent third parties to perform the work. Removal costs for certain components are based

on Unit Cost Factors (UCFs) based initially on the approach in Atomic Industrial Forum (AIF) AIF/NESP-036, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates" (AIF, 1986) and adjusted based on extensive experience by a contractor to the applicant with more than 20 years of experience in performing nuclear decommissioning work. Other costs are based on the estimated numbers and dimensions of facility components.

The staff reviewed the detailed explanation of the derivation of the UCFs and the UCFs themselves and concluded they were reasonable, using the criteria in NUREG-1757, Volume 3, Appendix A, Section A.3.1.3, that if cost justifications are based on past experience the experience must be relevant with respect to facilities, materials, processes, management, regulatory requirements, and price levels. When possible, the staff compared the applicant's estimates to the estimates in NUREG/CR-6477, "Revised Analyses of Decommissioning Reference Non-Fuel-Cycle Facilities" (NRC, 2002b). Although the cases in NUREG/CR-6477 (NRC, 2002b) do not include a case for decommissioning a laser uranium enrichment plant, and while in many cases NUREG-6477 (NRC, 2002b) did not have a directly corresponding activity or component, some information can be compared with the cost estimates provided by the applicant.

The applicant's costs for packaging, shipping, and disposal of radioactive wastes provided in Table C3.14 of Appendix C of the DFP (GLE, 2010a) are based on cost estimates provided by a third party transport company and on existing contracts for waste disposal services. The latter are escalated to FY 2009 dollars using the Bureau of Labor Statistics Consumer Price Index (CPI). The packaging, shipping, and disposal costs are provided in detail, and the staff concluded they are reasonable estimates. The staff confirmed that the applicant's DCE includes a 25 percent contingency and confirmed that no credit is taken for salvage of materials or equipment. The use of independent third party labor costs, a 25 percent contingency factor, and taking no credit for salvage value are all consistent with staff guidance in NUREG-1757, Volume 3, Section A.3.1 (NRC, 2006).

The publicly available estimate for decommissioning the remainder of the facility was also reviewed to evaluate the completeness, level of detail, and reasonableness of the estimate. The staff evaluated the estimated labor costs, decontamination methods and unit costs, waste disposal costs, depleted uranium disposition costs, and final survey costs. The applicant is designing the facility with specific features that simplify the eventual facility decommissioning and minimize worker exposure by minimizing the level and potential spread of radioactive contamination during operation. These features are described in Sections 10.1.1.1 and 10.1.1.2 of the LA (GLE, 2011).

Consistent with the recommendations in Section 10.5 of NUREG-1520 (NRC, 2002a), the DFP was evaluated against the NRC requirements and acceptance criteria identified in NUREG-1757 (NRC, 2006). Both the proprietary and nonproprietary estimates were evaluated and found to be complete, to have the necessary level of detail, and to be reasonable, considering the accuracy and magnitude of the estimated costs.

In Section 10.2.1.3 of the LA (GLE, 2011), the applicant described how it would update the DFP. In accordance with 10 CFR 30.35(e), 10 CFR 40.36(d), and 10 CFR 70.25(e), the applicant will update the decommissioning cost estimate for the facility and the associated funding levels, over the life of the facility. These updates will take into account changes resulting from inflation or site-specific factors, such as changes in facility conditions or expected decommissioning procedures. These funding level updates will also address anticipated accumulated tails. As required by 10 CFR 30.35(e), 10 CFR 40.36(d), and 10 CFR 70.25(e), such updates will occur



at least every 3 years. In Section 10.2.2 of the LA (GLE, 2011) the applicant is committing to adjust the cost estimate for UF<sub>6</sub> tails disposition annually, as discussed below.

In Section 10.2.1.4 of the LA (GLE, 2011), the applicant described its recordkeeping plans related to decommissioning funding. In accordance with 10 CFR 30.35(g), 40.36(f), and 70.25(g), the applicant will retain records of information that may have a material effect on the ultimate costs of decommissioning until the termination of the license. The records will include information regarding the following: (1) spills or other contamination that causes contamination to remain following cleanup efforts, (2) as-built drawings of structures and equipment, and modifications thereto, where radioactive contamination exists (such as from the use or storage of such materials); (3) original and modified cost estimates of decommissioning; and (4) original and modified decommissioning funding instruments and supporting documentation. The staff confirmed that these recordkeeping plans are consistent with the requirements of 10 CFR 30.35(g), 40.36(f), and 70.25(g) and meet the minimum criteria stated in NUREG-1757, Volume 3, Appendix A, Section A.1.5. (NRC, 2006).

In Section 10.2.2 of the LA (GLE, 2011) and in the DFP (GLE, 2010a), the applicant described its plan for dispositioning depleted UF<sub>6</sub> tails. Under Section 3113 of the USEC Privatization Act of 1996 (Title 42 U.S. Code 2297h), DOE "at the request of the generator, shall accept for disposal low-level radioactive waste, including depleted uranium, if it is ultimately determined to be low-level radioactive waste, generated by any person licensed by the Nuclear Regulatory Commission to operate a uranium enrichment facility." The generator must reimburse DOE for the disposal of depleted uranium in an amount equal to DOE's costs, including a pro rata share of any capital costs. On January 18, 2005, the Commission issued an order stating that depleted uranium is a low-level radioactive waste (NRC, 2005). Therefore, if the applicant requests, DOE is required under the USEC Privatization Act of 1996 to accept the depleted uranium generated by the applicant. At the request of the applicant, DOE provided a cost estimate for dispositioning depleted uranium generated by the applicant (DOE, 2009) included as Appendix E to the DFP (GLE, 2010a).

At full capacity, the facility will generate approximately 10,500 MT of UF<sub>6</sub> tails annually. The applicant estimates that it will take approximately 8 years after issuance of the license for the facility to ramp up to the full capacity of 6 million Separative Work Units (SWU) per year. The applicant indicated that the waste processing and disposal costs for UF<sub>6</sub> tails disposition are \$7.75/kg UF<sub>6</sub> tails. This cost is based on the total of the four cost components that make up the total disposition cost for DUF<sub>6</sub> (i.e., capital costs for the conversion facility, conversion operations, transportation and disposal, and decontamination and decommissioning of the conversion facility), as estimated by DOE. The staff reviewed the basis of each of these cost components, and has concluded that they are reasonable.

The capital costs component of the deconversion cost represents the applicant's pro rata share of the projected cost to design and construct the necessary facilities. The estimate for design and construction is based on a current contract between DOE and Uranium Disposition Services, LLC (UDS), which is the construction and initial operations contractor. An estimated cost increase from 2008 has been added by DOE to the UDS construction baseline cost from November 2007. The staff confirmed that DOE's calculation of capital costs to be amortized over the life of conversion operations (presented as cost per kilogram of depleted UF<sub>6</sub>) is reasonable, based on the total amounts of depleted UF<sub>6</sub> to be processed.

The staff reviewed the elements of the DOE cost estimate comprising the annual operations cost estimate for deconversion, which are based on estimates provided to DOE by UDS, the

initial operations contractor, in 2007 dollars. The estimated cost per kilogram DUF<sub>6</sub> includes direct operations of the deconversion facilities, project management and fee to UDS, and DOE management and contingency costs. Costs are presented for both minimum and maximum throughput over the course of the UDS contract with DOE. Transportation and disposal costs are based on rail shipment from the DOE conversion facility to a transload facility and truck shipments to the Nevada Test Site (NTS). DOE is directly funding the NTS operations and transload facility, and the transportation and disposal costs are based on DOE's 2007 Operations Baseline estimate for its own operations. DOE concluded that disposal at an Energy Solutions site would result in higher disposal costs, but lower transportation cost, and that on balance the cost difference would have a minimal impact on the cost per kilogram estimate. The decontamination and decommissioning of the conversion facility is estimated to begin in 2050, and is estimated at \$200 million in 2007 dollars. The staff noted that the DOE cost estimate takes into account only the conversion and disposal of GLE's projected inventory and DOE's current inventory of DUF<sub>6</sub>. According to DOE, "If DOE were to convert and dispose of additional inventories of DUF<sub>6</sub>, DOE anticipates that the estimated unit cost . . . would likely decrease" (GLE, 2010a, Appendix E).

The applicant based its estimate for the total disposal cost per kilogram of UF<sub>6</sub> tails on the maximum amount in 2007 dollars per kilogram from the DOE 2009 cost estimate, escalated to 2009 dollars, using the Bureau of Labor Statistics CPI. The applicant also increased the DOE estimate, which did not include transportation costs to the DOE conversion facility, by estimated transportation costs from the proposed GLE facility to the DOE conversion facility in Piketon, Ohio. The applicant based these shipping and transportation costs on estimates provided by third parties. The applicant then added a 25 percent contingency to reach the estimated cost of \$7.75/kg UF<sub>6</sub>.

Staff considers that the DOE estimate of depleted uranium disposition costs, as increased by the applicant to cover shipping, transportation, and contingency, provides assurance that the applicant's estimate is reasonable. In addition, in Sections 1.2.5.3 and 10.2.2 of the LA (GLE, 2011), the applicant requested an exemption to the decommissioning financial assurance requirements in 10 CFR 40.36(d) and 10 CFR 70.25(e) to allow incremental funding of the required decommissioning funding plan for DUF<sub>6</sub> disposition. The approval of this exemption request is further discussed in Section 1.2.3.7.5 of this SER. Under this exemption, the applicant would incrementally fund financial assurance, in a forward-looking manner, for the disposition of DUF<sub>6</sub> based on the expected amount of tails to be generated annually. Thus, if the DOE cost per kilogram for disposition of DUF<sub>6</sub> increases, the applicant will be notified of the increase and the updated amount per kg DUF<sub>6</sub> will be no less than the updated DOE estimate.

The applicant is proposing to provide initial financial assurance in the approximate amount of \$200 million (\$185 million for full facility decommissioning and \$13.5 million for the first year's generation of UF<sub>6</sub> tails). Total decommissioning financial assurance over the full 40-year life of the facility is estimated to be \$3.22 billion in 2009 dollars (\$185 million for facility decommissioning and \$3.04 billion for tails disposal), including a 25 percent contingency.

Based on the staff's review of the proprietary and nonproprietary information, the staff found that the cost estimate for decommissioning the facility is reasonable and the cost estimate meets all of the evaluation criteria in NUREG-1757, Volume 3, Section 4.1 (NRC 2006) as follows:

- The cost estimate meets the applicable regulatory requirements of 10 CFR 30.35(e), 10 CFR 40.36(d), and 10 CFR 70.25(e);

- The cost estimate is based on documented and reasonable assumptions;
- The unit cost factors used in the cost estimate are reasonable and consistent with NRC cost estimation reference documents;
- The cost estimate includes detailed costs for labor, equipment and supplies, overhead and contractor profit, sampling and laboratory analysis, and miscellaneous expenses, including license fees, insurance, and taxes;
- The cost estimates for individual facility activities and components are reasonable and, to the extent possible, consistent with cost estimation reference documents;
- The computations are correct;
- The cost estimate includes an adequate contingency factor of 25 percent;
- The cost estimate does not take credit for any salvage value that might be realized from the sale of potential assets during or after decommissioning or reduced taxes that might result from payment of decommissioning costs. The cost estimate includes an annual property tax cost during decommissioning;
- The means identified in the DFP for adjusting the decommissioning cost estimate and associated funding level over the life of the facility is adequate;
- The cost estimate reflects decommissioning under appropriate facility conditions; and
- The cost estimate includes costs for all major decommissioning activities specified in Section A.3 of NUREG-1757, Volume 3 (NRC, 2006), including planning and preparation; decontamination or dismantling of facility components; packaging, shipment, and disposal of radioactive wastes; and the final radiation survey. Restoration of contaminated areas on facility grounds and site stabilization and long-term surveillance are not necessary.

#### 10.3.2.2 Financial Assurance for Decommissioning

In Section 10.2.3 of the LA (GLE, 2011), the applicant stated it will utilize a surety bond method to provide reasonable assurance of decommissioning funding as required by 10 CFR 30.35(f)(2), 10 CFR 40.36(e)(2) and 10 CFR 70.25(f)(2). The applicant provided draft copies of the surety bond and standby trust language. The draft language is consistent with the guidance in NUREG-1757 (NRC, 2006), Volume 3, Section A.9 for surety bonds and Section A.17 for standby trusts. Finalization of the specific financial instruments to be utilized will be completed, and signed originals of those instruments and a certification of financial assurance will be provided to the NRC for final confirmation of the instrument at least 21 days prior to the applicant receiving licensed material at the facility.

The surety bond method to be adopted by the applicant will provide a guarantee that decommissioning costs will be paid in the event the applicant is unable to meet its decommissioning obligations at the time of decommissioning. The surety bond will be structured consistent with applicable NRC requirements and in accordance with NRC regulatory guidance contained in NUREG-1757, Volume 3 (NRC, 2006). Accordingly, in Section 10.2.3 of

the LA (GLE, 2011), the applicant stated that its surety bond will contain, but not be limited to, the following attributes:

1. A company that is listed as a qualified surety in the U.S. Department of Treasury's most-recent edition of Circular 570 for the State where the surety was signed with an underwriting limitation greater than or equal to the level of coverage specified in the bond will issue the bond.
2. The bond will be written for a specified term and will be renewable automatically unless the issuer serves notice at least 90 days prior to expiration of intent not to renew. Such notice must be served upon the NRC, the trustee of the external trust or standby trust, and GLE. Further, in the event GLE is unable to provide an acceptable replacement within 30 days of such notice, the full amount of the bond will be payable automatically, prior to expiration, without proof of forfeiture. The surety bond will require that the surety company deposit any funds paid under its terms directly into either an external trust or a standby trust.

In assessing the applicant's commitment to use a surety company listed in Treasury Circular 570 (Treasury, 2011), the staff reviewed the basis for listing of a surety company in the most recent edition of Treasury Circular 570 (Treasury, 2011). The Financial Management Service (FMS) of the U.S. Department of the Treasury is responsible for implementing the Federal law and regulations relating to sureties and surety bonds and issues Certificates of Authority to bonding companies to do business with the United States. (31 U.S.C 9304-9308, "Authorizing the Acceptance of Corporate Surety Companies on Bonds Given to the United States," and 31 CFR Part 223, "Regulations Governing Surety Companies Doing Business With the United States.") Treasury Circular 570 (Treasury, 2011) provides a list, updated effective July 1 of each year, of companies holding Certificates of Authority as acceptable sureties. All Certificates of Authority expire on June 30, and must be renewed annually.

To obtain a Certificate of Authority a company must submit to the FMS a copy of its charter or articles of incorporation demonstrating that it is authorized to be a surety "on obligations permitted or required by the laws of the United States." It must also provide a sworn statement showing its assets and liabilities. FMS reviews the company's financial statement and "any further evidence or information" that may be required to determine whether the company has capital "fully paid up in cash of not less than \$250,000, is solvent and financially and otherwise qualified to do the business . . ." (31 CFR 233.3) The cash capital and other funds of the company must be "safely invested" and valued in accordance with guidelines promulgated by Treasury. FMS may place its own valuation on the assets and liabilities of the company. (31 CFR 223.7 and 223.9)

In addition to Treasury requirements, a surety company must be licensed in States in which it provides a bond, and will be subject to State regulation and inspection. The National Association of Insurance Commissioners (NAIC) has developed model laws, regulations, and guidelines; financial analysis, audit and examination procedures; and model accounting practices and procedures that have been adopted in whole or part by numerous States. State license information in Treasury Circular 570 (Treasury, 2011) is provided by the companies. Updated information, if needed, is available directly from State Insurance Departments. The staff considers that State licensing and regulation provides a second source of scrutiny into the financial soundness of a surety company.

Certified companies must submit to FMS quarterly financial statements, reports of federal business written during the quarter and outstanding, and a detailed "Schedule of Excess Risks" (FMS Form 199). The latter form allows FMS to implement a strict "underwriting limitation." Regulations provide that "no company holding a certificate of authority shall underwrite any risk on any bond or policy on behalf of any individual, firm, association, or corporation, whether or not the United States is interested as a party thereto, the amount of which is greater than 10 percent of the paid-up capital and surplus of such company, as determined by the Treasury." (31 CFR 223.10) If the proposed bond would exceed the underwriting limitation, the company must coinsure with one or more other companies or obtain reinsurance from another company holding a Certificate of Authority. However, no certificate-holding company may cede to a reinsuring company any risk in excess of 10 percent of the reinsuring company's paid-up capital and surplus. (31 CFR 223.11)

NRC guidance parallels the FMS underwriting limitation requirements. NUREG-1757, Volume 3, Appendix A in Section A.9.1 (NRC, 2006) states that "the company's underwriting limitation (also specified in Circular 570) must be at least as great as the level of coverage for the license." A footnote to that statement, however, points out that "A company issuing a surety can only exceed its underwriting limitation if it brings another qualified company into the agreement to share the risk. When acting together none of the companies may exceed its individual underwriting limitation."

Annual filings to FMS by certified companies must include Certified Public Accountant-audited financial statements, U.S. Securities and Exchange Commission 10K reports, an independent actuarial opinion, certain reports defined by NAIC, copies of letters of credit or trust agreements for large recoverable amounts, the Schedule of Excess Risks (FMS Form 199), reinsurance agreements, a copy of NAIC's Insurance Regulatory Information System analysis of key financial ratios and explanation of any unusual results, a copy of the current State Insurance Commission inspection report, and several other documents and analyses addressing the financial condition of the company and the quality of its management. (FMS Annual Filing Checklist Certified Companies (Treasury, 2009)) This material is considered by FMS in making certification decisions for the following year.

In light of this information concerning the basis for a listing in Treasury Circular 570 (Treasury, 2011) and considering the scope and frequency with which FMS reviews surety companies for inclusion on Treasury Circular 570 (Treasury, 2011), the staff has concluded that it is reasonable to rely on the expertise of FMS in reviewing the financial soundness of surety companies and that listing in Treasury Circular 570 (Treasury, 2011) provides reasonable assurance of the financial soundness of a surety company.

The applicant described its approach to funding the surety bond financial assurance instrument to be used and for updating the DFP over time. Financial assurance for decommissioning will be provided during the operating life of the facility. Initially, the applicant will provide funding for the projected cost of facility decontamination and decommissioning, assuming operation at full capacity, and annually on a forward looking basis for disposition of the tails generated. Funding for tails dispositioning will thereafter be provided at annual intervals. The applicant requested an exemption to fund decommissioning on an incremental basis as required in 10 CFR 40.14 and 10 CFR 70.17. Updates of the DFP and the financial assurance instrument will be provided as follows:

- In the initial executed financial assurance instrument submitted prior to receipt of licensed material, the applicant will provide full funding for decontamination and decommissioning of the full-size facility.
- In the initial executed financial assurance instrument submitted prior to receipt of licensed material, the applicant will provide funding for the disposition of depleted uranium tails in an amount needed to disposition the first year of depleted uranium tails generation.
- Subsequent updated decommissioning funding estimates and revised funding instruments for facility decommissioning will be provided at least every three years.
- Subsequent updated decommissioning cost estimates and revised funding instruments for depleted uranium disposition will be provided annually on a forward-looking basis to reflect projections of depleted uranium byproduct generation. The annual depleted uranium disposition cost update schedule exceeds the requirements of updating the DFP at least every three years in accordance with 10 CFR 30.35(e), 10 CFR 40.36(d), and 10 CFR 70.25(e).

This approach to funding the financial assurance instrument is acceptable to NRC staff because the amount of financial assurance will be sufficient to cover the decommissioning obligation of the licensee at any point in time in the event that the licensee is unable to complete decommissioning for any reason. Because final executed copies of the financial assurance mechanism will not be provided to NRC until prior to receipt of licensed material, NRC staff is imposing the following license conditions:

*The Decommissioning Funding Plan shall be updated as follows:*

- a. *The Licensee shall provide to NRC for review an updated Decommissioning Funding Plan at least six months prior to the planned date for obtaining licensed material, and subsequently, after resolution of any NRC comments, final executed copies of the financial assurance instruments shall be provided to NRC at least 21 days prior to receipt of licensed material. The amount of the financial assurance instrument shall be updated to current year dollars and include any applicable change to the decommissioning cost estimate.*
- b. *In the first executed financial assurance instrument submitted prior to receipt of licensed material, the licensee shall provide full funding for decontamination and decommissioning of the full-size facility.*
- c. *In the first executed financial assurance instrument submitted prior to receipt of licensed material, the licensee shall provide funding for the disposition of depleted uranium tails in an amount needed to disposition the first year of depleted uranium tails generation. The cost estimate shall include an update to the DOE depleted uranium disposition cost estimate. The total amount funded for depleted uranium disposition shall be no less than the updated DOE cost estimate.*
- d. *Subsequent updated decommissioning funding estimates and revised funding instruments for facility decommissioning shall be provided for review, at a*

*minimum, every three years. Any proposed reduction in the funding estimate based on operational changes shall be submitted six months prior to the change.*

- e. *Subsequent updated decommissioning cost estimates and revised funding instruments for depleted uranium disposition shall be provided for review annually on a forward-looking basis to reflect projections of depleted uranium byproduct generation. The cost estimate shall include an update to the DOE depleted uranium disposition cost estimate. The total amount funded for depleted uranium disposition shall be no less than the updated DOE cost estimate.*

The applicant's DFP is being evaluated against the NRC requirements and acceptance criteria identified in NUREG-1757 (NRC, 2006). Section 4 of NUREG-1757, Volume 3 (NRC, 2006), specifies that for a licensee submitting a DFP at the time of license application, NRC staff will review the accuracy and appropriateness of the methods used by the licensee to estimate the costs of decommissioning; the acceptability of the licensee's submitted financial assurance mechanism(s) for decommissioning; and the means identified in the DFP for adjusting the cost estimate and associated funding level over the life of the facility. NRC staff finds the decommissioning cost estimate to be adequate, as discussed in Section 10.2.3.1 of this SER. As discussed in Section 10.2.3.2 of this SER, with the above proposed license conditions and the exemption discussed in Section 1.2.3.7.5 of this SER, NRC staff finds the proposed surety bond and means for adjusting the cost estimate and associated funding level to be adequate.

#### **10.4 EVALUATION FINDINGS**

The NRC staff has evaluated the applicant's plans and financial assurance for decommissioning in accordance with NUREG-1520 (NRC, 2002a) and NUREG-1757 (NRC, 2006). On the basis of this evaluation and the imposition of the following license conditions, the NRC staff has determined that the applicant's plans and financial assurance for decommissioning comply with the NRC's regulations and provide reasonable assurance of protection for workers, the public, and the environment:

*The Decommissioning Funding Plan shall be updated as follows:*

- a. *The Licensee shall provide to NRC for review an updated Decommissioning Funding Plan at least six months prior to the planned date for obtaining licensed material, and subsequently, after resolution of any NRC comments, final executed copies of the financial assurance instruments shall be provided to NRC at least 21 days prior to receipt of licensed material. The amount of the financial assurance instrument shall be updated to current year dollars and include any applicable change to the decommissioning cost estimate.*
- b. *In the first executed financial assurance instrument submitted prior to receipt of licensed material, the licensee shall provide full funding for decontamination and decommissioning of the full-size facility.*
- c. *In the first executed financial assurance instrument submitted prior to receipt of licensed material, the licensee shall provide funding for the disposition of depleted uranium tails in an amount needed to disposition the first year of depleted uranium tails generation. The cost estimate shall include an update to*

*the DOE depleted uranium disposition cost estimate. The total amount funded for depleted uranium disposition shall be no less than the updated DOE cost estimate.*

- d. Subsequent updated decommissioning funding estimates and revised funding instruments for facility decommissioning shall be provided for review, at a minimum, every three years. Any proposed reduction in the funding estimate based on operational changes shall be submitted six months prior to the change.*
- e. Subsequent updated decommissioning cost estimates and revised funding instruments for depleted uranium disposition shall be provided for review annually on a forward-looking basis to reflect projections of depleted uranium byproduct generation. The cost estimate shall include an update to the DOE depleted uranium disposition cost estimate. The total amount funded for depleted uranium disposition shall be no less than the updated DOE cost estimate.*

## **10.5 REFERENCES**

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(GLE, 2010b) General Electric-Hitachi Global Laser Enrichment (GLE). "Physical Security Plan (PSP) for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility," Revision 1, 2010.

(GLE, 2010c) General Electric-Hitachi Global Laser Enrichment (GLE). "Nuclear Material Transportation Security Plan (NMTSP) for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility," Revision 1, 2010.

(GLE, 2010d) General Electric-Hitachi Global Laser Enrichment (GLE). "Fundamental Nuclear Material Control Plan for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility," Revision 2, 2010.

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(NRC, 2002a) U.S. Nuclear Regulatory Commission (NRC). NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," 2002.

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(NRC, 2005) U.S. Nuclear Regulatory Commission (NRC). "Memorandum and Order," Louisiana Energy Services (National Enrichment Facility), CLI-05-05, January 18, 2005.

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(Treasury, 2009) U.S. Department of the Treasury (Treasury). "Financial Management Service Annual Filing Checklist Certified Companies," <http://www.fms.treas.gov/c570/forms/CA-checklist-annual-2010.pdf>. December 2009.

(Treasury, 2011) U.S. Department of the Treasury (Treasury). Department Circular 570, "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies," 2011.



## 11.0 MANAGEMENT MEASURES

Management measures are functions that General Electric-Hitachi Global Laser Enrichment, LLC (GLE or applicant), performs, generally on a continuing basis, that are applied to items relied on for safety (IROFS), to ensure that IROFS are available and reliable to perform their functions when needed. Management measures will be implemented to ensure compliance with performance requirements, and the degree to which they will be applied will be a function of the items' importance in terms of meeting performance requirements as evaluated in the Integrated Safety Analysis (ISA). This chapter addresses each of the management measures included in the 10 CFR Part 70 definition of management measures, including: (a) configuration management (CM); (b) maintenance; (c) training and qualifications; (d) procedures; (e) audits and assessments; (f) incident investigations; (g) records management; and (h) other quality assurance (QA) elements.

The purpose of this review is to verify that the management measures the applicant will apply to IROFS are described in sufficient detail in Chapter 11 of the License Application (LA) (GLE, 2011a) and provide adequate assurance that IROFS will be available and reliable, consistent with the performance requirements of 10 CFR 70.61.

### 11.1 REGULATORY REQUIREMENTS

The requirements for fuel cycle facility management measures are specified in 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material."

1. The regulations in 10 CFR 70.4 state that management measures include: (a) CM; (b) maintenance; (c) training and qualifications; (d) procedures; (e) audits and assessments; (f) incident investigations; (g) records management; and (h) other QA elements.
2. The regulations in 10 CFR 70.62(a)(3) state that records must be kept for all IROFS failures; describe required data to be reported; and set time requirements for updating the records.
3. The regulations in 10 CFR 70.62(d) require an applicant to establish management measures, for application to engineered and administrative controls and control systems that are identified as IROFS, pursuant to 10 CFR 70.61(e), to ensure they are available and reliable.
4. The regulations in 10 CFR 70.72 require a licensee to establish a CM program to evaluate, implement, and track changes to the facility; structures, systems and components (SSCs); processes; and activities of personnel.
5. The regulations in 10 CFR 70.22(a)(8) state the requirements for license applications to address proposed procedures to protect health and minimize danger to life and property.

6. The regulations in 10 CFR 70.72 require a licensee to establish a CM program to evaluate, implement, and track changes to the facility; SSCs; processes; and activities of personnel.
7. The regulations in 10 CFR 70.74(a) and (b) state requirements for incident investigation and reporting.

## 11.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA

The acceptance criteria for the U.S. Nuclear Regulatory Commission (NRC) staff's review of applicant's management measures program are contained in Section 11.4.3 of the "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," of NUREG-1520 (NRC, 2002a). This chapter is applicable in its entirety except for sections applying to existing facilities only.

The regulatory guidance that is described in Section 11.4.2 of NUREG-1520 (NRC, 2002a) (American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) NQA-1-1983, "Quality Assurance Requirements for Nuclear Facility Applications" (ANSI/ASME, 1983), as endorsed by Regulatory Guide 1.28, "Quality Assurance Program Requirements (Design and Construction)" (NRC, 2010) does not apply to the applicant because the regulatory guidance is only pertinent to applications for plutonium processing and fuel fabrication facilities.

The additional regulatory guidance documents identified in Section 11.4.2 of NUREG-1520 (NRC, 2002a) were not applied by the applicant and are thus not relevant to the review of the LA (GLE, 2011a):

- American National Standards Institute/International Standards Organization/ American Society for Quality (ANSI/ISO/ASQ) standards for quality management, ANSI/ISO/ASQ 9000 series.
- International Atomic Energy Agency (IAEA) Safety Guide, "Establishing and Implementing a Quality Assurance Program," Safety Guide 50-SG-Q1, (IAEA, 1996).
- U.S. Department of Energy (DOE), Draft, "Implementation Guide for Use with 10 CFR Part 830.120 and DOE Order 5700.6C," (DOE, 1997).
- U.S. Nuclear Regulatory Commission, "Guidance on Management Controls/Quality Assurance, Requirements for Operation, Chemical Safety, and Fire Protection for Fuel Cycle Facilities," *Federal Register* 54 (No. 53), 11590-11598, March 21, 1989 (NRC, 1989).
- U.S. Nuclear Regulatory Commission, "Training Review Criteria and Procedures," NUREG-1220, Revision 1, (NRC, 1993).

### 11.3 STAFF REVIEW AND ANALYSIS

Chapter 11 of the LA (GLE, 2011a) describes the management measures established by the applicant to ensure the availability and reliability of IROFS. The applicant commits to apply management measures to IROFS on a continuing basis to ensure that the proposed facility will be operated safely and provide adequate protection of the workers, the public, and the environment from credible hazards presented in the ISA (GLE, 2011b).

Management measures are applied to IROFS based on their importance. The importance of IROFS is determined using a graded approach that considers both the unmitigated likelihood of an initiating event and the severity of the consequence. The applicant will also consider the following factors for each IROFS: (1) risk significance, (2) regulations, industry codes, and standards applicable to the IROFS; (3) complexity or uniqueness of an item/activity and the environment in which it has to function; (4) quality history of the item in service or activity; (5) degree to which functional compliance can be demonstrated or assessed by test, inspection, or maintenance methods; (6) anticipated life span; and (7) degree of standardization; (8) importance of data generated; and (9) reproducibility of results (GLE, 2011a). Based on the importance of the IROFS and considerations of the factors identified above, the appropriate type and number of management measures are assigned to assure the IROFS are functional when needed. The applicant determines the extent that attributes of management measures and QA program elements are applied to IROFS by evaluating the design, function, and task analyses associated with operating and maintaining the IROFS.

The management measures and QA elements assigned to each IROFS will be approved through the configuration management process associated with ISA Baseline Documents and specifically through approval of the IROFS Boundary Definition Packages throughout the facility design and readiness review period.

#### 11.3.1 CONFIGURATION MANAGEMENT

The NRC staff reviewed the applicant's CM program in accordance with the acceptance criteria in Section 11.4.3.1 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.1 of NUREG-1520 (NRC, 2002a) address the CM policy, design requirements, document control, change control, and assessments. The acceptance criteria in Section 11.4.3.1.6 of NUREG-1520 (NRC, 2002a) address design reconstitution, which applies only to existing facilities and not to new license applications, and were not considered in this review.

The applicant describes the CM program functions in Section 11.1 of the LA (GLE, 2011a). The applicant states that the objective of the CM Program is to ensure that the information used to design, construct, operate, and maintain IROFS is current (GLE, 2011a). The safety controls implemented for IROFS include SSCs and procedures that prevent or mitigate the risk of credible accidents (GLE, 2011a).

##### 11.3.1.1 CM Policy

The NRC staff reviewed the applicant's CM policy in accordance with the acceptance criteria in Section 11.4.3.1.1 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.1.1 of NUREG-1520 (NRC, 2002a) address the overall CM functions covering at least the following topics: (1) the scope of the IROFS and management measures to be included in the CM function; (2) the objectives of each CM activity; (3) a description of each CM activity; and (4) the organizational structure and staffing interfaces.

In Section 11.1.1 of the LA (GLE, 2011a), the applicant describes the CM Program as a process implemented by approved written procedures to ensure that changes from the facility's technical design baseline are identified and controlled. The applicant commits to maintain a CM Program in accordance with 10 CFR 70.72 that includes the following activities: (a) maintenance of facility design information; (b) control of information used to operate and maintain the facility; (c) identification of IROFS; (d) assurance of adequate safety reviews for changes; (e) control of information used to operate and maintain the facility; and (f) periodic performance assessments (GLE, 2011a).

As described in Section 11.1.1 of the LA (GLE, 2011a), the CM Manager is responsible for the CM Program. The CM Manager reports to the Commercial Facility Project Manager during the design and construction phase and to the Operations Manager during the operational phase (GLE, 2011a). During the design phase, to establish and maintain the Technical Design Baseline, CM is based on design control and the associated procedural controls (GLE, 2011a). The applicant states that design documents, including the ISA, provide design input, analysis, or results for IROFS and will be reviewed before issuance (GLE, 2011a). During the construction phase, changes to drawings and specifications issued for construction, procurement, or fabrication will be reviewed, evaluated, and verified for impact before being implemented (GLE, 2011a). The applicant commits to verify proper implementation of changes and to document them in the design basis records (GLE, 2011a).

The applicant states that controls are implemented to ensure that the quality of the SSCs is not compromised by modifications in the facility (GLE, 2011a). The Quality Level (QL) designation is used to determine the level of CM applied to the SSCs, processes, equipment, and personnel activities (GLE, 2011a). Quality levels are defined in Section 3.1 of the Quality Assurance Program Description (QAPD) (GLE, 2011c).

Before changes are implemented, the following items are considered: (a) the technical basis for the change; (b) impact on safety, health, and control of licensed material; (c) authorization requirements for the change; (d) required modifications to existing procedures; (e) impacts or modifications to the ISA and the ISA Summary (GLE, 2011b); and (f) the approved duration of the change for temporary changes (GLE, 2011a).

The applicant describes how design requirements and associated design bases will be established and maintained through control of the design process to ensure that the quality of SSCs will be maintained (GLE, 2011a). The applicant also describes the management structure and reporting lines for the CM function and commits to evaluate, implement, and track each change to the site, structures, processes, systems, equipment, components, computer programs, and activities of personnel (GLE, 2011a). The CM policy description, including the CM organizational structure and interfaces, provided by the applicant meets the acceptance criteria in Section 11.4.3.1.1 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.1.2 Design Requirements

The NRC staff reviewed the applicant's CM design requirements in accordance with the acceptance criteria in Section 11.4.3.1.2 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.1.2 of NUREG-1520 (NRC, 2002a) address how design requirements and associated design bases are established and maintained through control of the design process and to describe technical review and approval functions.

In Section 11.1.2 of the LA (GLE, 2011a), the applicant states that design requirements are developed to support safety, environmental impact-oriented, and mission-based functions of the proposed facility. The design requirements for IROFS and other SSCs are developed to meet the baseline design criteria, as defined in 10 CFR 70.64 (GLE, 2011a). The applicant states that the Engineering Organization has the responsibility to develop the design requirements to support IROFS and other SSCs and to capture these requirements in design documents (GLE, 2011a). Before the design documents are approved, the applicant will review them to determine accuracy, adequacy, and completeness (GLE, 2011a). After the design document and the ISA Summary (GLE, 2011b) are approved, these documents provide the Technical Design Baseline for the facility (GLE, 2011a). The ISA and the design documents are considered controlled documents and as such must undergo the Change Control Process for any modifications made to the documents (GLE, 2011a).

The applicant's design process meets the acceptance criteria in Section 11.4.3.1.2 of NUREG-1520 (NRC, 2002a) in that it will ensure that the development of design requirements (i.e., drawings and other statements of requirements), proceeds logically from the design basis, and provides the Technical Design Baseline for the facility. The applicant commits to maintain design documents as controlled documents and to thus maintain them under the CM program. As described in Section 11.1.2 of the LA (GLE, 2011a), the information provided meets the acceptance criteria of Section 11.4.3.1.2 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.1.3 Document Control

The NRC staff reviewed the applicant's CM document control in accordance with the acceptance criteria in Section 11.4.3.1.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.1.3 of NUREG-1520 (NRC, 2002a) address the description of an acceptable method to create and control documents within the CM function, including cataloging the document database, the information content of the document database, maintaining and distributing documents, document retention policies, and document retrieval policies. The acceptance criteria also state that the application should include a description of how CM will capture documents that are relevant and relied on for safety including design requirements, the ISA, as-build drawings, specifications, all procedures that are IROFS, procedures involving training, QA, maintenance, audits and assessments, emergency operating procedures, emergency response plans, system modification documents, assessment reports, and others that the applicant may deem part of CM. A document database should also be used to control documents and track document change status.

In Section 11.1.3 of the LA (GLE, 2011a), the applicant states that document control is implemented in accordance with approved written procedures. The document control procedures include guidance for the creation, revision, storage, tracking, distribution, and retrieval of information including, but not limited to, instructions, drawings, manuals, procedures, plans, specifications, design documents, and other documents related to the CM function (GLE, 2011a). The applicant commits to establish appropriate procedures to control the life-cycle of documents and to establish measures to ensure that documents are: (a) adequately reviewed; (b) approved; and (c) released for use by authorized personnel (GLE, 2011a).

The applicant states that it will implement an electronic document management system (EDMS) to file project records and to maintain availability of the latest version of controlled documents (GLE, 2011a). Controlled documents will be maintained in the EDMS until cancelled or superseded. Indices of controlled documents will be maintained and available to personnel and

will include identification of documents with unique numbers that include the revision level (GLE, 2011a). When the EDMS is not available or if so required by approved written procedure, the applicant states that controlled documents will be distributed in hardcopy form (GLE, 2011a).

The applicant's document control program includes measures to control documents that are important to the safety of the proposed facility through: (1) the maintenance of controlled documents in an electronic database; (2) the review, approval, and release of documents; and (3) the retention of life-cycle documents. These measures, as described in Section 11.1.3 of the LA (GLE, 2011a), meet the acceptance criteria of Section 11.4.3.1.3 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.1.4 Change Control

The NRC staff reviewed the applicant's CM change control in accordance with the acceptance criteria in Section 11.4.3.1.4 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.1.4 of NUREG-1520 (NRC, 2002a) address the description of how the CM function will maintain strict consistency among the design requirements, the physical configuration, and the facility documentation. In addition, the acceptance criteria in Section 11.4.3.1.4 of NUREG-1520 (NRC, 2002a) states that the applicant should commit to an acceptable process for: (1) identifying and authorizing proposed changes; (2) performing appropriate technical, management, and safety reviews of proposed changes in IROFS; (4) tracking and implementing changes; and (4) documenting changes (including placement of documentation in a document control center and dissemination to affected functions such as training, engineering, operations, maintenance, and QA). The applicant should also describe an acceptable process, within the CM function, for providing reasonable assurance that the ISA is systematically reviewed and modified to reflect design or operational changes from an established safety bases, and that all documents outside the ISA that are affected by safety basis changes are properly modified, authoritatively approved, and made available to personnel. When a change is made in accordance with 10 CFR 70.72, changes to the affected onsite documentation must be made promptly to avoid inadvertent access by facility personnel to outdated design and other specifications for IROFS.

In Section 11.1.4 of the LA (GLE, 2011a), the applicant describes the approved written procedures that will be implemented to control the CM process. The applicant commits to implement procedures to control design changes and to detail the distinction between different types of design changes in procedures (GLE, 2011a). The applicant states that procedures will require the review and approval of any changes to controlled documents in order to determine if the ISA is affected by the proposed change (GLE, 2011a). Such reviews will be conducted by trained safety reviewers and, should the review identify an impact to the ISA, an ISA team will review and approve the change in accordance with the process described in the ISA Summary (GLE, 2011b).

The applicant commits to implement an interdisciplinary review process during the design phase to ensure consistency between documents, including design changes and the ISA (GLE, 2011a). The interdisciplinary review includes the evaluation of vendor drawings and data to ensure compliance with drawings and procurement specifications and to incorporate interface requirements into controlled documents (GLE, 2011a). During the construction phase, the applicant states that changes to documents issued for construction, fabrication, and procurement will be documented, reviewed, approved, and incorporated into each affected design document (GLE, 2011a).



In Section 11.1.4 of the LA (GLE, 2011a), the applicant describes the change control process that will be implemented during the operations phase in accordance with the requirements of 10 CFR 70.72. Prior to the implementation of design changes, the applicant will ensure that design changes are documented, reviewed, and approved and that any facility personnel who may be affected by the modification are made aware of the changes (GLE, 2011a). When a modification or change is completed to a SSC: (a) the responsible area manager or individual will ensure that the applicable testing has been completed to ensure the correct operation of the system; (b) the documentation (such as revised process descriptions, checklists for operations and flow sheets) will be made available to the Operations and Maintenance Organizations when the system becomes operational to ensure that operators are able to operate the modified system safely; (c) a notice that the modification has been completed will be distributed to the appropriate manager; (d) the modifications will be included in the as-constructed drawings; and (e) the records documenting the change will be identified and retained for the duration of the facility license (GLE, 2011a).

In Section 11.1.4 of the LA (GLE, 2011a), the applicant describes the change control process that will be implemented for design changes within the CM program. The applicant also commits to implement an interdisciplinary review process to ensure consistency between documents, including design changes and the ISA (GLE, 2011a). The change control process meets the acceptance criteria in Section 11.4.3.1.4 of NUREG-1520 (NRC, 2002a) for ensuring that: (1) the ISA will be systematically reviewed and modified to reflect design or operational changes from the established safety basis; and (2) all documents outside the ISA that are affected by safety-basis changes will be properly modified, authoritatively approved, and made available to personnel. As described in Section 11.1.4 of the LA (GLE, 2011a), the information provided meets the acceptance criteria of Section 11.4.3.1.4 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.1.5 Assessments

The NRC staff reviewed the applicant's CM assessment process in accordance with the acceptance criteria in Section 11.4.3.1.5 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.1.5 of NUREG-1520 (NRC, 2002a) address the applicant's confirmation that initial and periodic assessments of the CM function are conducted to determine the program's effectiveness and to correct deficiencies. Both assessments and physical assessments (system walkdowns) should be conducted periodically to check the adequacy of the CM function. All assessments and follow-ups should be documented. These reports should provide a basis for future changes. The applicant should also indicate that such assessments are systematically planned and conducted in accordance with an overall facility audit and assessment function.

In Section 11.1.5 of the LA (GLE, 2011a), the applicant states that periodic assessments of the CM Program are conducted to determine the program effectiveness and to correct identified deficiencies. The assessments, which are conducted internally as well as by independent entities, will evaluate the application and effectiveness of management measures and the implementation of the facility safety programs (GLE, 2011a). The applicant commits to perform CM assessments at least on an annual basis by individuals not involved in the area being assessed and to include a review of the documentation and system walk downs of the facility in the conduct of the assessments (GLE, 2011a). The applicant also addresses assessments in Section 11.5.1.1 of the LA (GLE, 2011a).

In the LA (GLE, 2011a), the applicant commits to perform initial and periodic assessments of the CM function to determine the program's effectiveness and to correct deficiencies. The assessments will be performed by the applicant's personnel as well as by independent entities (GLE, 2011a). The commitments described in Section 11.1.5 and 11.5.1 of the LA (GLE, 2011a) are consistent with the guidance provided in Section 11.4.3.1.5 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

### 11.3.2 MAINTENANCE

The NRC staff reviewed the applicant's CM maintenance program in accordance with the acceptance criteria in Section 11.4.3.2 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.2 of NUREG-1520 (NRC, 2002a) address surveillance and monitoring, corrective maintenance, preventive maintenance, and functional testing.

In Section 11.2 of the LA (GLE, 2011a), the applicant states that the purpose of the IROFS maintenance program is to ensure that systems are kept in a readiness condition to perform their intended function when required. The applicant states that it will use a systems-based approach program to plan, schedule, track, and maintain records for the maintenance activities of the facility (GLE, 2011a).

Facility area managers have the responsibility to ensure the operational readiness of safety controls in the facility (GLE, 2011a). Approved written procedures will be used to document the selection and qualification of the maintenance program personnel (GLE, 2011a).

The applicant will use the analyses described in the ISA Summary (GLE, 2011b) to identify the maintenance requirements for safety controls, such as functional testing, calibration, and replacement of specified components (GLE, 2011a). Maintenance activities will include four categories: (a) surveillance and monitoring; (b) corrective maintenance; (c) preventive maintenance (PM); and (d) functional testing (GLE, 2011a).

#### 11.3.2.1 Surveillance and Monitoring

The NRC staff reviewed the applicant's maintenance surveillance and monitoring process in accordance with the acceptance criteria in Section 11.4.3.2.1 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.2.1 of NUREG-1520 (NRC, 2002a) address the applicant's description of IROFS identified in the ISA Summary, the surveillance function and its commitment to the organization and conduct of surveillances at a specified frequency. The surveillance activity should support the determination of performance trends for IROFS, thus providing data useful in determining PM frequencies. The applicant should also describe how the results from incident investigations, the review of the failure records required by 10 CFR 70.62(a)(3), and identified root causes are used to modify the affected maintenance function and eliminate or minimize the root cause. Records showing the current surveillance schedule, performance criteria, and test results for all IROFS are maintained by the applicant. For surveillance tests that can only be done while IROFS are out of service, proper compensatory measures are prescribed for the continued normal operation of a process.

In Section 11.2.3 of the LA (GLE, 2011a), the applicant states that the Surveillance and Monitoring Program will provide a periodic check of the ability of IROFS to perform their designed safety function when required through performance checks, tests, calibrations, and inspections.

The applicant states that IROFS will be monitored on a routine basis as part of the operating process (GLE, 2011a). The applicant commits to use active engineered controls in routine operations as much as practicable and will implement passive engineered systems such as fixed physical design features to maintain safe process conditions for IROFS (GLE, 2011a). The applicant will perform preoperational audits and periodic verifications to maintain the reliability and availability of IROFS (GLE, 2011a). These verifications, which are described in the ISA, will consider the safety importance of the IROFS as well as information related to reliability and other quality factors (GLE, 2011a).

The applicant states that the facility work control process will include surveillances to enable the timely planning and scheduling of work, establishment of system or facility conditions, execution of activities, and documentation of surveillance results (GLE, 2011a). Surveillance frequencies will be established in accordance with the degree of safety importance of the IROFS (GLE, 2011a). Determination of an item's safety importance is based on the item's role in satisfying performance requirements as evaluated in the ISA. The applicant will use the results of surveillances to identify performance trends related to IROFS and will take corrective actions or adjust the frequency of PM activities when performance degradation is identified (GLE, 2011a).

Incident investigations will be performed to identify the root cause of failures that are related to maintenance and the lessons learned from incident investigations will be incorporated into the PM Program as well as in the Surveillance and Monitoring Program (GLE, 2011a).

The applicant describes a program for the surveillance and monitoring of IROFS that meets the acceptance criteria in Section 11.4.3.2.1 of NUREG-1520 (NRC, 2002a) and includes: (1) justification for assignment of differing degrees of surveillance and monitoring to individual IROFS, based on the item's contribution to safety; (2) a description of the surveillance function and frequency for IROFS identified in the ISA Summary (GLE, 2011b); (3) a description of how the results of incident investigations, failure records, and identified root causes are used to modify the affected maintenance function and eliminate or minimize the root cause; and (4) a description of how surveillances support the determination of performance trends for IROFS and are used in determining PM frequencies. The GLE Surveillance and Monitoring Program as described in Section 11.2.3 of the LA (GLE, 2011a), is, therefore, acceptable.

#### 11.3.2.2 Corrective Maintenance

The NRC staff reviewed the applicant's corrective maintenance process in accordance with the acceptance criteria in Section 11.4.3.2.2 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.2.2 of NUREG-1520 (NRC, 2002a) address the documented approach used to perform corrective actions or repairs on IROFS. The maintenance function should provide a planned, systematic, integrated, and controlled approach for the repair and replacement activities associated with identified unacceptable performance deficiencies of IROFS. After conducting corrective maintenance and before returning an IROFS to operational status, if necessary, a functional test should be conducted to provide reasonable assurance that the safety control performs as designed and provides the safety action expected.

The applicant defines corrective maintenance in Section 11.2.1 of the LA (GLE, 2011a) as situations in which replacements, repairs, or major adjustments occur in the facility. The applicant commits to promptly perform corrective actions to remediate unacceptable performance deficiencies in IROFS (GLE, 2011a).

The applicant states that documentation related to the SSCs that have been repaired or replaced will be maintained in the Maintenance Planning and Control System (GLE, 2011a). Following the repair or replacement of any safety control components, the functionality of the component will be verified through post-maintenance testing to ensure that the component will perform its designed safety function when required (GLE, 2011a). In the case that the performance of a repaired or replaced safety control could differ from the original component, the change will be approved under the CM program and preoperational testing will be conducted to ensure that the component will perform its desired safety function when required (GLE, 2011a).

The corrective maintenance program is consistent with the acceptance criteria contained in Section 11.4.3.2.2 of NUREG-1520 (NRC, 2002a) and is acceptable based on the following: (1) the applicant describes a process for corrective maintenance that will ensure that corrective actions or repairs are performed on IROFS as needed; (2) the applicant's maintenance function provides a planned, systematic, integrated, and controlled approach for repair and replacement activities associated with identified unacceptable performance deficiencies of IROFS; and (3) the applicant commits to maintain documentation related to corrective maintenance in the Maintenance Planning and Control System.

#### 11.3.2.3 Preventive Maintenance

The NRC staff reviewed the applicant's PM process in accordance with the acceptance criteria in Section 11.4.3.2.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.2.3 of NUREG-1520 (NRC, 2002a) address the applicant's PM function, which should demonstrate a commitment to conduct preplanned and scheduled periodic refurbishing, or partial or complete overhaul, for the purpose of ensuring that unanticipated loss of IROFS do not occur. This activity should include: (1) use of results of surveillance data; (2) instrument calibration; (3) balancing the objectives of preventing equipment failures and minimizing the unavailability of IROFS; (4) conduct of functional testing prior to returning equipment to service; (5) the basis for determining PM frequencies; (6) the conduct of incident investigations and root cause analysis; (7) using feedback from PM, corrective maintenance, and incident investigations to modify the frequency or scope of PM activities; (8) providing a rationale for deviating from industry standards or from vendor recommendations for PM; and (9) providing records showing PM schedules and results for all IROFS.

Section 11.2.2 of the LA (GLE, 2011a) describes the PM program for the proposed facility. PM will be periodically performed to facilitate performance, prevent failures, and maintain or extend the life of equipment to ensure that IROFS will be available and reliable (GLE, 2011a). The Maintenance Organization is responsible for the coordination of the PM activities and requires input from the Engineering and Operations Organizations (GLE, 2011a).

The Engineering Organization will develop, evaluate, and approve the formal documented bases for the PM tasks (GLE, 2011a). The bases for performing PM on IROFS will be based on the following: (a) historical operating information, (b) review of manufacturer recommendations; and (c) available industry standards (GLE, 2011a). The frequency or scope of the PM activities will be appropriately modified according to the feedback received from corrective maintenance, incident investigations, and PM (GLE, 2011a). The tasks in the PM activities may be changed or modified according to the recommendations made by the Operations, Maintenance, or Engineering Organization personnel (GLE, 2011a).

A functional test of the SSC may be performed after the PM is completed and before returning an IROFS to service, to ensure that IROFS will perform its expected safety functions (GLE, 2011a). The records related to PM will be maintained in accordance with the Records Management (RM) system (GLE, 2011a).

The applicant's maintenance function will ensure that IROFS are reliable and available to perform their safety function when called upon. The applicant's PM program description is consistent with the guidance contained in Section 11.4.3.2.3 of NUREG-1520 (NRC, 2002a) as it addresses: (1) the basis for performing PM; (2) development and modification of the scope and frequency of PM activities; (3) functional testing provisions; and (4) maintenance of records related to PM.

#### 11.3.2.4 Functional Testing

The NRC staff reviewed the applicant's functional testing process in accordance with the acceptance criteria in Section 11.4.3.2.4 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.2.4 of NUREG-1520 (NRC, 2002a) address the methods used and the commitment to perform functional testing, as needed, of IROFS after PM or corrective maintenance. These tests should be conducted using applicant-approved procedures and should include compensatory measures while the test is being conducted. The applicant should design the functional tests to include all operational aspects of the IROFS that are important to safety. In addition, the acceptance criteria in Section 11.4.3.2.4 address recordkeeping, administrative controls, work control methods, use of contractors, and how maintenance elements will be addressed in IROFS management measures.

In Section 11.2.4 of the LA (GLE, 2011a), the applicant describes the procedures that will be used to perform the functional testing of IROFS. The functional testing of IROFS will be performed after installation as part of periodic surveillance testing and after corrective maintenance, PM, or calibration activities to ensure that the items are able to perform their designated safety function when required (GLE, 2011a). The applicant will perform functional tests according to approved written procedures that define the testing methods and the required acceptable results (GLE, 2011a). The results of tests will be recorded and maintained (GLE, 2011a).

The applicant will use approved written procedures to document administrative controls that are identified as IROFS (GLE, 2011a). The applicant states that it will ensure that administrative controls will be available and reliable during operations through the use of applicable procedures, employee training programs, and management measures (GLE, 2011a).

The applicant's commitments: (1) to use written procedures for functional testing; (2) to ensure that the administrative controls identified as IROFS will be available and reliable to perform their intended safety function over extended periods of operation; (3) to maintain records of functional test results; and (4) to perform functional testing, as needed, of IROFS after PM or corrective maintenance are consistent with the acceptance criteria in Section 11.4.3.2.4 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.3 TRAINING AND QUALIFICATIONS

The NRC staff reviewed the applicant's training and qualifications program in accordance with the acceptance criteria in Section 11.4.3.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3 of NUREG-1520 (NRC, 2002a) address: (1) the applicant's training

organization and management; (2) the analysis and identification of activities requiring training; (3) position training requirements; (4) development of the basis for training and training objectives; (5) organization of instruction using lesson plans and other training guides; (6) evaluation of trainee accomplishment; (7) conduct of on-the-job training; (8) evaluation of training effectiveness; (9) personnel qualification; and (10) provisions for continued assurance.

The applicant discusses the training and qualification program in Section 11.3 of the LA (GLE, 2011a). The program ensures that the personnel performing activities relied on for safety have the knowledge and skills necessary to safely design, operate, and maintain the facility (GLE, 2011a). Performance-based training is used as the primary management tool to analyze, design, develop, conduct, and evaluate training (GLE, 2011a). Facility personnel are trained and tested to ensure that they are qualified on practices important to safeguarding licensed material, protecting the environment, and public and worker safety (GLE, 2011a). The applicant commits to document any exceptions granted from the requirements of the training program and to make such exceptions in accordance with approved written procedures and management approval (GLE, 2011a).

#### 11.3.3.1 Organization and Management of the Training Function

The NRC staff reviewed the applicant's program for the organization and management of training in accordance with the acceptance criteria in Section 11.4.3.3.1 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.1 of NUREG-1520 (NRC, 2002a) address how the organization and management of training is organized, staffed, and managed to facilitate planning, directing, evaluating, and controlling a training process for the design, construction, modification, maintenance, and decommissioning of the facility. The training process should fulfill the objectives for the training identified by the applicant, especially where human factors are relied on for safety. Formal training should be provided for each position or activity that is relied on for safety. Training may be either or both classroom or on-the-job training. The applicant should state what training will be conducted and which personnel will be provided with this training. In addition, the acceptance criteria in Section 11.4.3.3.1 of NUREG-1520 (NRC, 2002a) state that the applicant should commit to: (1) making line management responsible for the content and effective conduct of training; (2) defining the job function, responsibility, authority, and accountability of personnel involved in managing, supervising, and implementing training; (3) using performance-based training as the primary management tool for analyzing, designing, developing, conducting, and evaluating training; (4) documenting and implementing procedures to provide reasonable assurance that all phases of training are conducted reliably and consistently; (5) linking training documents to the CM system to provide reasonable assurance that design changes and modifications are accounted for in the training; (6) granting exemptions from training to trainees and incumbents only when justified, documented, and approved by management; and (7) maintaining programmatic and individual training records to support management needs and provide required data on each individual's training, job performance, and qualification.

In Section 11.3.1 of the LA (GLE, 2011a), the applicant states that facility line management and the Environmental, Health, and Safety (EHS) disciplines share the responsibility to implement training programs for personnel who perform activities relied on for safety. The applicant states that performance based training is implemented as the primary tool to assist management in the analysis, design, development, conduct, and evaluation of training (GLE, 2011a). As described in their position descriptions, line managers have the authority to implement training for authorized personnel (GLE, 2011a). Line managers are responsible for the content and effective conduct of training for assigned personnel with support from the facility training

function. Area managers are responsible for the content and conduct of training for operations personnel (GLE, 2011a).

The applicant states that the requirements for the instruction and training of the personnel performing activities relied on for safety and for ensuring the consistent and reliable execution of the training program are established in approved written procedures (GLE, 2011a). The applicant states that training guides or lesson plans are used in classrooms and on-the-job training (OJT) activities to provide a consistent subject matter (GLE, 2011a). The applicant commits to update these materials in accordance with the CM program when design changes or facility modifications are made and to maintain training records in accordance with RM procedures (GLE, 2011a).

Exemptions from training requirements may be granted if an individual's qualifications, prior training experience, and job performance history provide information that the individual has achieved the necessary required skills (GLE, 2011a). Exemptions from training are approved by management and will be documented according to written procedures (GLE, 2011a).

The organization and management of the training function described in Section 11.3.1 of the LA (GLE, 2011a) meets the acceptance criteria in Section 11.4.3.3.1 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable. Specifically, the applicant describes the organization and management of training for facility personnel and states that line management will be responsible for the content and effective conduct of the training. The applicant defines the job function, responsibility, authority, and accountability of personnel involved in managing, supervising, and implementing training. Further, the applicant commits to provide formal training for each position or activity that is relied on for safety through the use of classroom and on-the-job training, or a combination of both. The applicant also commits to document the requirements for such training in written procedures.

#### 11.3.3.2 Analysis and Identification of Functional Areas Requiring Training

The NRC staff reviewed the applicant's analysis and identification of functional areas requiring training in accordance with the acceptance criteria in Section 11.4.3.3.2 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.2 of NUREG-1520 (NRC, 2002a) address how the applicant will identify, document, and address the analysis and identification of activities requiring training for competent and safe job performance. The applicant should also use design, construction, operations, training, and other subject matter experts, as appropriate for conducting an analysis to identify activities requiring training. These activities should include, as a minimum, those activities for managing, supervising, performing, and verifying the activities relied on for safety specified in the ISA Summary as preventing or mitigating accident sequences. Each activity selected for training (initial or continuing) from the facility-specific activities should be matrixed to supporting procedures and training material. The facility-specific activities selected for training and the comparison with training materials should be reviewed on an established schedule and updated as necessitated by changes in procedures, facility systems and equipment, or job scope.

In Section 11.3.2 of the LA (GLE, 2011a), the applicant states that the objective of the Training Program is to ensure compliance with the applicable regulatory requirements and to ensure the safe and efficient operation of the facility. The program provides training for each individual at the facility according to the individual's assigned roles and responsibilities (GLE, 2011a). Training requirements are applicable (but not restricted) to personnel with a direct relationship to the maintenance, testing, operation, or other technical aspects of IROFS (GLE, 2011a).

Personnel are required to satisfy applicable training and qualification requirements prior to performing assigned tasks independently; and fully assuming safety-significant duties (GLE, 2011a). Line managers responsible for contracted activities will verify that contractor personnel meet minimum training and qualification requirements that are required of their duties (GLE, 2011a).

The applicant states that the functional areas requiring training include: (a) General Employee Training (GET); (b) Nuclear Safety Training; (c) Industrial Safety Training; (d) Technical Training; and (e) Professional Development (GLE, 2011a). As stated in Section 11.3.2 of the LA (GLE, 2011a), the training requirements associated with the Emergency Response Organization (ERO) and emergency response activities are addressed in the Radiological Contingency and Emergency Plan (RC&EP) (GLE, 2010).

The applicant defines the functional areas requiring training at the proposed facility and commits to provide training for each individual at the facility according to assigned roles and responsibilities. The training requirements, as outlined in Section 11.3.2 of the LA (GLE, 2011a), meet the acceptance criteria in Section 11.4.3.3.2 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.3.2.1 General Employee Training

The NRC staff reviewed the applicant's general employee training in accordance with the acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a) address the specific, minimum requirements for positions of candidates whose activities are relied on for safety and who perform actions that prevent or mitigate accident sequences described in the ISA Summary. Trainees should meet entry-level criteria defined for the position, including minimum educational, technical, experience, and, if necessary, physical fitness requirements.

In Section 11.3.2.1 of the LA (GLE, 2011a), the applicant discusses its program for GET. All personnel, including contractors and temporary service and maintenance personnel, must participate in applicable portions of GET related to their assigned duties (GLE, 2011a). The applicant identifies the topics covered in GET as follows: (a) QA policies and procedures; (b) nuclear safety (criticality and radiological); (c) industrial safety; (d) fire protection and fire brigade; (e) RC&EP and implementing procedures associated with alarm response and evacuation; (f) new employee orientation; (g) environmental protection; and (h) general administrative controls and procedures and their use (GLE, 2011a). The applicant will conduct continuing training in GET topics as necessary to maintain employee proficiency (GLE, 2011a).

The general employee training topics required for all facility personnel, along with the commitment to perform additional training as needed to maintain proficiency, is consistent with the guidance contained in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.3.2.2 Nuclear Safety Training

The NRC staff reviewed the applicant's nuclear safety training in accordance with the acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a) address the specific, minimum requirements for positions for candidates whose activities are relied on for safety and who perform actions that prevent or mitigate accident sequences described in the ISA Summary.



Trainees should meet entry-level criteria defined for the position, including minimum educational, technical, experience, and, if necessary, physical fitness requirements.

In Section 11.3.2.2 of the LA (GLE, 2011a), the applicant establishes nuclear safety training programs for personnel commensurate with their criticality and radiation protection (RP) responsibilities. Nuclear Safety Training activities include the following topics: (a) radiation and radioactive materials; (b) risks involved in receiving low-level radiation exposure; (c) basic criteria and practices for RP; and (d) nuclear criticality safety (NCS) principles (GLE, 2011a). The applicant states that it will evaluate personnel understanding and effectiveness of the Training Program by requiring personnel to pass an initial training examination that covers formal training contents (GLE, 2011a). Employees are required by the facility training policy to complete the nuclear safety training before accessing Radiological Controlled Areas (RCAs) without an escort (GLE, 2011a). The applicant states that, at a minimum, previously trained employees who are allowed unescorted access to an RCA will be trained annually, and visitors to any RCA will be escorted by trained employees or will be trained in the formal Training Program (GLE, 2011a). The applicant will maintain the Training Program contents current and adequate through the implementation of scheduled program reviews, which will be performed by the NCS and RP functions (GLE, 2011a).

The applicant's nuclear safety training program, including training topics, requirements for personnel, and the use of program reviews to keep the training material up to date, meets the acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.3.2.3 Industrial Safety Training

The NRC staff reviewed the applicant's industrial safety training in accordance with the acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a) address the specific, minimum requirements for positions for candidates whose activities are relied on for safety and who perform actions that prevent or mitigate accident sequences described in the ISA Summary. Trainees should meet entry-level criteria defined for the position, including minimum educational, technical, experience, and, if necessary, physical fitness requirements.

In Section 11.3.2.3 of the LA (GLE, 2011a), the applicant commits to provide Industrial Safety Training as part of employee orientation to ensure that new and transferred employees are aware of the rules, hazards, and the safety procedures involved in their assigned duties. New employee orientation may include, as appropriate, the review of the following topics: (a) employee/employer responsibilities; (b) general site safety rules; (c) the Occupational Safety and Health Administration General Duty Clause; (d) fire extinguisher training; (e) emergency evacuation procedure; (f) hazard communication training; (g) lockout/tagout awareness; (h) laser safety training; and (i) Job Hazards Analysis and Chemical Job Hazards Analysis (GLE, 2011a).

The applicant describes industrial safety training topics and requirements for personnel to ensure site safety. The industrial safety training program, as described in Section 11.3.2.3 of the LA (GLE, 2011a), meets the acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.3.2.4 Technical Training

The NRC staff reviewed the applicant's technical training in accordance with the acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a) address the specific, minimum requirements for positions for candidates whose activities are relied on for safety and who perform actions that prevent or mitigate accident sequences described in the ISA Summary. Trainees should meet entry-level criteria defined for the position, including minimum educational, technical, experience, and, if necessary, physical fitness requirements.

Technical training, as described in Section 11.3.2.4 of the LA (GLE, 2011a), is provided to support the maintenance and operations personnel in understanding the applicable fundamentals, procedures, and technical practices related to nuclear fuel enrichment facilities. Technical training is specific to assigned technical duties and will consist of: (a) initial training; (b) OJT; (c) continuing training; and (d) special training, as applicable (GLE, 2011a).

As described in Section 11.3.2.4 of the LA (GLE, 2011a), the technical training program contains the commitment to train operations and maintenance personnel commensurate with their responsibilities at the proposed facility. The program for providing technical training to personnel meets the acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a) as part of the overall facility training program and is, therefore, acceptable.

#### 11.3.3.2.5 Professional Development

The NRC staff reviewed the applicant's professional development training in accordance with the acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a) address the specific, minimum requirements for positions for candidates whose activities are relied on for safety and who perform actions that prevent or mitigate accident sequences described in the ISA Summary. Trainees should meet entry-level criteria defined for the position, including minimum educational, technical, experience, and, if necessary, physical fitness requirements.

In Section 11.3.2.5 of the LA (GLE, 2011a), the applicant describes the professional development activities to assist facility personnel in gaining additional understanding of the technical practices and fundamentals related to their job functions. Professional development utilizes internal or external professionals through formal workshops, tutorials, and selected training programs (GLE, 2011a).

The applicant's professional development program meets the acceptance criteria in Section 11.4.3.3 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable because it presents training mechanisms that ensure that the facility training program conveys all required skills and knowledge necessary for personnel performance of assigned duties.

#### 11.3.3.3 Job Specific Training Requirements

The NRC staff reviewed the applicant's job specific training requirements in accordance with the acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a) address the specific, minimum requirements for positions for candidates whose activities are relied on for safety and who perform actions that prevent or mitigate accident sequences described in the ISA Summary.

Trainees should meet entry-level criteria defined for the position, including minimum educational, technical, experience, and, if necessary, physical fitness requirements.

In Section 11.3.3 of the LA (GLE, 2011a), the applicant commits to develop minimum training requirements for positions associated with activities that are relied on for safety. The applicant utilizes employee experience to identify job-specific training requirements for each employee (GLE, 2011a). The entry-level criteria for positions, which are contained in position descriptions, include education, technical background, and experience (GLE, 2011a). Job-specific training, including operator training, is performance-based and is established with the relevant technical EHS safety discipline and Operations leadership to develop a list of qualifications for assigned duties (GLE, 2011a). Operator training will incorporate the structured elements of analysis, design, development, implementation, and evaluation commensurate with assigned duties (GLE, 2011a). The applicant will revise the list of qualifications to include changes to facilities, processes, equipment, and job duties (GLE, 2011a).

The applicant's training program includes commitments to: (1) establish minimum requirements for positions that involve the performance of activities relied on for safety and (2) identify entry-level criteria for positions. The applicant also commits to use performance based-training and to revise qualification requirements as necessary to reflect facility design changes and modifications. These commitments meet the acceptance criteria in Section 11.4.3.3.3 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.3.4 Basis of Training and Objectives

The NRC staff reviewed the applicant's basis of training and objectives in accordance with the acceptance criteria in Section 11.4.3.3.4 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.4 of NUREG-1520 (NRC, 2002a) address how the applicant will develop the basis for training, including the objectives, to identify training content, define satisfactory trainee performance, and identify objectives from the analysis of activities and performance requirements. The objectives should state the knowledge, skills, and abilities the trainee should acquire, the conditions under which required actions will take place; and the standards of performance the trainee should achieve on completion of the training activity.

In Section 11.3.4 of the LA (GLE, 2011a), the applicant states that the Training Program is designed to prepare personnel for the safe, reliable, and efficient operation of the facility and that emphasis is placed on safety requirements where human actions are important to safety.

The applicant states that learning objectives are established to: (a) identify the training content; (b) define satisfactory trainee performance for the task, or a group of tasks, selected for training from the job analysis; (c) state the requisite knowledge, skills, and abilities the trainee must demonstrate; (d) determine the conditions under which the required actions must take place; and (e) determine the standards of performance required of the trainee (GLE, 2011a). The learning objectives are: (a) sequenced within training materials based on the relationship to one another; (b) documented in lesson plans and training guides; and (c) revised as necessary, based on changes in procedures, facility SSCs, or job scope (GLE, 2011a).

As described in Section 11.3.4 of the LA (GLE, 2011a), the applicant commits to develop and implement training objectives that identify the knowledge, skills, and abilities that the trainee should acquire; the conditions under which required actions will take place; and the standards of performance the trainee should achieve upon completion of the training activity. These

activities meet the acceptance criteria in Section 11.4.3.3.4 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.3.5 Organization of Instruction

The NRC staff reviewed the applicant's organization of instruction in accordance with the acceptance criteria in Section 11.4.3.3.5 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.5 of NUREG-1520 (NRC, 2002a) address lesson plans and other training guides to assure the consistent conduct of training activities. In addition, lessons plans and other training guides should be based on required learning objectives derived from specific job performance requirements. Plans or guides should be used for in-class training and on-the-job training and should include standards for evaluating acceptable trainee performance. In addition, review and approval requirements should be established for all plans or guides and other training materials before their issue and use.

In Section 11.3.5 of the LA (GLE, 2011a), the applicant states that lessons plans are: (a) developed from learning objectives that are based on job performance; (b) reviewed by line management and the organization responsible for the subject matter; and (c) approved prior to issue or use.

The commitment to ensure the consistent conduct of training activities by using lesson plans derived from specific job performance requirements, including standards for evaluating acceptable trainee performance in lesson plans, and requiring review and approval of lesson plans is consistent with the guidance contained in Section 11.4.3.3.5 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.3.6 Evaluation of Trainee Accomplishment

The NRC staff reviewed the applicant's evaluation of trainee accomplishment in accordance with the acceptance criteria in Section 11.4.3.3.6 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.6 of NUREG-1520 (NRC, 2002a) address how the applicant will periodically evaluate trainees to determine their progress toward full capability to perform the job requirements and, at the completion of training, to determine their capability to perform the job requirements.

As described in Section 11.3.6 of the LA (GLE, 2011a), the applicant commits to use individuals who are qualified in the training subject matter to evaluate the trainee's skill and knowledge of job performance requirements. Evaluation methods will include observation, demonstration, and oral or documented examinations (GLE, 2011a). The applicant commits to ensure that operator training and qualification requirements are met: (1) prior to process safety-related tasks being performed independently; (2) prior to startup; or (3) following significant changes to safety controls (GLE, 2011a).

The measures established for the evaluation of training performance, as described above and in Section 11.3.6 of the LA (GLE, 2011a), meet the acceptance criteria in Section 11.4.3.3.6 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.3.7 On-the-Job Training

The NRC staff reviewed the applicant's on-the-job training program in accordance with the acceptance criteria in Section 11.4.3.3.7 of NUREG-1520 (NRC, 2002a). The acceptance

criteria in Section 11.4.3.3.7 of NUREG-1520 (NRC, 2002a) address the conduct of on-the-job training used for activities relied on for safety and listed in the ISA Summary. On-the-job training should be conducted using well-organized and current training materials and by designated personnel who are competent in the program standards and methods of conducting the training. Completion of on-the-job training should be by actual task performance. When the actual task cannot be performed and is, therefore, "walked-down," the conditions of task performance, references, tools, and equipment should reflect the actual task to the extent possible.

The applicant states that the OJT program objective is to assure the trainee's ability to proficiently perform job duties as required for the assigned role. As described in Section 11.3.7 of the LA (GLE, 2011a), OJT is conducted systematically in the work environment to provide personnel with the required job related skills and knowledge (GLE, 2011a). The OJT Qualifications Program for each technical area includes tasks and procedures that supplement training received through formal classroom, laboratory, or simulator training (GLE, 2011a). The completion of the OJT requirements is demonstrated by employee performance of the task using conditions that replicate those of the actual activity to the extent practicable (GLE, 2011a).

The applicant's provisions for OJT meet the acceptance criteria in Section 11.4.3.3.7 of NUREG-1520 (NRC, 2002a) and are acceptable because they include commitments to perform OJT in the work environment under conditions that mimic those under which the actual work tasks will be performed to the extent possible. The OJT program complements other training methods and materials, as appropriate, to ensure that personnel achieve the required level of skill and knowledge for the task.

#### 11.3.3.8 Evaluation of Training Effectiveness

The NRC staff reviewed the applicant's evaluation of training effectiveness in accordance with the acceptance criteria in Section 11.4.3.3.8 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.8 of NUREG-1520 (NRC, 2002a) address reasonable assurance that the training conveys all required skills and knowledge and is used to revise the training, where necessary, based on the performance of trained personnel in the job setting. A comprehensive evaluation of individual training should be conducted periodically by qualified individuals to identify strengths and weaknesses. Feedback from trainee performance during training and from former trainees and their supervisors should be used to evaluate and refine the training. Change actions (e.g., procedure changes, equipment changes, facility modifications) should be monitored and evaluated for their impact on the development or modification of initial and continuing training and should be incorporated in a timely manner and be accomplished with document control through the CM function. Improvements and changes to initial and continuing training should be initiated, evaluated, tracked, and incorporated to correct training deficiencies and performance problems.

As described in Section 11.3.8 of the LA (GLE, 2011a), the applicant commits to assess the effectiveness of the facility training program through periodic evaluations of the Training Program content and requirements. The data for the periodic evaluations are gathered from trainees' feedback after the completion of training sessions (GLE, 2011a). The evaluations: (a) determine whether training content matches current job needs; (b) identify program strengths and weaknesses; and (c) determine if corrective actions are needed to improve program effectiveness (GLE, 2011a).

In addition to trainee feedback as an indicator of training program effectiveness, the applicant identifies that independent audits of the EHS safety disciplines may also be used to provide independent evaluations of the overall Training Program effectiveness as it relates to the ISA, IROFS implementation, and protection of the public, worker, and environment (GLE, 2011a). The evaluation objectives applicable to the overall organization and management of the Training Program may include, but are not limited to: (a) development and qualification of the matrix organization; (b) management and administration of training programs; (c) Training Program interface with the CM Program; (d) design and development of training programs, content, and conduct of training, and trainee examinations and evaluations; and (e) Training Program assessments and evaluations (GLE, 2011a).

The measures established for the evaluation of training program effectiveness provide reasonable assurance that the facility training program conveys all required skills and knowledge necessary for personnel competence and will be used to revise the training, where necessary, based on demonstrated job needs and program weaknesses. The evaluations, as described in Section 11.3.8 of the LA (GLE, 2011a), meet the acceptance criteria in Section 11.4.3.3.8 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.3.9 Personnel Qualification

The NRC staff reviewed the applicant's personnel qualification program in accordance with the acceptance criteria in Section 11.4.3.3.9 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.9 of NUREG-1520 (NRC, 2002a) address the applicant's commitments regarding minimum qualifications for personnel required to meet NRC requirements. Minimum qualifications should be commensurate with the assigned functional responsibility and authority of the respective personnel. The application should contain such commitments regarding personnel qualification for managers, supervisors, designers, technical staff, construction personnel, facility operators, technicians, maintenance personnel, and other staff required to meet NRC regulations.

In Section 11.3.9 of the LA (GLE, 2011a), the applicant commits to establish and implement qualification and training requirements for Operations personnel in accordance with approved written procedures. The applicant refers to Chapter 2, "Organization and Administration," of the LA (GLE, 2011a), for the description of qualification requirements for key management positions. As described in Chapter 2 of the LA (GLE, 2011a), the applicant established training requirements that meet the acceptance criteria in Section 11.4.3.3.9 of NUREG-1520 (NRC, 2002a) for key management positions at the facility; thus, the staff finds the personnel qualification requirements acceptable. Personnel qualification is further evaluated in Section 2.3.2 of this Safety Evaluation Report (SER).

#### 11.3.3.10 Provisions for Continuing Assurance

The NRC staff reviewed the applicant's provisions for continuing assurance in accordance with the acceptance criteria in Section 11.4.3.3.10 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.3.10 of NUREG-1520 (NRC, 2002a) is for the applicant to provide for periodic requalification of personnel, by training or testing as necessary, to provide reasonable assurance that they continue to understand, recognize the importance of, and be qualified to perform activities that are relied on for safety.

In Section 11.3.10 of the LA (GLE, 2011a), the applicant commits to establish continuing or periodic training, when applicable, to ensure the proficiency of the personnel assigned to the

facility and to ensure the retention of knowledge and skills important to operations. These training activities may include periodic retraining exercises, instructions, or a review of training subjects (GLE, 2011a). The applicant requires retraining to include information that is new or has changed due to facility modifications, procedure changes, and QA Program changes (GLE, 2011a). The applicant also commits to appropriately document the results of the retraining program (GLE, 2011a).

The applicant has established provisions for continuing assurance of personnel training and qualification that meet the acceptance criteria in Section 11.4.3.3.10 of NUREG-1520 (NRC, 2002a) and will ensure that personnel continue to understand, recognize the importance of, and be qualified to perform activities that are relied on for safety. The staff, therefore, finds the applicant's provisions for continuing assurance to be acceptable.

### 11.3.4 PROCEDURES

The NRC staff reviewed the applicant's procedure program in accordance with the acceptance criteria in Section 11.4.3.4 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4 of NUREG-1520 (NRC, 2002a) address procedure preparation and implementation of written procedures.

#### 11.3.4.1 Use of Written Procedures

The NRC staff reviewed the applicant's program for the development and implementation of procedures in accordance with the acceptance criteria in Sections 11.4.3.4.1 and 11.4.3.4.5 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.1 of NUREG-1520 (NRC, 2002a) address procedures written or planned for the operations of IROFS and for all management measures supporting those IROFS. The acceptance criteria in Section 11.4.3.4.5 of NUREG-1520 (NRC, 2002a) is for the applicant to include a commitment to conduct activities involving licensed Special Nuclear Material (SNM) or IROFS in accordance with approved procedures.

In Section 11.4 of the LA (GLE, 2011a), the applicant commits to perform activities involving the handling of SNM or activities involving IROFS in accordance with written procedures. The applicant commits to use policies and plans to define and describe the following aspects of facility operations: (a) senior management expectations; (b) guidelines for the safe operation of the facility; and (c) guidelines for compliance with State and Federal regulations, permits, and licenses (GLE, 2011a). Procedures are used to ensure the implementation of the requirements of policies and plans, which are upper tier documents (GLE, 2011a). The applicant's commitment to conduct all activities involving the handling of SNM or activities involving IROFS in accordance with written procedures meets the acceptance criteria in Sections 11.4.3.4.1 and 11.4.3.4.5 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

In Section 11.4.1 of the LA (GLE, 2011a), the applicant states that the facility's procedures are categorized as management control procedures or operating procedures/instructions. Management control procedures describe general and administrative practices, direct and control activities in different organizational functions, and assign functional responsibilities and requirements for these activities (GLE, 2011a). Operating procedures are used to directly control process operations at the workstation and provide specific direction for task-based work (GLE, 2011a).

The applicant requires compliance with facility procedures and requires personnel to safely stop the operation or activity and contact management if any aspect of a procedure is unclear or incorrect as written (GLE, 2011a). Should work be stopped in this manner, the applicant states that the operation or activity will not restart until corrective action has been taken (GLE, 2011a). The applicant also requires management notification in the event that a situation occurs that is not defined in the procedure content or an unexpected response is obtained (GLE, 2011a). Finally, in response to deviations from operating procedures and unforeseen alterations in process conditions that affect nuclear criticality safety, the applicant requires that conditions must be reported to management, investigated promptly, corrected as appropriate, and documented (GLE, 2011a).

The procedural controls that are implemented at the proposed facility meet the acceptance criteria in Section 11.4.3.4 of NUREG-1520 (NRC, 2002a) and are acceptable as they include: (1) the identification and description of procedure categories that are used at the proposed facility (Section 11.4.3.4.1 of NUREG-1520 (NRC, 2002a); (2) the requirement that procedural compliance is mandatory for all personnel (Section 11.4.3.4.5 of NUREG-1520 (NRC, 2002a); (3) provisions that allow for the cessation of operations and the placement of processes in a safe condition if a step of a procedure cannot be performed as written; and (4) measures that will be implemented for procedural deviations and unexpected conditions that affect nuclear safety.

#### 11.3.4.1.1 Management Control Procedures

The NRC staff reviewed the applicant's management of control procedures in accordance with the acceptance criteria in Sections 11.4.3.4.1 and 11.4.3.4.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.1 of NUREG-1520 (NRC, 2002a) address planned or written procedures for the operations of IROFS and for all management measures supporting those IROFS. The acceptance criteria in Section 11.4.3.4.3 of NUREG-1520 (NRC, 2002a) address important elements of the function described in NUREG-1520 (NRC, 2002a) and include design, CM, procurement, construction, radiation safety, maintenance, QA elements, training and qualification, audits and assessments, incident investigations, records management, criticality safety, fire safety, chemical safety, and reporting requirements.

Section 11.4.1.1 of the LA (GLE, 2011a) identifies activities that are controlled through the use of management control procedures. These activities support process operations and may include: (a) design; (b) CM; (c) procurement; (d) construction; (e) RP; (f) maintenance; (g) QA; (h) training and qualification; (i) audits and assessments; (j) incident investigations; (k) RM; (l) NCS; (m) industrial safety; and (n) reporting requirements (GLE, 2011a).

The management control procedures, as described in Section 11.4.1.1 of the LA (GLE, 2011a), are consistent with the description of types of procedures that will be used at the proposed facility (per Section 11.4.1 of the LA (GLE, 2011a)) and meet the acceptance criteria in Sections 11.4.3.4.1 and 11.4.3.4.3 of NUREG-1520 (NRC, 2002a). As such, the procedures described in Section 11.4.1.1 of the LA (GLE, 2011a) are acceptable.

#### 11.3.4.1.2 Operating Procedures/Instructions

The NRC staff reviewed the applicant's management of control procedures in accordance with the acceptance criteria in Sections 11.4.3.4.2, 11.4.3.4.6 and 11.4.3.4.11 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.2 of NUREG-1520 (NRC, 2002a) address written operating procedures with the following elements: (1) purpose; (2)



requirements, guidelines, and policies governing the procedure; (3) procedure type; (4) procedure steps; (5) initial startup; (6) normal operations; (7) temporary operations; (8) emergency shutdown; (9) emergency operations; (10) normal shutdown; (11) startup following emergencies or extended shutdown; (12) hazards and safety considerations; (13) operating limits; (14) precautions to prevent exposure to hazardous materials; (15) measures to be taken if exposures to hazardous materials occur; (16) IROFS associated with the procedure; and (17) timeframe for which the procedure is valid.

The acceptance criteria in Section 11.4.3.4.6 of NUREG-1520 (NRC, 2002a) address the types of procedures used during facility operation including management, operating, maintenance, and emergency procedures.

The acceptance criteria in Section 11.4.3.4.11 of NUREG-1520 (NRC, 2002a) address maintenance procedures involving IROFS to include pre-maintenance activities, required notifications, and comprehensive procedures for control of maintenance work.

In Section 11.4.1.2 of the LA (GLE, 2011a), the applicant states that operating procedures/instructions will include direction for initial startup, normal operations, off-normal operations, temporary operations, maintenance, alarm response, normal shutdown, emergency operations and shutdown, and startup following an emergency or extended downtime. The procedures, as described by the applicant, will ensure that industrial safety, security, emergency preparedness, RP, NCS, and environmental protection are maintained (GLE, 2011a).

The applicant states that, as applicable, the operating procedures/instructions will contain the following elements: (1) purpose; (2) regulations, policies, and guidelines governing the procedure; (3) type of procedure; (4) steps for each operating process (5) hazards and safety considerations; (6) operating limits; (7) precautions necessary to prevent exposure to hazardous chemicals (resulting from operations with SNM) or to licensed SNM; (8) measures to be taken if contact or exposure occurs; (9) IROFS associated with the process and associated functions; and (10) the timeframe for which the procedure is valid (GLE, 2011a).

Maintenance procedures involving IROFS for corrective maintenance, PM, testing after maintenance, and surveillance maintenance activities will describe the following as needed: (1) personnel qualifications; (2) controls applicable to, and specification of, any replacement components or materials to be used; (3) post-maintenance testing to verify equipment operability; (4) tracking and RM maintenance activities; (5) safe work practices; (6) pre-maintenance activities that require reviews of the work to be performed; and (7) steps that require notification of affected parties (technicians and supervisors) before performing work and on completion of maintenance work (GLE, 2011a).

Alarm response procedures will provide information for the identification of: (1) symptoms of the alarm; (2) possible causes; (3) automatic actions; (4) immediate operator action to be taken; and (5) required supplementary actions (GLE, 2011a). Off-normal procedures will describe actions to be taken during unusual or out-of-the ordinary situations (GLE, 2011a). Emergency operating procedures will identify actions necessary to mitigate potential events or events in progress that require protection of onsite personnel; public health and safety; and the environment (GLE, 2011a).

As described in Section 11.4.1.2 of the LA (GLE, 2011a), the applicant identified operating procedures that will be implemented at the proposed facility to control normal and off-normal operations, maintenance, alarm response, and emergency operations. The list of operating

procedures is consistent with the acceptance criteria in Section 11.4.3.4.6 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable. The applicant commits to include topics relevant to corrective and preventive maintenance, functional testing after maintenance, and surveillance maintenance activities in maintenance procedures involving IROFS. The topics identified for inclusion in maintenance procedures are consistent with the acceptance criteria contained in Section 11.4.3.4.11 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

The applicant outlines the elements that will be contained in the procedures. This description of the elements that will be included in operating procedures (i.e., purpose, time for which procedure is valid, etc.) meets the acceptance criteria in Section 11.4.3.4.2 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.4.2 Procedure Development Process

##### 11.3.4.2.1 Identification

The NRC staff reviewed the applicant's process for identifying the need for and development of procedures in accordance with the acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a) address a method for identifying, developing, approving, implementing, and controlling operating procedures based on ISA results.

The applicant describes the identification phase of the procedure development process in Section 11.4.2.1 of the LA (GLE, 2011a) and states that line managers or other designees are responsible for the identification of procedures needed for assigned functional areas. As described in the LA (GLE, 2011a), area managers are responsible for the identification of procedures that incorporate control and limitation requirements established by the RP, NCS, Industrial Safety and Environmental Protection functions (GLE, 2011a). Procedures necessary for human actions that are important to safety are identified through the ISAs, and each approved written procedure will have a unique identifier that is assigned by the Document Control function (GLE, 2011a). The provisions that the applicant described in Section 11.4.2.1 of the LA (GLE, 2011a), meet the acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

##### 11.3.4.2.2 Development

The NRC staff reviewed the applicant's procedure development process in accordance with the acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a) address a method for identifying, developing, approving, implementing, and controlling operating procedures based on ISA results.

The applicant describes the procedure development process in Section 11.4.2.2 of the LA (GLE, 2011a) and states that procedure development is: (1) initiated, developed, and controlled by the Document Control Program; (2) completed in accordance with approved written procedures; and (3) performed under the responsibility of line managers or other designees. Nuclear safety control requirements for workers will be incorporated into the appropriate operating, maintenance, and test procedures for uranium enrichment operations and detailed step-by-step procedures will not be required for activities that require skills normally possessed by qualified personnel (GLE, 2011a). Such activities will be performed in accordance with the appropriate documents, such as planning sheets, external manuals, forms, and job descriptions (GLE,

2011a). The description of the procedure development process, as described in Section 11.4.2.2 of the LA (GLE, 2011a), includes descriptions of lines of authority, document control requirements, and provisions for activities not requiring written procedures that meet the acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.4.2.3 Verification/Validation

The NRC staff reviewed the applicant's procedure verification and validation process in accordance with the acceptance criteria in Section 11.4.3.4.8 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.8 of NUREG-1520 (NRC, 2002a) address how the applicant verify the technical accuracy of procedures and verify that they can be performed as written and to identify who is responsible for verification. The verification process should provide reasonable assurance that the technical information, including formulas and set-points, and acceptance criteria are complete and correct and include a walk-down of the procedure in the field or a tabletop walkthrough. In addition, the process should include cross-disciplinary reviews and include both new procedures and changes to existing procedures. The process should also address operating limits and IROFS identified in the ISA Summary, QA requirements, and responsible management approval.

In Section 11.4.2.3 of the LA (GLE, 2011a), the applicant states that before procedures are used, they are verified and validated to ensure the technical accuracy (verification) and to ensure that they can be performed as written (validation). The applicant commits to employ the applicable guidance contained in NUREG-0700, "Human-System Interface Design Review Guidelines," (NRC, 2002b) and NUREG-0711, "Human Factors Engineering Program Review Model," (NRC, 2004) in the conduct of verification and validation activities (GLE, 2011a).

The verification process is performed by the procedure owner during the procedure development or change process and includes two basic attributes: (1) a technical accuracy verification to ensure that technical information, including formulas, set points, and acceptance criteria, are correctly identified in the procedures; and (2) an administrative process to verify the procedure format and style and to verify that the procedures meet the requirements specified in the approved written CM procedures (GLE, 2011a).

The validation process purpose, as stated in the LA (GLE, 2011a), is to ensure that no technical errors or human factor issues were inadvertently introduced during the procedure development or review process. The validation process is: (a) required for new procedures and for procedure changes; (b) performed in the field by qualified personnel; (c) performed in a training environment in situations where a particular system or process is not available for walk-down validation; and (d) required to be documented. As described by the applicant, validation may be accomplished by detailed scrutiny of the procedure as part of walk-through exercises or drills (GLE, 2011a).

The procedure verification and validation processes of procedure development, as described in Section 11.4.2.3 of the LA (GLE, 2011a), ensures that facility procedures are technically accurate and able to be performed as written. These measures meet the acceptance criteria in Section 11.4.3.4.8 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.4.2.4 Review/Approval

The NRC staff reviewed the applicant's procedure review and approval in accordance with the acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a) address a method for identifying, developing, approving, implementing, and controlling operating procedures based on ISA results.

In Section 11.4.2.4 of the LA (GLE, 2011a), the applicant describes the review and approval process for procedures. The applicant states that new procedures and changes to procedures undergo review by the appropriate technical and safety disciplines, including cross-discipline reviews as necessary (GLE, 2011a). The applicant states that the organization from which the procedure originated resolves the comments or questions generated during the review process (GLE, 2011a). Upon completion of the review process, procedures are approved by the organization manager responsible for the procedure activity (GLE, 2011a). This manager is also responsible for ensuring that the appropriate training is completed on the new and revised procedures (GLE, 2011a).

As described in Section 11.4.2.4 of the LA (GLE, 2011a), the QA function reviews QA implementing procedures for compliance and consistency with the QA Program and ensures that the provisions of the QA Program are effectively incorporated into QA implementing procedures.

The procedure review and approval process includes provisions for the issue of new procedures, procedure revisions, comment resolutions, training, and management involvement in procedure approval. These measures meet the acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable, as they will maintain the quality and consistency of procedures issued and used at the facility.

#### 11.3.4.2.5 Issuance and Distribution

The NRC staff reviewed the applicant's procedure issuance and distribution process in accordance with the acceptance criteria in Section 11.4.3.4.9 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.9 of NUREG-1520 (NRC, 2002a) address the distribution of documents in accordance with applicable distribution lists and a process that limits the use of outdated procedures. In addition, copies of procedures should be available to appropriate personnel and the process for issuance and distribution should be documented and refer to the records management function.

The applicant commits, in Section 11.4.2.5 of the LA (GLE, 2011a), to distribute controlled documents and approved revisions in a controlled manner in accordance with the Document Control Program. As stated in the LA (GLE, 2011a), line managers, or other designees, are responsible to ensure that personnel whose work requires the use of procedures have access to the controlled copies of such procedures. The procedure issuance and distribution process, as described in Section 11.4.2.5 of the LA (GLE, 2011a), presents measures to ensure that documents and revisions thereto are controlled and distributed in accordance with the document control program and available to appropriate personnel. This process meets the acceptance criteria in Section 11.4.3.4.9 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

Further descriptions of the provisions of the document control program are found in Section 7 of the QAPD (GLE, 2011c). Further evaluation of the applicant's document control program is found in Section 11.A.3.7 of Appendix A to Chapter 11 of this SER.

#### 11.3.4.3 Temporary Changes to Procedures

The NRC staff reviewed the applicant's temporary change process in accordance with the acceptance criteria in Section 11.4.3.4.10 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.10 of NUREG-1520 (NRC, 2002a) address a formal process for making temporary changes to procedures. Such changes should not involve changes to the ISA and should be conducted in accordance with a documented review and approval process. Temporary changes should only be issued when permanent procedures do not exist to (1) direct operations during testing, maintenance, and modifications; (2) provide guidance in unusual situations; and (3) provide assurance of orderly and uniform operations for short periods. The process should establish time frames for use of temporary procedures and set the same level of review and approval as used for permanent procedures.

The applicant describes provisions for the use of temporary changes in Section 11.4.3 of the LA (GLE, 2011a) and states that temporary changes to procedures can be made when the change does not result in a change to the ISA and when the change does not involve an intent change (a change in scope, method, or acceptance criteria that has safety significance). Temporary changes are documented in accordance with written procedures (GLE, 2011a). Temporary procedure changes may be used for identified periods of time that should not exceed 30 days or for the period for which the temporary condition exists, whichever is greater (GLE, 2011a). If the temporary procedure needs to exceed this period, the temporary change will be assessed to ensure that it is appropriate to extend its use or if a permanent change needs to be processed (GLE, 2011a). A temporary change may be made permanent after the change is reviewed and approved by the requirements of the Procedure Development Process (GLE, 2011a).

The applicant has established formal requirements governing the use of temporary procedure changes. These requirements dictate the conditions under which a temporary procedure change may be used, the time period for which it may be implemented, and the review and documentation responsibilities associated with the changes. These requirements, as described in Section 11.4.3 of the LA (GLE, 2011a), meet the acceptance criteria in Section 11.4.3.4.10 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.4.4 Temporary Procedures

The NRC staff reviewed the applicant's temporary change process in accordance with the acceptance criteria in Section 11.4.3.4.10 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.10 of NUREG-1520 (NRC, 2002a) address a formal process for making temporary changes. Such changes should not involve changes to the ISA and should be conducted in accordance with a documented and approval process. Temporary changes should only be issued when permanent procedures do not exist to (1) direct operations during testing, maintenance, and modifications; (2) provide guidance in unusual situations; and (3) provide assurance of orderly and uniform operations for short periods. The process should establish time frames for use of temporary procedures and set the same level of review and approval as used for permanent procedures.

In Section 11.3.4 of the LA (GLE, 2011a), the applicant states that temporary procedures are issued to address changes in normal conditions that are not addressed in operating procedures;

these conditions can be related to safety, quality, production, or maintenance procedures. Temporary procedures are classified in three categories: (a) emergency; (b) standard (valid for up to 90 days from initial start); and (c) long-term (valid for periods not to exceed one year) (GLE, 2011a). Long-term procedures, which require equivalent signatures to new operating procedures, are used for projects that require a long-term startup phase before facility acceptance or process qualification (GLE, 2011a).

The applicant's description of temporary procedures includes identification of the classification categories, conditions of use, and approval requirements for temporary procedures. These requirements, as described in Section 11.3.4 of the LA (GLE, 2011a), meet the acceptance criteria in Section 11.4.3.4.10 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.4.5 Periodic Reviews

The NRC staff reviewed the applicant's periodic procedure review process in accordance with the acceptance criteria in Sections 11.4.3.4.7 and 11.4.3.4.12 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.7 of NUREG-1520 (NRC, 2002a) address how the applicant will review procedures after unusual events, such as accidents, unexpected transients, significant operator error, or equipment malfunction, or after any modification to the system and revise the procedures as needed.

The acceptance criteria in Section 11.4.3.4.12 of NUREG-1520 (NRC, 2002a) is for the applicant to conduct periodic procedure reviews to assure their continued accuracy and usefulness and establish the time frame for reviews of the various types of procedures.

The periodic review of procedures, as stated by the applicant in Section 11.4.5 of the LA (GLE, 2011a), is performed to assure their continued accuracy and usefulness. The applicant commits to review operating procedures at least once every three years and to review emergency procedures at least annually (GLE, 2011a). Procedures will be reviewed after unusual incidents, including accidents, unexpected transients, significant operator error, or equipment malfunctions, to determine if changes are appropriate based on the cause and corrective action determination for the particular incident (GLE, 2011a). The applicant identifies the frequency with which it will conduct periodic reviews of controlled documents in Table 11-1, "Procedure Periodic Reviews," of the LA (GLE, 2011a).

As described in Section 11.4.5 of the LA (GLE, 2011a), the applicant made commitments to perform periodic and issue-based procedure reviews. The applicant's commitment to review procedures periodically and after unusual incidents, including accidents, unexpected transients, significant error operator, or equipment malfunctions, meets the acceptance criteria in Section 11.4.3.4.7 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable. The applicant's commitment to review procedures to ensure continued accuracy and applicability meets the acceptance criteria in Section 11.4.3.4.12 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.4.6 Use and Control of Procedures

The NRC staff reviewed the applicant's use and control of procedures in accordance with the acceptance criteria in Section 11.4.3.4.9 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.9 of NUREG-1520 (NRC, 2002a) address the distribution of documents in accordance with applicable distribution lists and a process that limits the use of outdated procedures. In addition, copies of procedures should be available to appropriate

personnel and issuance and distribution should be documented and refer to the records management function.

Section 11.4.6 of the LA (GLE, 2011a) states that line managers and area managers will ensure that procedures are readily available in the work area and that personnel are trained in the requirements of the procedures. The applicant commits to train personnel to understand the policy of mandatory compliance with procedures and to immediately report inadequate procedures or the inability to follow procedures (GLE, 2011a). These provisions regarding the use and control of procedures ensure that current procedures are available and used at all work locations. The procedure use and control measures described in Section 11.4.6 of the LA (GLE, 2011a) meet the acceptance criteria in Section 11.4.3.4.9 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.4.7 Records

The NRC staff reviewed the applicant's procedure records process in accordance with the acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a) address a method for identifying, developing, approving, implementing, and controlling operating procedures based on ISA results.

In Section 11.4.7 of the LA (GLE, 2011a), the applicant states that the facility Safety Program requires the establishment and maintenance of approved written procedures for EHS limitations and requirements to govern the safety aspects of operations. The applicant commits to document requirements for procedure control and approval authorities (GLE, 2011a). The commitment to identify and document the management personnel who are responsible and accountable for the approval and maintenance of procedures meets the acceptance criteria in Section 11.4.3.4.4 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.4.8 Topics to be Covered in Procedures

The NRC staff reviewed the applicant's procedure topics in accordance with the acceptance criteria in Sections 11.4.3.4.3 and 11.4.3.4.6 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.4.3 of NUREG-1520 (NRC, 2002a) address important elements of the function described in NUREG-1520 (NRC, 2002a) and include design, CM, procurement, construction, radiation safety, maintenance, QA elements, training and qualification, audits and assessments, incident investigations, records management, criticality safety, fire safety, chemical safety, and reporting requirements.

The acceptance criteria in Section 11.4.3.4.6 of NUREG-1520 (NRC, 2002a) address the types of procedures used during facility operation including management, operating, maintenance, and emergency procedures.

In Section 11.4.8 of the LA (GLE, 2011a), the applicant commits to cover, as a minimum, all the activities identified in Section 11.4.1 of the LA (GLE, 2011a) in controlled documents. The applicant provides a listing with of topics to be covered by procedures and identifies that the list may not be all-inclusive and is meant for guidance only (GLE, 2011a). Topics identified on the list are:

- Management control procedures  
 Training; audits and inspections; investigations and reporting; RM and document control; changes in facilities and equipment; modification design control; QA; equipment control (lockout/tagout); shift turnover; work and management control; nuclear criticality safety; fire safety; chemical process safety; radiation protection; radioactive waste management; maintenance; environmental protection; operations; IROFS surveillances; calibration control; procurement (GLE, 2011a);
- System procedures that address start-up, operation, and shutdown  
 Electrical power; ventilation; shift routines, shift turnover, and operating practices; sampling; uranium hexafluoride (UF<sub>6</sub>) cylinder handling; UF<sub>6</sub> material handling equipment; decontamination operations; facility air and nitrogen; cooling, sanitary, and facility water; temporary changes in operating procedures; purge and evacuation vacuum systems (GLE, 2011a);
- Abnormal operation/alarm response  
 Loss of cooling, instrument air, and/or electrical power; fires; chemical process releases; loss of feed or withdrawal capacity; loss of purge vacuum (GLE, 2011a);
- Maintenance activities that address system repair, calibration, inspection and testing  
 Repairs and preventive repairs of IROFS; calibration and functional testing of IROFS; high-efficiency particulate air filter maintenance; safety system relief valve replacement; surveillance/monitoring; piping integrity testing; containment device testing; repair of UF<sub>6</sub> valves; testing of cranes; UF<sub>6</sub> cylinder inspection and testing (GLE, 2011a); and
- Emergency procedures  
 Toxic chemical releases (including UF<sub>6</sub>) (GLE, 2011a).

The applicant's list of the types of activities that are covered, or will be covered, by written procedures includes the topics of administrative procedures; system procedures that address startup, operation, and shutdown; abnormal operation or alarm response; maintenance activities that address system repair, calibration, inspection, and testing; and emergency procedures (GLE, 2011a). The applicant also clearly states areas for which a procedure is required, including examples of specific activities. The description of facility procedures meets the acceptance criteria in Section 11.4.3.4.6 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable. The commitment to establish and implement procedures to direct fire safety and chemical process safety meets the acceptance criteria in Section 11.4.3.4.3 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

### 11.3.5 AUDITS AND ASSESSMENTS

The NRC staff reviewed the applicant's audit and assessment process in accordance with the acceptance criteria in Section 11.4.3.5 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.5 of NUREG-1520 (NRC, 2002a) address the applicant's audit and assessment process to include applicable policy objectives, a commitment to conduct audits



and independent assessments, identification of the areas in which audits and assessments are conducted, and the commitment to use qualified personnel to conduct audits and assessments.

As described in Section 11.5 of the LA (GLE, 2011a), the applicant commits to implement a system of audits and assessments to help ensure that the EHS functions are adequate and effectively implemented. The system of audits and assessments will ensure comprehensive program oversight at least once every three years (i.e., each program area will be audited or assessed at no greater than three year intervals). The applicant's commitment to conduct audits and assessments of activities significant to facility safety and environmental protection meets the acceptance criteria in Section 11.4.3.5 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.5.1 Activities to be Audited or Assessed

##### 11.3.5.1.1 Assessments

The NRC staff reviewed the applicant's assessment process in accordance with the acceptance criteria in Sections 11.4.3.5.2 and 11.4.3.5.4 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.5.2 of NUREG-1520 (NRC, 2002a) address the applicant's commitments to conduct independent assessments of activities significant to facility safety and environmental protection. The acceptance criteria in Section 11.4.3.5.4 of NUREG-1520 (NRC, 2002a) address the conduct of independent assessments by offsite groups or individuals not involved in the licensed activity, to verify that the health, safety, and environmental compliance functions are effectively achieving their designed purposes.

Section 11.5.1.1 of the LA (GLE, 2011a) states that assessments will be performed by management to verify the effective implementation of the Safety Program elements (RP, NCS, Industrial Safety, Security and Emergency Preparedness, and Environmental Protection); management measures; and QA Program elements. Assessments: (1) include an evaluation of procedural compliance, conformance to regulations, and the overall adequacy of the safety program; (2) are documented and reported in accordance with approved written procedures; and (3) engage the Corrective Action Program as necessary for condition reporting and corrective action (GLE, 2011a). The applicant states that it will allow personnel from the area being assessed to perform the assessment provided that they do not have direct responsibility for the specific activity being assessed (GLE, 2011a). The responsible line manager has the responsibility for resolving any observations that arise from programmatic assessments. In addition to the management assessments described above, the applicant commits to perform independent assessments of its Safety Program elements (GLE, 2011a).

The applicant commits to: (1) conduct independent assessments of activities significant to facility safety and environmental protection to verify that the health, safety, and environmental compliance functions are effectively achieving their designed purposes; and (2) ensure that these assessments are performed by individuals not involved in the licensed activity (GLE, 2011a). This meets the acceptance criteria in Sections 11.4.3.5.2 and 11.4.3.5.4 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable. The applicant describes the management responsibilities related to assessments as well as the documentation and corrective action requirements for assessments (GLE, 2011a). The applicant's program for assessments, as described in Section 11.5.1.1 of the LA (GLE, 2011a), is consistent with the guidance contained in Sections 11.4.3.5.2 and 11.4.3.5.4 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.5.1.2 Audits

The NRC staff reviewed the applicant's audit process in accordance with the acceptance criteria in Sections 11.4.3.5.2 and 11.4.3.5.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.5.2 of NUREG-1520 (NRC, 2002a) address the applicant's commitment to conduct internal audits of activities significant to facility safety and environmental protection. The acceptance criteria in Section 11.4.3.5.3 of NUREG-1520 (NRC, 2002a) address the conduct of audits to verify that operations are being conducted in accordance with regulatory requirements and commitments in the LA.

The applicant states, in Section 11.5.1.2 of the LA (GLE, 2011a), that audits are performed to determine if operations conform to NCS, RP, and Industrial Safety requirements. As described in the LA (GLE, 2011a), audits are: (1) conducted by representatives of the NCS, RP, and Industrial Safety functions; (2) performed in accordance with approved written procedures; and (3) scheduled to assess the safety of uranium enrichment and process support areas. The applicant states that audit results are reported in writing to the Facility Manager, the EHS Manager, the NCS Manager, area managers, the manager of the safety function being audited, and other line management as appropriate (GLE, 2011a).

The scope of the audit program, organizational responsibilities for audits, guidelines for the scheduling and conduct of audits, and the levels of management to which results are reported are described in Section 11.5.1.2 of the LA (GLE, 2011a). The applicant commits to conduct audits to verify that operations are being conducted in accordance with regulatory requirements and commitments in the license application for NCS, RP, and Industrial Safety. This commitment meets the acceptance criteria in Sections 11.4.3.5.2 and 11.4.3.5.3 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.5.2 Scheduling of Audits and Assessments

The NRC staff reviewed the applicant's audit and assessment scheduling process in accordance with the acceptance criteria in Sections 11.4.3.5.1 and 11.4.3.5.5 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.5.1 of NUREG-1520 (NRC, 2002a) address policy directives covering the audit and assessment function. The acceptance criteria in Section 11.4.3.5.5 of NUREG-1520 (NRC, 2002a) address the conduct of audits and assessments in the areas of radiation safety, NCS, chemical safety, fire safety, environmental protection, emergency management, QA, CM, maintenance, training and qualification, procedures, incident investigation, and records management.

As described in Section 11.5.2 of the LA (GLE, 2011a), an assessment of each management measure is performed annually. Assessments may focus on a single organizational element or the entire organization and are conducted as follows: (1) NCS and RP audits will be performed quarterly (at intervals not to exceed 110 days) under the direction of the manager of the NCS and RP functions; (2) weekly nuclear criticality safety walkthroughs of uranium enrichment and process support areas will be conducted by facility personnel in accordance with approved written procedures, with any findings from the walkthrough being documented and sent to the affected line manager or area manager for resolution; (3) triennial independent assessments will be conducted of facility safety program elements; and (4) an audit schedule will be developed annually by the Environmental Protection function to evaluate the Environmental Protection Program (GLE, 2011a).

The applicant commits to conduct audits and assessments of the Environmental Protection Program, RP, NCS, and facility Safety Program elements, which includes management measures. These audits and assessments encompass the program areas identified in the acceptance criteria of Section 11.4.3.5.5 of NUREG-1520 (NRC, 2002a), which include radiation safety, NCS, chemical safety, fire safety, environmental protection, emergency management, QA, CM, maintenance, training and qualification, procedures, incident investigation, and records management. The applicant also describes the frequency of audits that will be conducted as part of the audit program. The description of the audit and assessment function (i.e., the activities to be audited and audit frequency) meets the acceptance criteria in Section 11.4.3.5.1 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.5.3 Procedures for Audits and Assessments

The NRC staff reviewed the applicant's procedures for audits and assessments in accordance with the acceptance criteria in Section 11.4.3.5.1 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.5.1 of NUREG-1520 (NRC, 2002a) address the policy directives covering the audit and assessment function including the areas to be audited, the frequency of audits, guidance to be used, assigned responsibilities, and procedures for recording results and making recommendations.

The applicant describes its procedure requirements for audits and assessments in Section 11.5.3 of the LA (GLE, 2011a). Specifically, the applicant commits to: (1) communicate audit results in writing to the responsible line manager, the Facility Manager, area managers, and to the EHS Manager; (2) document corrective actions that need to be performed; (3) ensure that corrective actions are approved by management and tracked to completion by the EHS function; and (4) maintain records of the audit or inspection, instructions and procedures used, persons conducting the audits or inspections, audit or inspection results, and corrective actions for identified violations of license conditions in accordance with procedural requirements for a minimum period of three years in accordance with written procedures (GLE, 2011a).

The applicant also states that industrial safety audits will be performed under the direction of the Industrial Safety Manager, and environmental protection audits will be conducted in accordance with approved written procedures to ensure that operational activities conform to documented environmental requirements (GLE, 2011a).

The applicant describes the procedural requirements that will be implemented to control the documentation and communication of audit results and corrective actions. As described in Section 11.5.3 of the LA (GLE, 2011a), the commitments regarding audit and assessment procedures meet the acceptance criteria in Section 11.4.3.5.1 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.5.4 Qualifications and Responsibilities for Audits and Assessments

The NRC staff reviewed the applicant's qualifications and responsibilities for audits and assessments in accordance with the acceptance criteria in Section 11.4.3.5.6 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.5.6 of NUREG-1520 (NRC, 2002a) address the use of qualified personnel without direct responsibility for the function and area being audited or assessed, specify the responsible staff positions and committees for conducting the audits and assessments, and specify the levels of management for reporting results and corrective actions.

In Section 11.5.4 of the LA (GLE, 2011a), the applicant commits to form audit teams with members who: (a) are appropriately trained and experienced; (b) do not report to the audited organization; and (c) have no direct responsibility to the function being audited. As stated in the LA (GLE, 2011a), audit results in the form of corrective action items are reported to the Facility Manager and staff for monitoring of closure status. Also, the responsible line or area manager are responsible for addressing corrective action commitments related to nonconformances in accordance with approved written procedures (GLE, 2011a).

As stated in the LA (GLE, 2011a), the Environmental Project Manager, or delegate, are responsible for resolution of identified nonconformances associated with the Environmental Protection Program.

In Section 11.5.4 of the LA (GLE, 2011a), the applicant commits to ensure that qualified personnel without direct responsibility for the function and area being audited or assessed perform audits and assessments. The applicant also specifies the staff positions and committees responsible for audits and assessments, describes the levels of management to which results will be reported, and includes a description of the process for resolution and reporting of nonconformances and corrective actions. The responsibilities and qualification requirements for audits and assessments meet the acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.6 INCIDENT INVESTIGATIONS

The NRC staff reviewed the applicant's incident investigation process in accordance with the acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a) address the applicant's description of and commitment to a process to investigate abnormal events at the facility, monitor and document corrective actions, and maintain documentation of lessons learned. The incident investigation process should have a formal policy and procedures and include the investigation of abnormal events.

In Section 11.6 of the LA (GLE, 2011a), the applicant states that incident investigations are performed to assure that upset conditions are understood and appropriate corrective actions are identified and implemented to prevent recurrence. The applicant states that the facility's management measures include the documentation of upset conditions in unusual incident reports (UIRs), which will be documented and their related corrective actions will be tracked to completion (GLE, 2011a).

As described in Section 11.6 of the LA (GLE, 2011a), the objectives of the incident investigation and reporting procedures are to: (a) establish the validity of the data related to the incident; (b) develop and implement corrective action plans when appropriate; (c) document an event which was or could become a danger to persons or property; and (d) ensure that proper levels of management and public agencies are notified.

##### 11.3.6.1 Incident Identification, Categorization, and Notification

The NRC staff reviewed the applicant's incident investigation process in accordance with the acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a) address the applicant's description of and commitment to a process to investigate abnormal events at the facility, monitor and document

corrective actions, and maintain documentation of lessons learned. The process should have a formal policy and procedures and include the investigation of abnormal events.

In Section 11.6.1 of the LA (GLE, 2011a), the applicant commits to maintain a system to identify, track, investigate, and implement corrective actions for abnormal events that may occur during the operation of the facility. The system will determine the specific or generic root causes(s), the generic implication, recommended corrective actions, and report events as required by 10 CFR 70.50 and 70.74 (GLE, 2011a).

The Corrective Action System, as described in the LA (GLE, 2011a), contains the following requirements and features: (a) operates in accordance with approved written procedures; (b) provides for the documentation, tracking, and reporting of abnormal events to facility management; (c) identifies abnormal events associated with IROFS or their associated management measures; (d) considers each event in terms of regulatory reporting criteria and in terms of severity (where precursor events are considered unusual events and events concerning compliance with regulations or license conditions are considered potential non-compliances (PNCs)); (e) requires investigation of UIRs, a determination of root or most probable (proximate) cause, and the identification of required corrective action(s); (f) for more significant UIRs and PNCs, requires a formal, systematic determination of root cause, creation of a Corrective Action Plan, and a higher level management review and approval of the investigation and corrective actions; (g) requires that monthly reports covering the status of UIRs and PNCs be issued to facility management; (h) grades events for the purpose of an ongoing management evaluation of facility performance and use as one element in driving safety culture focus; (i) maintains records of the events and the documented evidence of closure for a minimum of three years; and (j) uses UIR and PNC information where appropriate when performing ISAs.

In Section 11.6.1 of the LA (GLE, 2011a), the applicant provides a description of the process that will be used to: (1) investigate abnormal events that may occur during operation of the facility to determine their specific or generic root cause(s), generic implications, and risk significance; (2) recommend corrective actions; and (3) make any report to the NRC that is required by 10 CFR 70.50 or 10 CFR 70.74. The applicant's description of the corrective action system as it relates to the investigation of abnormal facility events and the commitment to implement this system in accordance with written procedures will ensure that incident investigations will be properly identified, investigated, and resolved. This system meets the acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.6.2 Conduct of Incident Investigations

The NRC staff reviewed the applicant's incident investigation process in accordance with the acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a) address the applicant's description of and commitment to a process to investigate abnormal events at the facility, monitor and document corrective actions, maintain lessons learned documents. The process should have a formal policy and procedures and include the investigation of abnormal events.

In Section 11.6.2 of the LA (GLE, 2011a), the applicant commits to implement the incident investigation process in accordance with approved written procedures, perform a prompt risk-based evaluation of the event, and conduct investigations with investigators who are independent of the function(s) involved with the incident under investigation. When

investigations warrant the use of a team, such teams will: (1) include a minimum of one individual trained in root cause analysis and one member knowledgeable of the area being investigated; (2) undergo no retaliation as a result of their participation in investigations; and (3) be composed of qualified investigators, whether internally or externally appointed (GLE, 2011a).

As described in the LA (GLE, 2011a), investigations will be initiated within 48 hours of the abnormal event, or sooner, based on the event's safety significance, and will include a review of the record of IROFS failures as required by 10 CFR 70.62(a)(3). The details of the accident event sequence(s) will be compared with accident sequence(s) already considered in the ISA, and the ISA Summary (GLE, 2011b) will be modified to include the evaluation of the risk associated with accidents of the type actually experienced (GLE, 2011a). The applicant commits to maintain auditable records and documentation related to abnormal events, investigations, and root cause analyses so that "lessons learned" may be applied to future operations of the facility (GLE, 2011a). The applicant further commits to include a description of the event and contributing factors, a root cause analysis, findings, and recommendations in the incident report for each abnormal event experienced at the facility (GLE, 2011a). The applicant will also review relevant findings with affected personnel and revise records, as required by post-failure investigation conclusions, within five working days of investigation completion (GLE, 2011a).

The Incident Investigation Process includes the following steps: (1) investigate the problem; (2) derive an understanding of the issues and drivers and determine the fundamental or root cause(s); (3) develop appropriate corrective and preventive actions; (4) assign responsible individual(s) to address each corrective or protective action, determine the required timing for each action, and provide scheduled target date for each action; (5) compile adequate records (hard copy or electronic files) to demonstrate completion or closure of the corrective actions; (6) conduct an investigation to determine if the corrective action was appropriate; (7) ensure that identified corrective actions are completed in an appropriate and timely manner; (8) input the corrective action completion data, documentation, and any related notes of interest in a hard copy or electronic copy file; (9) provide appropriate facility management with closure documentation for internal type items; and (10) provide the Licensing Organization with closure documentation for external agency items or input the documentation electronically into the controlled electronic file (GLE, 2011a).

The applicant provides a comprehensive description of the activities it will perform as part of incident investigations including: (1) comparing details of the event sequence with accident sequences already considered in the ISA; (2) modifying the ISA Summary to include evaluation of the risk associated with accidents of the type actually experienced; and (3) maintaining documentation related to abnormal events (GLE, 2011a). As described in the LA (GLE, 2011a), the process for investigating abnormal events meets the acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

#### 11.3.6.3 Written Followup Report

The NRC staff reviewed the applicant's incident investigation documentation in accordance with the acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a) address the applicant's description of and commitment to a process to investigate abnormal events at the facility, monitor and document corrective actions, and maintain documentation of lessons learned. The process should have a formal policy and procedures and include the investigation of abnormal events.

In Section 11.6.3 of the LA (GLE, 2011a), the applicant states that following the completion of the incident investigation, a report of the incident and the investigation will be made to ensure that corrective and preventive actions are defined, completed, and closed. At least quarterly, a status report will be issued by the EHS function and distributed to management and individuals responsible for corrective actions (GLE, 2011a). The applicant's commitments to prepare written reports and status reports related to incident investigations meet the acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a) as they will ensure that abnormal events will be promptly resolved and communicated. The applicant's provisions for written follow-up reports are, therefore, acceptable.

#### 11.3.6.4 Corrective Actions

The NRC staff reviewed the applicant's corrective action process in accordance with the acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a) address the applicant's description of and commitment to a process to investigate abnormal events at the facility, monitor and document corrective actions, and maintain documentation of lessons learned. The process should have a formal policy and procedures and include the investigation abnormal events.

In Section 11.6.4 of the LA (GLE, 2011a), the applicant states that the line and area managers have the responsibility to ensure proper action is taken to control any incidents that occur in their assigned area through: (a) consulting EHS for a determination as to whether or not the investigation of an incident is required; (b) notifying the appropriate management; (c) participating in the investigation as required; (d) assuring adequate corrective actions are completed; and (e) reviewing and approving the corrective actions associated with each UIR in their area of responsibility by creating a corrective action within each UIR. The applicant's delineation of management responsibilities associated with the investigation of unusual incidents, including the determination of the need for investigation and the identification, review, and approval of corrective actions, will ensure that incidents are appropriately monitored, documented, and corrected. These responsibilities meet the acceptance criteria in Section 11.4.3.6 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

### 11.3.7 RECORDS MANAGEMENT

#### 11.3.7.1 Records Management Program

The NRC staff reviewed the applicant's records management program in accordance with the acceptance criteria in Sections 11.4.3.7.1 through 11.4.3.7.4 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.7.1 of NUREG-1520 (NRC, 2002a) address a records management program that includes preparation, verification, characterization, and maintenance of records. The acceptance criteria in Section 11.4.3.7.2 of NUREG-1520 (NRC, 2002a) address a records management program that includes ensuring that records are legible, identifiable, and retrievable for their designated lifetimes. The acceptance criteria in Section 11.4.3.7.3 of NUREG-1520 (NRC, 2002a) address a records management program that includes ensuring records are protected against tampering, theft, loss, unauthorized access, damage, or deterioration for their storage lifetime. The acceptance criteria in Section 11.4.3.7.4 of NUREG-1520 (NRC, 2002a) address a records management program that includes the establishment and documentation of procedures for specifying requirements and responsibilities for record selection, verification, protection, transmittal, distribution, retention, maintenance, and disposition.

Section 11.7.1 of the LA (GLE, 2011a) describes the RM controls performed by the applicant to provide identifiable and retrievable documentation of QA records. The QAPD (GLE, 2011c) requires procedures for the review, approval, handling, identification, retention, retrieval, and maintenance of QA records, which include: (a) results of tests and inspections required by applicable codes and standards; (b) construction procurements and receiving records; (c) personnel certification records; (d) design calculations; (e) purchase orders; (f) specifications and amendments; (g) procedures; (h) incident investigation results and approvals or corrective action taken; (i) various certification forms; (j) component data packages; (k) source surveillance and audit reports, and (l) any other QA documentation required by specifications or procedures (GLE, 2011a). For computer codes and computerized data used for IROFS activities, as discussed in the ISA Summary (GLE, 2011b) and the LA (GLE, 2011a), the applicant states that procedures are established to maintain readability and usability of older codes and data as computing technology changes.

Section 11.7.1 of the LA (GLE, 2011a) identifies that QA records are not considered valid until they are authenticated and dated by authorized personnel. The applicant commits to maintain records at locations where they can be reviewed and audited to establish that the required quality has been assured (GLE, 2011a). As described in the LA (GLE, 2011a), the RM function is responsible for maintaining a master file of documents and records with controlled access. Documents in the master file may be originals or reproduced copies and may include computer storage of data (GLE, 2011a).

As described in Section 11.7.1 of the LA (GLE, 2011a), the applicant requires that documents in the master file: (1) be legible and identifiable as to the subject to which they pertain; (2) be considered valid only if stamped, initialed, signed, or otherwise authenticated, and dated by authorized personnel; and (3) be protected in order to prevent deterioration. The applicant also requires that all record storage areas (including satellite files) be evaluated to assure that records are adequately protected from damage by fire.

As stated in Section 11.7.1 of the LA (GLE, 2011a), the applicant requires that the master file storage system provide for the accurate retrieval of information without undue delay. As such, the applicant requires the preparation of approved written instructions regarding the storage of records in the master file and states that a designated supervisor is responsible for ensuring the implementation of these written instructions (GLE, 2011a).

The applicant commits to implement procedures for the review, approval, handling, identification, retention, retrieval, and maintenance of QA records (GLE, 2011a), which meets the acceptance criteria of Section 11.4.3.7.4 of NUREG-1520 (NRC, 2002a). As described in Section 11.7.1 of the LA (GLE, 2011a), these procedures will describe RM responsibilities, identify records having controlled access in a master file, and provide for the protection of records from loss, unauthorized access, damage, or deterioration while in storage. The commitment to protect records against tampering, theft, loss, unauthorized access, damage, or deterioration for the time they are in storage meets the acceptance criteria of Section 11.4.3.7.3 of NUREG-1520 (NRC, 2002a) and is, therefore, acceptable.

The applicant requires that documents in the master file be legible, identifiable, and retrievable for their designated lifetimes consistent with the acceptance criteria of Section 11.4.3.7.2 of NUREG-1520 (NRC, 2002a). Furthermore, for computer codes and computerized data used for activities relied on for safety, as specified in the ISA Summary (GLE, 2011b), the applicant commits to establish procedure(s) for maintaining readability and usability of older codes and data as computing technology changes.



The applicant commits to ensure that: (1) records are verified and validated (stamped, initialed, signed, or otherwise authenticated, and dated by authorized personnel); (2) prepared and characterized such that they are legible and identifiable as to the subject to which they pertain; and (3) maintained in a manner that prevents deterioration or loss. These measures meet the acceptance criteria in Section 11.4.3.7.1 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.7.2 Record Retention

The NRC staff reviewed the applicant's records record retention process in accordance with the acceptance criteria in Section 11.4.3.7.3 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.7.3 of NUREG-1520 (NRC, 2002a) address a records management program that includes ensuring records are protected against tampering, theft, loss, unauthorized access, damage, or deterioration for their storage lifetime.

In Section 11.7.2 of the LA (GLE, 2011a), the applicant commits to maintain records related to the ISA; IROFS; the application of management measures to IROFS, NCS, and RP activities; training/retaining; occupational exposure of personnel to radiation; releases of radioactive materials to the environment; and other pertinent safety activities to demonstrate compliance with license conditions and regulations. The applicant also commits to maintain records of criticality safety analyses in sufficient detail to enable the independent review and audit of the calculational method and results (GLE, 2011a). In addition, records related to radiation exposure will be maintained in accordance with the requirements of 10 CFR Part 20 (GLE, 2011a).

The applicant identifies RP records that must be maintained for at least three years (GLE, 2011a). These records include: (a) records of the Facility Safety Review Committee meetings; (b) surveys of equipment for release to unrestricted areas; (c) instrument calibrations; (d) safety audits; (e) personnel training and retraining; (f) radiation work permits; (g) surface contamination surveys; (h) concentrations of airborne radioactive material in the facility; and (i) radiological safety analyses (GLE, 2011a). The LA (GLE, 2011a) specifies that records associated with Environmental Protection activities are generated and retained in a manner that complies with the requirements of 10 CFR Part 20.

The applicant's commitments to maintain records associated with safety-related activities in order to demonstrate regulatory compliance and to retain these records for specified retention periods meet the acceptance criteria in Section 11.4.3.7.3 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

#### 11.3.7.3 Organization and Administration

The NRC staff reviewed the applicant's records management organization and administration in accordance with the acceptance criteria in Sections 11.4.3.7.5 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.7.5 of NUREG-1520 (NRC, 2002a) address a records management program that includes an organization and procedures to promptly detect and correct any deficiencies in the records management system or its implementation.

In Section 11.7.3.1 of the LA (GLE, 2011a), the applicant states that the QA and Infrastructure Program Manager has responsibility for the RM Program during the design and construction phases of the project, and the Infrastructure Program Manager has responsibility for the RM

Program during the Operations phase. The RM Program functions, as described in Section 11.7.3.1 of the LA (GLE, 2011a), include: (a) directing the development, implementation, and maintenance of methods and procedures encompassing a RM Program; and (b) assuring the laws, codes, standards, regulations, and company procedures pertaining to record keeping requirements are met.

In Section 11.7.3.2 of the LA (GLE, 2011a), the applicant commits to manage the RM Program with appropriately trained and qualified personnel. The applicant states that although no specific experience related to the control of documents or management of records is required, previous technical or RM experience is recommended (GLE, 2011a). As described in Section 11.7.3.3 of the LA (GLE, 2011a), general training in RM is provided to employees as part of the general topics covered in GET, and specific professional development training is provided on an as needed basis.

The applicant identifies examples of the types of records maintained by the RM Program in Section 11.7.3.4 of the LA (GLE, 2011a). These records include: (a) general information (safety analyses, facility and equipment descriptions, drawings, etc.); (b) organization and administration (organization charts, position descriptions, personnel exposure records, QA records, safety inspections, audits, assessments, and investigations, etc.); (c) the ISA and ISA related analyses; (d) radiation safety (radiation training records, radiation work permits, etc.); (e) nuclear criticality safety (NCS evaluations, records pertaining to nuclear criticality inspections, audits, investigations, etc.); (f) chemical safety (chemical process safety procedures, plans, diagrams, charts, and drawings, chemical process safety reports and analyses, etc.); (g) fire safety (pre-fire emergency plans, fire hazards analyses, etc.); (h) emergency management (emergency drill records, memoranda of understanding with outside emergency response organizations, etc.); (i) environmental protection (environmental release and monitoring records, etc.); (j) decommissioning (decommissioning records and cost estimates, site characterization data, final survey data, etc.); and (k) management measures (approved current operating procedures, calibration and testing data for IROFS, training procedures and modules, corrective action records, etc.) (GLE, 2011a).

The applicant defines the organizational responsibilities for RM and commits to provide employees with general training in RM as part of GET (GLE, 2011a). The applicant also identifies examples of the types of records maintained in the RM Program (GLE, 2011a). The applicant identifies responsibilities for the development, implementation, and maintenance of the RM Program and for ensuring that all laws, codes, standards, regulations, and company procedures pertaining to record keeping requirements are met. The implementation of the RM organization, personnel training, and procedures described in Section 11.7.3 of the LA (GLE, 2011a) will ensure the effectiveness of the RM program, the proper maintenance of records, and the prompt detection and correction of any deficiencies in the RM system or its implementation. These commitments meet the acceptance criteria in Section 11.4.3.7.5 of NUREG-1520 (NRC, 2002a) and are, therefore, acceptable.

### 11.3.8 OTHER QA ELEMENTS

The NRC staff reviewed the applicant's system of other QA elements in accordance with the acceptance criteria in Sections 11.4.3.8 of NUREG-1520 (NRC, 2002a). The acceptance criteria in Section 11.4.3.8 of NUREG-1520 (NRC, 2002a) address how the applicant will apply other QA elements in proportion to the importance of the item to safety using a graded approach. The other QA elements should address: (1) organization; (2) the QA program; (3) design control; (4) procurement control; (5) instructions, procedures, and drawings; (6)

document control; (7) control of purchased items and services; (8) identification and control of material, parts, and components; (9) control of special processes; (10) inspection; (11) test control; (12) control of measuring and test equipment; (13) handling, storage, and shipping; (14) inspection, control, testing, and operating status; (15) control of nonconforming items; (16) corrective actions; (17) QA records; (18) audits; and (19) provisions for change.

As described in Section 11.8 of the LA (GLE, 2011a), the applicant developed a QA Program that applies to the design, construction, operation, and decommissioning of the proposed facility. This QA Program is described in the facility QAPD (GLE, 2011c). The QAPD (GLE, 2011c) is evaluated in Appendix A to Chapter 11 of this SER. As explained in Appendix A to Chapter 11 of this SER, the QAPD (GLE, 2011c) meets the acceptance criteria in Section 11.4.3.8 of NUREG-1520 (NRC, 2002a).

### 11.3.9 DEFINITIONS

In Section 1.2.5.6, "Exemption from 10 CFR 21.3 Definitions," of the LA (GLE, 2011a), the applicant requested approval to replace the definitions of basic component, commercial grade item, critical characteristics, dedication, and dedicating entity identified in 10 CFR Part 21 for facilities licensed pursuant to 10 CFR Part 70 with modified definitions. The modified definitions describe procurement, verification, and dedication measures that will be implemented by the applicant to ensure that items purchased as basic components or dedicated will perform their IROFS function. The staff's review and approval of the modified definitions can be found in Section 1.2.3.7.6 of this SER.

## 11.4 EVALUATION FINDINGS

The staff finds that the management measures, as applied to specific IROFS, are acceptable for providing reasonable assurance that the IROFS will be available and reliable to perform their safety functions. The NRC staff reviewed the above information and found that the licensee's description of the management measures applied to the IROFS are acceptable to meet the requirements of 10 CFR 70.65(b)(4).

### 11.4.1 CONFIGURATION MANAGEMENT

The NRC Staff has reviewed the CM function for the facility described in Section 11.1 of the LA (GLE, 2011a) according to Section 11.4.3.1 of the regulatory acceptance criteria of NUREG-1520 (NRC, 2002a). The staff evaluation of the CM program included the review of the CM policy, design requirements, document control, change control and assessments.

The applicant has suitably and acceptably described its commitment to a proposed CM program, including the method for managing changes in procedures, facilities, activities, and equipment for IROFS. Management-level policies and procedures, including an analysis and independent safety review of any proposed activity involving IROFS, are described that will provide reasonable assurance that consistency among design requirements, physical configuration, and facility documentation is maintained as part of a new activity or change in an existing activity involving licensed material. The applicant's management measures include the following elements of CM:

#### 11.4.1.1 CM Policy

The organizational structure, policies, procedures and responsibilities necessary to implement the CM program are in place or committed to.

#### 11.4.1.2 Design Requirements

The design requirements and design bases are documented and supported by analyses, and all the documentation is maintained current.

#### 11.4.1.3 Document Control

Documents, including drawings, are appropriately stored and accessible. Drawings and related documents maintained in the document control program are those necessary and sufficient to adequately describe IROFS.

#### 11.4.1.4 Change Control

Responsibilities and procedures adequately describe how the applicant will achieve and maintain strict consistency among the design requirements, physical configuration and the facility documentation. Methods are in place for suitable analysis, review, approval, and implementation of identified changes to IROFS. This includes appropriate CM controls to ensure that configurations are appropriately verified, functional tests are performed as needed, and accurate documentation is maintained for equipment or procedures that have been modified.

#### 11.4.1.5 Assessments

The applicant committed to conduct initial and periodic assessments to verify the implementation and effectiveness of the CM function.

### 11.4.2 MAINTENANCE

The applicant has committed to the maintenance of IROFS in Section 11.2 of the LA (GLE, 2011a). The applicant's maintenance commitments contain the basic elements to maintain availability and reliability of IROFS including: corrective maintenance preventive maintenance, functional testing, equipment calibration, and work control for the maintenance of IROFS. The applicant's maintenance function is proactive, using maintenance records, PM records, and surveillance tests to analyze equipment performance and to seek the root cause of repetitive failures.

The surveillance and monitoring, preventative maintenance, and functional testing activities described in Section 11.2 of the LA (GLE, 2011a) provide assurance that IROFS will be available and reliable to prevent or mitigate accident consequences.

The maintenance function: (1) is based on approved procedures; (2) employs work control methods that properly consider personnel safety, awareness of facility operating groups, QA, and the rules of CM; (3) uses the ISA Summary (GLE, 2011b) to identify IROFS that require maintenance and at what level; (4) justifies the preventive maintenance intervals in terms of equipment reliability goals; (5) provides for training that emphasizes the importance of IROFS identified in the ISA Summary (GLE, 2011b), regulations, codes, and personnel safety; and (6)

creates documentation that includes records of all surveillance, inspections, equipment failures, repairs, and replacement of IROFS.

The NRC staff concludes that the applicant's maintenance functions meet the requirements of 10 CFR Part 70.62(d) and the acceptance criteria in Section 11.4.3.2 of NUREG-1520 (NRC, 2002a), and provide reasonable assurance that the health and safety of the worker and the public are provided for.

#### 11.4.3 TRAINING AND QUALIFICATIONS

Based on the review of Section 11.3 of the LA (GLE, 2011a), the applicant's description of its training and qualification program adequately addresses: (a) training organization and management; (b) analysis and identification of functional and position training requirements; (c) training basis and objectives; (d) organization of instruction; (e) evaluation of trainee accomplishment; (f) conduct of on-the-job training; (g) evaluation of training effectiveness; and (h) personnel evaluations and qualifications. The NRC staff has concluded that the applicant has adequately described and assessed its personnel training and qualification in a manner that satisfies regulatory requirements, meets the acceptance criteria in Section 11.4.3.3 of NUREG-1520 (NRC, 2002a), and is acceptable.

There is reasonable assurance that implementation of the described training and qualification will result in personnel who are qualified and competent to design, construct, startup, operate, maintain, modify, and decommission the facility safely. The NRC staff concludes that applicant's plan for personnel training and qualification meets the requirements of 10 CFR Part 70.62(d).

#### 11.4.4 PROCEDURES

In Section 11.4 of the LA (GLE, 2011a), the applicant described a suitably detailed process for the development, review, approval, implementation, distribution, and revision of procedures. The applicant adequately described procedures that will control activities involving the handling of SNM, activities involving IROFS, and items important to the health of facility workers and the public and the protection of the environment. The applicant identified the types of procedures that will be implemented at the facility (i.e., management control procedures, abnormal operation procedures, maintenance procedures) and described specific topics to be covered by the procedures. The applicant also committed to document requirements for procedure control and approval authorities. The NRC staff concludes that the applicant's plan for procedure development and implementation meets the acceptance criteria in Section 11.4.3.4 of NUREG-1520 (NRC, 2002a) and meets the requirements of 10 CFR Part 70.62(d).

#### 11.4.5 AUDITS AND ASSESSMENTS

Based on the review of Section 11.5 of the LA (GLE, 2011a), the applicant's audits and assessments program description considers: (a) the structure of audit and assessment activities; (b) facility procedures; (c) personnel qualifications and independence from the area being reviewed; and (d) the documentation of corrective actions. As described by the applicant, the audit and assessment program will help ensure that environmental health and safety functions are adequate and effectively implemented through ensuring that a comprehensive program oversight is completed at least once every three years. The NRC staff concluded that the applicant has adequately described its audit and assessment program and that the program meets the acceptance criteria in Section 11.4.3.5 of NUREG-1520 (NRC, 2002a).

The NRC staff concludes that the applicant's plan for audits and assessments meets the requirements of 10 CFR Part 70.62(d) and provides reasonable assurance of protection of the health and safety of the public and workers and the environment.

#### 11.4.6 INCIDENT INVESTIGATIONS

In Section 11.6 of the LA (GLE, 2011a), the applicant committed to perform incident investigations to assure that upset conditions are understood and appropriate corrective actions are identified and implemented to prevent recurrence. The applicant committed to establish an organization responsible for: (a) performing incident investigations of events that may occur during operation of the facility; (b) determining the root cause(s) and generic implications of the event; and (c) recommending corrective actions for ensuring a safe facility and safe facility operations in accordance with the acceptance criteria of Section 11.4.3.6 of NUREG-1520 (NRC, 2002a).

The applicant will implement incident investigation and reporting procedures to establish the validity of data related to incidents, develop and implement corrective action plans when appropriate, document any event that was or could become a danger to persons or property, and ensure that proper levels of management and public agencies are notified. The applicant has committed to monitoring and documenting corrective actions through to completion and has committed to the maintenance of documentation so that lessons learned may be applied to future operations of the facility.

Accordingly, the NRC staff concluded that the applicant's description of the incident investigation process complies with the requirements of 10 CFR 70.62(d), meets the acceptance criteria of Section 11.4.3.6 of NUREG-1520 (NRC, 2002a), and is acceptable.

#### 11.4.7 RECORDS MANAGEMENT

The NRC staff has reviewed the applicant's RM system described in Section 11.7 of the LA (GLE, 2011a) against the acceptance criteria in Section 11.4.3.7 of NUREG-1520 (NRC, 2002a) and concluded that the system: (a) will be effective in collecting, verifying, protecting, and storing information regarding the facility and its design, operations, and maintenance; (b) will be able to retrieve the information in readable form for the designated lifetimes of the records; (c) will provide a records storage area with the capability to protect and preserve health and safety records that are stored there during the mandated retention periods, including protection of the stored records against loss, theft, tampering, or damage during and after emergencies; and (d) will provide reasonable assurance that any deficiencies in the records management system or its implementation will be detected and corrected in a timely manner.

The NRC staff concludes that the applicant's program for records management meets the acceptance criteria contained in Section 11.4.3.7 of NUREG-1520 (NRC, 2002a) and meets the requirements of 10 CFR Part 70.62(d).

#### 11.4.8 OTHER QA ELEMENTS

Based on the review of the applicant's QAPD (GLE, 2011c), the NRC staff concluded that the applicant described the application of other QA elements to IROFS and management measures in an acceptable manner. The staff further concluded that the applicant provided an adequate

description of its quality assurance program and provided reasonable assurance that: (a) authorized activities will be carried out in compliance with the license requirements; and (b) deviations from requirements will be promptly identified and corrected. In Appendix A to Chapter 11 of this SER, the staff documents its review of the QAPD (GLE, 2011c) and the basis for the staff's conclusion that the other QA elements presented in the QAPD (GLE, 2011c) meet the requirements of 10 CFR Part 70.62(d) and the acceptance criteria of Section 11.4.3.8 of NUREG-1520 (NRC, 2002a), and provide reasonable assurance of protection of public health and safety, and of the environment.

## 11.5 REFERENCES

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## **CHAPTER 11.0, APPENDIX A**

### **QUALITY ASSURANCE PROGRAM DESCRIPTION**

The General Electric-Hitachi Global Laser Enrichment LLC (GLE or the applicant) Quality Assurance Program Description (QAPD) (GLE, 2011a) describes the Quality Assurance (QA) Program that will be implemented at the applicant's proposed laser-based uranium enrichment facility to satisfy the requirements of Paragraph 70.62 of Title 10 of the *Code of Federal Regulations* (10 CFR), which requires applicants for new facilities to submit a description of the safety program that will be applied at the facility. The safety program must contain a description of the applicant's management measures. As defined in 10 CFR 70.4, "*management measures*" mean the functions performed by the licensee, generally on a continuing basis, that are applied to items relied on for safety, to ensure the items are available and reliable to perform their functions when needed. Management measures include configuration management, maintenance, training and qualifications, procedures, audits and assessments, incident investigations, records management, and other quality assurance elements." The QAPD (GLE, 2011a) supplements the description of the applicant's management measures, as described in Chapter 11 of the License Application (LA) (GLE, 2011b) by providing a description of "Other QA Elements." Management measures are evaluated in Chapter 11 of this Safety Evaluation Report (SER).

#### **11.A.1 REGULATORY REQUIREMENTS**

The applicant's QA Program, applicable to the design, construction (including preoperational testing), operation (including testing), maintenance, modification, and decommissioning of the proposed facility, is described in the QAPD (GLE, 2011a).

The QAPD (GLE, 2011a) is part of the applicant's description of management measures that will be applied at the proposed facility in accordance with the requirements of 10 CFR 70.62(d) and 10 CFR 70.65(b)(4).

#### **11.A.2 REGULATORY GUIDANCE AND ACCEPTANCE CRITERIA**

NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (NRC, 2002), which provides guidance and regulatory acceptance criteria to support the review of fuel cycle facility license applications, was applied in the completion of this review. Acceptance criteria, applicable to the review of the QAPD (GLE, 2011a), is found in Section 11.4.3.8 of NUREG-1520 (NRC, 2002) under "Other QA Elements."

#### **11.A.3 STAFF REVIEW AND ANALYSIS**

##### **11.A.3.1 INTRODUCTION**

In Section 1 of the QAPD (GLE, 2011a), the applicant commits to maintain full responsibility for ensuring that the proposed facility is designed, constructed, operated, and decommissioned in

conformance with applicable regulatory requirements, design requirements, applicable industry standards, and good engineering practices in a manner to protect the health and safety of the workers, the public, and the environment. The application of the QA Program, as described in the QAPD (GLE, 2011a), is compulsory for items (structures, systems, components (SSCs), equipment, and activities) identified as items relied on for safety (IROFS). All IROFS have a designated quality level (QL) of QL-1, QL-2, or QL-NFPA, and the QAPD (GLE, 2011a) will be applied to all IROFS in a manner consistent with the IROFS' assigned quality level. The applicant commits to apply the requirements of 10 CFR Part 21 to basic components designated as QL-1, QL-2, and QL-NFPA. Items and activities designated as QL-3 are non-IROFS and will be controlled in accordance with standard commercial practice; hence, the QAPD (GLE, 2011a) will not be applied to QL-3 items and activities (GLE, 2011a).

### 11.A.3.2 ORGANIZATION

U.S. Nuclear Regulatory Commission (NRC) staff reviewed the applicant's organization in accordance with the acceptance criteria Section 11.4.3.8.1 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.1 of NUREG-1520 (NRC, 2002) call for a description of: (a) the organizational structure; (b) the functional responsibilities, (c) the organization charts, lines, interrelationships, and areas of responsibility and authority for all organizations performing activities relied on for safety, including the applicant's organization and, as applicable, its principal contractors (architect/engineer, constructor, construction manager, and operator). The acceptance criteria in Section 11.4.3.8.1 of NUREG-1520 (NRC, 2002) also state that persons or organizations responsible for ensuring the appropriate QA has been established and for verifying that activities affecting quality have been correctly performed should have sufficient authority, access to work areas, and organizational independence to carry out their responsibilities.

In Section 2 of the QAPD (GLE, 2011a) and in Chapter 2 of the LA (GLE, 2011b), the applicant discusses the QA organization. The applicant described the functional responsibilities, interrelationships, and minimum qualifications required for the following quality assurance-related project personnel and key positions within the QA organization: GLE President and Chief Executive Officer; QA Manager; Operations Manager; Engineering Manager; GLE Projects Manager; Security Manager; GLE Environmental, Health, and Safety (EHS) Manager; and Sourcing Manager (GLE, 2011a). Each of these personnel will have sufficient authority, access to work areas, and organizational independence to carry out his or her responsibilities (GLE, 2011a).

The applicant provided an organization chart in Figure 1 of the QAPD (GLE, 2011a) and in Figure 2-1 of the LA (GLE, 2011b) depicting the lines of authority of key personnel applicable during the design and construction phases of the proposed facility. Figure 2-2 of the LA (GLE, 2011b) depicts the planned organization to be applied during facility operation. Section 2.1.4 of the LA (GLE, 2011b) describes in detail the management of personnel and activities as the facility transitions from design and construction to operations. The transition description included descriptions of the following responsibilities: (1) the Operations Organization will be staffed as facility construction nears completion to ensure a smooth transition from construction to operations; (2) the EHS Manager and QA Manager positions will be duplicated during the transition from design and construction to operations to ensure quality and safety are adequately maintained throughout the transition phase; (3) as the construction of systems is completed, the systems will undergo acceptance testing, after which systems will be transferred from the Projects Organization to the Operations Organization by means of a detailed transition plan; and (4) the facility design basis will be maintained throughout the transition process

through the configuration management program (GLE, 2011b). The Operations Organization will be updated prior to the commencement of decommissioning activities; this information will be submitted to the NRC for review and approval as part of the Decommissioning Plan (GLE, 2011b).

The applicant identified responsibilities applicable to all facility personnel in Section 2.9 of the QAPD (GLE, 2011a). Specifically, every individual working on the project, including contractor personnel, will be responsible for quality (GLE, 2011a). Each worker will have an obligation to identify concerns using the corrective action process whenever the health and safety of the workers, the public, or the environment is involved; or when continued work will produce results that are not in compliance with the QA Program (GLE, 2011a). The corrective action process is controlled by approved written policies, plans, or procedures that apply to all personnel (GLE, 2011a). In the event of a nonconforming condition, these approved written policies, plans, or procedures are implemented to control safety-related activities until the deficiency or unsatisfactory condition has been resolved (GLE, 2011a). The applicant commits to define the authority and responsibility for stopping work, the criteria and documentation required to process the stop work, and the actions that must be performed before work may resume in approved written policies, plans, or procedures (GLE, 2011a).

In the QAPD (GLE, 2011a), the applicant identified the responsibilities, qualifications, and authorities of the key personnel responsible for QA during design, construction, operation, maintenance, modification, testing, and decommissioning of the proposed facility. These responsibilities, qualifications, and authorities are clearly defined and sufficient to ensure that competent QA and management staff with sufficient experience will be in place. The applicant described the organizational structure and provided charts depicting the lines, interrelationships, and areas of responsibility and authority for all organizations performing activities relied on for safety. The applicant also committed to ensure that persons or organizations responsible for ensuring that appropriate QA has been established and for verifying that activities affecting quality have been correctly performed have sufficient authority, access to work areas, and organizational independence to carry out their responsibilities. The information provided meets the acceptance criteria in Section 11.4.3.8.1 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.3 QUALITY ASSURANCE PROGRAM

NRC staff reviewed the applicant's QA Program in accordance with the acceptance criteria Section 11.4.3.8.2 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.2 of NUREG-1520 (NRC, 2002) address the application of QA elements in the form of a QA Program in which the applicant commits to meet the applicable requirements of applicable industry standards. The commitment may describe the applicant's graded approach to QA, in which measures are implemented consistent with the item's importance to safety, or the commitment may describe a QA Program applicable to all IROFS. The application of QA elements should be well-documented, planned, implemented, and maintained to provide reasonable assurance that, together with the management measures, IROFS will be available and reliable when needed. The QA Program should be functional before performing the ISA required 10 CFR Part 70.

The QA Program, which is described in Section 3 of the QAPD (GLE, 2011a), consists of the QAPD (GLE, 2011a) and policies, plans, and procedures that implement specific requirements of the QAPD (GLE, 2011a). The QA Program will apply to all workers and contractor personnel who perform quality-affecting activities associated with safety-related aspects of the proposed

facility (GLE, 2011a). The QA Program is risk-informed and will be applied to the design, fabrication, testing, operation, procurement, inspection, maintenance, and modification of IROFS and activities affecting those IROFS (GLE, 2011a). The QA Program, in addition to other management measures, will ensure that IROFS will be available and reliable to perform their intended safety functions when needed (GLE, 2011a).

In the event that work cannot be accomplished as specified in implementing QA policies, plans, or procedures, or accomplishment of such work would result in an unsafe condition, work will be stopped until proper corrective action can be taken (GLE, 2011a). Furthermore, if a procedure cannot be used as written, then work will be stopped until the procedure has been changed (GLE, 2011a).

Indoctrination and training will be provided to personnel who perform or manage activities affecting quality (GLE, 2011a). The training will include familiarization with the QA Program and appropriate QA implementing policies, plans, or procedures (GLE, 2011a). Managers will be responsible for ensuring that their personnel receive the applicable indoctrination, training, and qualifications needed for their work functions (GLE, 2011a).

Effective implementation of the QA Program will be regularly assessed as follows: (1) line management of organizations implementing the QA Program, or portions thereof, will regularly assesses the adequacy of the program areas for which they are responsible through a combination of reviews, approvals, self-assessments, or audits; and (2) responsible senior managers will regularly assess the adequacy and effective implementation of the QA Program through review meetings and by performing reviews of audit and corrective action reports (GLE, 2011a).

#### 11.A.3.3.1 Quality Levels

QLs are discussed in Section 3.1 of the QAPD (GLE, 2011a). The applicant defined four QLs that will be applied to items and services used in the design, construction, testing, startup, operation, maintenance, modification, and decommissioning of the proposed facility (GLE, 2011a). The QLs describe the applicant's graded approach to QA, in which management measures and other QA elements will be implemented consistent with an item's importance to safety (GLE, 2011a). The QLs include: QL-1, QL-2, QL-NFPA, and QL-3, where QL-1 is applied to IROFS of the highest safety significance (GLE, 2011a).

QL-1 is applicable to single (sole) IROFS that prevent or mitigate a high consequence event (GLE, 2011a). QL-2 is applicable where two or more IROFS are credited to prevent or mitigate a high or intermediate consequence event, or where any single (sole) IROFS prevents or mitigates an intermediate consequence event (GLE, 2011a). QL-3 is applicable to items that are not IROFS (not QL-1, QL-2, or QL-NFPA) (GLE, 2011a).

QL-NFPA is applicable only to fire suppression systems identified as IROFS (GLE, 2011a). The minimum standards and requirements for the design, testing, installation, inspection, and maintenance of fire suppression systems credited as IROFS are established by National Fire Protection Association (NFPA) codes and standards as supplemented by QA controls identified in Appendix A of the QAPD (GLE, 2011a). The established failure frequencies for fire suppression systems identified as IROFS are based on reliability data developed by NFPA such that demonstrated conformance with the requirements of NFPA codes and standards will provide sufficient control of fire suppression IROFS to ensure their reliability and availability in

service (GLE, 2011a). Implementation of NFPA QA provisions to fire protection IROFS is further discussed in Sections 7.3.1.3 and 11.A.3.21 of this SER.

Management measures will be applied to all IROFS (QL-1, QL-2, and QL-NFPA) consistent with the type of IROFS to ensure that IROFS remain reliable at their credited failure frequencies when called upon to be available (GLE, 2011a). All applicable QA Program requirements will be applied to QL-1, QL-2, and QL-NFPA IROFS in a manner necessary to achieve this level of reliability and performance (GLE, 2011a). QL-3 items will be controlled in accordance with standard commercial practice and will not require the application of management measures (GLE, 2011a). Applicable QA Program requirements for QL-1 and QL-2 IROFS are addressed in Sections 1 through 20 of the QAPD (GLE, 2011a) and in Sections 11.A.3.2 through 11.A.3.20 of this SER. Applicable QA Program requirements for QL-NFPA items are addressed in Appendix A of the QAPD (GLE, 2011a) and Section 11.A.3.21 of this SER.

The applicant will determine the extent to which management measures and QA Program elements will be applied to IROFS by evaluating the factors that contribute to the reliability of each IROFS, including the IROFS' design, function, and task analyses associated with operating and maintaining the IROFS (GLE, 2011a). The applicant will also consider the following factors for each IROFS: (1) risk significance, (2) regulations, industry codes, and standards applicable to the IROFS; (3) complexity or uniqueness of an item/activity and the environment in which it has to function; (4) quality history of the item in service or activity; (5) degree to which functional compliance can be demonstrated or assessed by test, inspection, or maintenance methods; (6) anticipated life span; and (7) degree of standardization; (8) importance of data generated; and (9) reproducibility of results (GLE, 2011a).

After using the evaluation factors identified above to define the management measures and QA element attributes assigned to each IROFS, the measures will be approved through the configuration management (CM) process associated with Integrated Safety Analysis (ISA) baseline documents (GLE, 2011a). As the design progresses, facility procedures and training programs are developed, and pre-operational readiness reviews are conducted, the management measures and QA element attributes assigned to each IROFS will be approved through approval of the IROFS Boundary Definition Packages (GLE, 2011a). These packages, as defined in the QAPD (GLE, 2011a) are:

*“documents that contain the physical descriptions and parameters of structures, systems, and components that are used to meet the performance requirements of 10 CFR 70.61. IROFS boundary definition packages are also prepared for administrative procedures or worker actions, which are defined as IROFS. The boundary packages also identify the specific functions to be performed by an IROFS and identify any items that may affect the function of the IROFS. The boundary packages also identify the facility areas in which the IROFS is used, design and functional attributes, management measures, any open items, and supporting documentation (e.g., P&IDs [piping and instrumentation diagrams], schematics, etc.).”*

#### 11.A.3.3.2 Application of Management Measures

The applicant described the application of management measures to IROFS in Section 3.2 of the QAPD (GLE, 2011a).

## Configuration Management

The elements of CM, including the CM policy, design requirements, document control, change control, and assessments, will be applied to QL-1, QL-2, and QL-NFPA IROFS consistent with descriptions in the QAPD (GLE, 2011a).

## Maintenance

The application of maintenance attributes will be decided based on consideration of the nine IROFS evaluation factors (see Section 11.A.3.3.1 of this SER above), as applicable, for each IROFS, regardless of its QL designation (GLE, 2011a). This method will be applied to maintenance planning because the type of IROFS, the specific components within the IROFS boundary, the historical failure frequency associated with the components or with the human elements of performance, and the reliability required of the IROFS are critical factors in determining the appropriate type(s) of maintenance to perform and the requisite frequency (GLE, 2011a). Maintenance activities may include any combination of corrective, preventative, surveillance, monitoring, and functions testing (GLE, 2011a).

## Training and Qualifications

Training and qualification attributes will be developed using a systematic approach that analyzes the training needs of each task based on the human factors elements associated with the task, complexity of the safety function being carried out, skill needed to perform the task, and the existing level of knowledge possessed by the individuals involved (GLE, 2011a). Based on the results of the task analysis and consideration of the nine IROFS evaluation factors (see Section 11.A.3.3.1 of this SER, above), appropriate training will be developed utilizing classroom, performance-based, on-the-job, testing, or other training techniques (GLE, 2011a).

For hazardous operations where QL-1, QL-2, or QL-NFPA IROFS are involved or located nearby, minimum training requirements will be established for workers working with, or in the vicinity of, such operations (GLE, 2011a).

## Procedures

Activities associated with the operation of IROFS will be governed by policies, plans, or procedures that cover all aspects of the task (GLE, 2011a). In order to ensure that proper, accurate, valid procedures are used for activities involving IROFS, procedures involving IROFS will be controlled in accordance with the CM Program (GLE, 2011a).

The level of rigor applied to each task will be based on the task analysis and consideration of the nine IROFS evaluation factors (see Section 11.A.3.3.1 of this SER above) (GLE, 2011a). The requisite level of rigor, as informed by the task analysis and evaluation factors, will dictate the level of detail needed in the procedure and the appropriate usage of policies (GLE, 2011a). For instance, some complex activities will require procedures that have higher levels of human factors elements incorporated in their use (such as in-hand use, step-by-step check offs, two-person verification of action confirmation, etc.) in order to ensure appropriate completion of the task (GLE, 2011a).

### Audits and Assessments

A basic level of audits and assessments will be applied to all IROFS (GLE, 2011a). The frequency of audits and assessments will take into consideration the nine IROFS evaluation factors (see Section 11.A.3.3.1 of this SER above) as well as the status and importance of the activity (GLE, 2011a).

### Incident Investigations

Incident Investigations will be performed for all incidents associated with the failure or degradation of IROFS (GLE, 2011a). The investigation and resolution of IROFS incidents will use the same approach for all IROFS (GLE, 2011a).

### Records Management

Records for activities associated with IROFS implementation will be managed with the same approach regardless of QL (GLE, 2011a).

### Other Quality Assurance Elements

There are no distinctions within the QA program with respect to the treatment of QL-1 and QL-2 IROFS for the following QA elements: Design Control; Procurement Control; Document Control; Control of Purchased Items and Services; Identification and Control of Materials, Parts and Components; Control of Measuring and Test Equipment; Handling, Storage and Shipping Controls; Control of Nonconforming Items; Corrective Action; and Quality Assurance Records (GLE, 2011a). Distinctions for the remaining QA elements are described under the respective QA element descriptions in the QAPD (GLE, 2011a). Quality assurance elements for QL-NFPA are specified in Appendix A of the QAPD (GLE, 2011a).

#### A.11.3.3.3 QA Program Evaluation Summary

The acceptance criteria in Section 11.4.3.8.2 of NUREG-1520 (NRC, 2002) states that the applicant may describe its application of QA elements in the form of a QA Program in which the applicant commits to meet the applicable requirements of applicable industry standards. The commitment may describe the applicant's graded approach to QA, in which measures are implemented consistent with the item's importance to safety, or the commitment may describe a QA Program applicable to all IROFS. The application of QA elements should be well-documented, planned, implemented, and maintained to provide reasonable assurance that, together with the management measures, IROFS will be available and reliable when needed. The QA Program should be functional before performing the ISA required 10 CFR Part 70.

In Section 3.2 of the QAPD (GLE, 2011a), the applicant described its application of QA elements. The applicant described its graded approach to QA, in which management measures and QA elements will be implemented consistent with an item's importance to safety. All IROFS will be assigned a QL based on their safety significance, and QA controls will be implemented commensurate with the designated quality level, as described in the QAPD (GLE, 2011a). The application of other QA elements is well-documented and planned in the QAPD (GLE, 2011a) and is linked to the implementation of all management measures; as described in the QAPD (GLE, 2011a), the QA elements, together with the other management measures, will be implemented and maintained to provide reasonable assurance that IROFS will be available and

reliable when needed. The information provided meets the acceptance criteria in Section 11.4.3.8.2 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.4 DESIGN CONTROL

NRC staff reviewed the applicant's design control function in accordance with the acceptance criteria Section 11.4.3.8.3 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.3 of NUREG-1520 (NRC, 2002) address the establishment of a design control function that includes design inputs, process, analyses, verification, interfaces, changes, and design documentation and records.

In Section 4 of the QAPD (GLE, 2011a), the applicant discusses design control. The applicant commits to use approved written engineering and design policies, plans, or procedures to control the design process, identify design control requirements, and ensure that applicable requirements are correctly translated into design documents (GLE, 2011a). Design control activities will be governed by written policies, plans, or procedures and will include design inputs; analyses; outputs; reviews, checks, and approvals; change control; technical interfaces; and administrative activities (GLE, 2011a). Engineering management will ensure that design documents (including requirement documents, drawings, reports, criteria, specifications, analyses, computer programs, system descriptions, technical reports, and the ISA) are prepared, reviewed, checked, and approved by qualified individuals (GLE, 2011a).

The applicant commits to apply sound engineering judgment, scientific principles, and applicable codes and standards in the design process (GLE, 2011a). The applicant also commits to define the work scope and responsibilities applicable to design groups and disciplines (GLE, 2011a). As described in the QAPD (GLE, 2011a), typical design control activities managed by engineering will include controlling the exchange of technical information between internal and external organizations; implementing design policies, plans, or procedures; establishing technical requirements and design standards; preparing design documents; defining the extent of design reviews; determining and specifying acceptance criteria, required tests and inspections, and program requirements for records; and controlling design changes.

The ISA, which identifies the safety significance of functions performed by IROFS, will be used with inputs from the design phase in order to determine the level of rigor that needs to be applied to design control activities (GLE, 2011a). The design of both IROFS and non-IROFS SSCs that involve a higher than normal level of risk will be subject to a greater degree of design control and verification than those of normal or low risk (GLE, 2011a).

Information from design output documents for IROFS such as IROFS Boundary Definition Packages, specifications, system descriptions, and drawings will be used in the development of inspection, test, and maintenance instructions and/or procedures to ensure that instructions and procedures contain the necessary details and acceptance criteria for design control during inspection, test, and maintenance activities (GLE, 2011a). The design control process will also take into consideration the useful life expectancy of SSCs in order to facilitate development of facility decommissioning, disassembly, and disposal plans (GLE, 2011a).

Written policies, plans, or procedures will be approved and implemented for the development, validation, and control of software that is used to produce or manipulate data directly used in the design, analysis, and operation of SSCs designated as IROFS (GLE, 2011a). Although



commercially available software will not undergo validation, the results obtained from such software will be independently reviewed and verified (GLE, 2011a).

Records of the design process will be maintained in accordance with Sections 7 and 18 of the QAPD (GLE, 2011a).

In Section 4 of the QAPD (GLE, 2011a), the applicant defined a design control process that will: (1) use written approved policies, plans, or procedures to control design inputs; analyses; outputs; reviews, checks, and approvals; change control; technical interfaces; and administrative activities; (2) use the ISA and other design analysis inputs to determine the rigor needed for design control activities; and (3) ensure that applicable requirements are correctly translated into design documents. The applicant described activities within the scope of the design control program; defined management responsibilities for design activities; and identified how documents and records associated with design control will be maintained. The applicant also described design control measures that will be applied for software. The information provided meets the guidance contained in Section 11.4.3.8.3 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.5 PROCUREMENT CONTROL

NRC staff reviewed the applicant's procurement control in accordance with the acceptance criteria Section 11.4.3.8.4 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.4 of NUREG-1520 (NRC, 2002) address applicable design bases and other requirements necessary to provide reasonable assurance of quality are included or referenced in documents for procurement of items or services relied on for safety. To the extent necessary, suppliers are required to have QA consistent with the quality level of the item or service to be procured.

The applicant addresses procurement control in Section 5 of the QAPD (GLE, 2011a). The applicant commits to develop and approve written policies, plans, or procedures to direct procurement activities, including the procurement process (sourcing), procurement documents, and the control of procured materials, components, and services (GLE, 2011a). Procurement document requirements delineated in these policies, plans, or procedures will include requirements for the content, review, approval, and change of procurement documents (GLE, 2011a). Changes to procurement documents will require the same degree of review, approval, and control as that applied to the preparation of the original procurement document (GLE, 2011a).

Design bases and other requirements necessary to provide reasonable assurance of quality of items and services relied on for safety will be included or referenced in procurement documents (GLE, 2011a). Procurement documents for QL-1 and QL-2 items or services will include, as appropriate, the following information: (1) scope of work; (2) technical requirements; (3) QA requirements applicable to the supplier; (4) a description of the interrelationships and areas of responsibility/authority for the supplier's organization if workers will be performing activities relied on for safety; (5) requirements for the reporting and control of nonconformances and changes; (6) applicability of 10 CFR Part 21 requirements; (7) requirements applicable to sub-tier suppliers, if applicable; and (8) requirements related to document submittal requirements and records retention, turnover, and disposition (GLE, 2011a).

The extent of the QA program requirements imposed on suppliers will depend on the type and application of item or service being procured; as such, procurement documents may require suppliers to have a QA Program that is determined to be acceptable by the applicant or a system of management measures consistent with the applicable portions of the QA Program in order to supply certain items and services (GLE, 2011a). QA requirements specified in procurement documents for Q-1 and QL-2 items and services may also include provisions to allow access rights to the supplier's facilities and records for inspection or audit (GLE, 2011a).

To the extent possible, the applicant commits to procure basic components from suppliers that possess and implement a QA Program that meets the requirements of Appendix B to 10 CFR Part 50 and that have been evaluated and placed on an Approved Supplier List (GLE, 2011a). In situations in which an IROFS or part thereof cannot be procured as a basic component because the applicable supplier does not have an approved Appendix B QA Program, then the applicant will formally dedicate a commercial-grade item for use as (or in) an IROFS (basic component) (GLE, 2011a).

As described in Section 5.1 of the QAPD (GLE, 2011a), the applicant will allow QL-1 and QL-2 items to be procured as commercially available items provided that the item undergoes commercial grade dedication (GLE, 2011a). Items and services not relied on for safety may be designated as QL-2 or QL-3 and may be procured as commercially available items (GLE, 2011a). For the purchase of commercial-grade items that will be dedicated, facility procurement procedures will require personnel to define to the supplier those elements of the supplier's process controls that are mandatory and any other requirements necessary to assure that critical characteristics are met (GLE, 2011a).

In Section 1.2.5.6, "Exemption from 10 CFR 21.3 Definitions," of the LA (GLE, 2011b), the applicant requested approval to replace the definitions of basic component, commercial grade items, critical characteristics, dedication, and dedicating entity identified in 10 CFR Part 21 for facilities licensed pursuant to 10 CFR Part 70 with modified definitions. The modified definitions describe procurement, verification, and dedication measures that will be implemented by the applicant to ensure that items purchased as basic components or dedicated will perform their IROFS function (GLE, 2011b). The staff's review and approval of the modified definitions can be found in Section 1.2.3.7.6 of this SER.

In Section 5 of the QAPD (GLE, 2011a), the applicant committed to include or make reference to applicable design bases and other requirements necessary to provide reasonable assurance of quality in procurement documents issued for items or services relied on for safety. The applicant also committed to use approved written policies, plans, or procedures to control procurement activities. The applicant will require suppliers to have a QA program or a system of management measures consistent with the quality level of the item or service to be procured. In situations when such a supplier cannot be found for safety-related items, the applicant will procure a commercial grade item and perform dedication to provide reasonable assurance that the item can perform its IROFS function. Items of all quality levels (QL-1, QL-2, and QL-3) may be procured as commercially available items; however, items procured as commercially available items that will be used as IROFS will be dedicated. The information provided by the applicant with respect to procurement control meets the guidance in Section 11.4.3.8.4 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.6 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

NRC staff reviewed the applicant's program for instructions, procedures, and drawings in accordance with the acceptance criteria Section 11.4.3.8.5 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.5 of NUREG-1520 (NRC, 2002) call for the applicant to ensure that activities affecting quality are prescribed by and performed in accordance with documented instructions, procedures, or drawings of a type appropriate for the circumstances.

Instructions, procedures, and drawings are described in Section 6 of the QAPD (GLE, 2011a). Activities affecting the availability or reliability of IROFS will be prescribed by and accomplished in accordance with documented specifications, requirements, policies, plans, procedures, instructions, and drawings that: (1) include or make reference to acceptance criteria that are appropriate for determining that prescribed activities have been satisfactorily accomplished; (2) are of a type appropriate to the circumstance; and (3) follow standard guidelines for the format, content, review, and approval process that are established in approved written policies, plans, or procedures (GLE, 2011a). Policies, plans, and procedures that implement QA requirements will be reviewed by the QA function in order to ensure compliance and consistency with the QA Program and effective incorporation of QA program provisions (GLE, 2011a).

A hierarchy of policies, plans, and procedures will be used to implement project requirements (GLE, 2011a). Policies will be used to establish senior management expectations for quality and safety, while implementing policies, plans, and procedures will provide specific instructions to workers performing quality-affecting activities associated with safety-related aspects of the facility (GLE, 2011a). Functional area managers will be responsible for the preparation, review, and approval of policies, plans, and procedures associated with their functional area (GLE, 2011a).

The applicant will require mandatory compliance with policies, plans, and procedures, and should a conflict or error involving a policy, plan, or procedure be identified, the activity in question will be placed in a safe condition until the policy, plan, or procedure has been corrected or changed (GLE, 2011a). Work activities will not resume until the correction or change has been implemented (GLE, 2011a). Policies, plans, procedures, instructions, and drawings, and changes thereto, will be controlled in accordance with Sections 4 and 7 of the QAPD (GLE, 2011a). These sections include requirements to ensure that all changes to documents are reviewed and approved at the appropriate level within the facility organization (GLE, 2011a).

Prescriptive, step-by-step policies, plans, or procedures will not be required for activities that require skills normally possessed by qualified personnel (GLE, 2011a). These activities will be performed in accordance with appropriate documents such as planning sheets, job descriptions, or external manuals (GLE, 2011a).

In Section 6 of the QAPD (GLE, 2011a), the applicant states that activities affecting quality will be prescribed by and performed in accordance with documented instructions, procedures, or drawings of a type appropriate for the circumstances. The applicant also described the structure and content of policies, plans, and procedures used at the facility and identified responsibilities for the development, review, and approval of these documents. The applicant will require compliance with guidance documents, and where compliance to the written guidance may not be achieved, the applicant will require that work be stopped and not proceed until the policy, plan, or procedure has been reconciled. The information provided by the applicant to describe instructions, procedures, and drawings that will be used at the proposed

facility meets the guidance contained in Section 11.4.3.8.5 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.7 DOCUMENT CONTROL

NRC staff reviewed the applicant's document control program in accordance with the acceptance criteria Section 11.4.3.8.6 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.6 of NUREG-1520 (NRC, 2002) call for the establishment of a process to control the preparation, issuance, and modification of documents that specify quality requirements or prescribe activities affecting quality are controlled to provide reasonable assurance that the appropriate documents are in use. In addition, document changes need to be reviewed for adequacy and approved for implementation by authorized personnel.

In Section 7 of the QAPD (GLE, 2011a), the applicant discusses its document control program. The applicant will control documents that identify quality requirements or prescribe activities affecting the availability or reliability of IROFS in a manner to ensure the use of the correct document (GLE, 2011a). Control of quality-related documents will be implemented in accordance with a defined, management-approved process that will apply to original documents and changes thereto and will include the review of documents for adequacy, approval for release, and maintenance under revision control (GLE, 2011a). Policies, plans, and procedures will identify: documents to be controlled; personnel responsibilities for preparing, reviewing, approving, and issuing documents; and requirements for establishing and updating distribution lists for documents (GLE, 2011a).

Policies, plans, procedures, instructions, and drawings will be maintained under revision control and will ensure that documents are: (1) prepared and reviewed for adequacy, correctness, and completeness by a qualified individual; (2) approved for release; and (3) used appropriately in performing the activity; and (4) removed or appropriately identified should the document become obsolete or be superseded (GLE, 2011a).

Changes to documents may be classified as minor, major, or temporary (GLE, 2011a). Minor changes, such as inconsequential editorial corrections, may be made to documents without being subject to the review and approval requirements required of major changes (GLE, 2011a). Major changes will be reviewed for adequacy, correctness, and completeness prior to approval and issuance (GLE, 2011a). The review and approval of major changes will be performed by the same organization that performed the original review and approval unless other organizations are specifically designated (GLE, 2011a). Temporary changes to procedures will be performed in accordance with applicable procedure controls (GLE, 2011a).

As described in Section 7 of the QAPD (GLE, 2011a), the preparation, issuance, and modification of documents that specify quality requirement or prescribe activities affecting quality will be controlled by the applicant to provide reasonable assurance that the appropriate documents are in use at the proposed facility. The applicant committed to ensure that document changes are reviewed for adequacy and approved for implementation by qualified personnel and that superseded or obsolete documents are removed or identified to preclude inadvertent use. The applicant described the content and control of policies, procedures, and plans that will be used to identify document control program provisions and requirements. The applicant also described the controls that will be in place for the implementation of minor, major, and temporary changes to policies, plans, procedures, instructions, and drawings. The applicant's description of its document control program meets the guidance contained in Section 11.4.3.8.6 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

### 11.A.3.8 CONTROL OF PURCHASED ITEMS AND SERVICES

NRC staff reviewed the applicant's program to control purchased items and services in accordance with the acceptance criteria Section 11.4.3.8.7 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.7 of NUREG-1520 (NRC, 2002) address assurance that purchased IROFS and services relied on for safety are controlled to provide reasonable assurance of conformance with specified requirements.

Control of purchased items and services is described in Section 8 of the QAPD (GLE, 2011a). The procurement of items and services will be controlled to ensure that purchased items and services conform to procurement requirements through use of supplier (source) evaluation and selection; evaluation of objective evidence of quality furnished by the supplier; source inspection; audit; and examination of items or services upon delivery or completion (GLE, 2011a). To ensure a systematic approach to the procurement process, sourcing activities will be planned and documented (GLE, 2011a) through a collaborative process involving the sourcing, design, and QA organizations.

Supplier selection will be based, in part, on an evaluation of the supplier's capability to provide items or services in accordance with the requirements of sourcing documents (GLE, 2011a). Supplier evaluations may include audits or assessments of the supplier program or system for ensuring quality, or an evaluation of the supplier's history of providing an identical or similar product that performs satisfactorily in service (GLE, 2011a). Measures will be established for interface with the supplier and to verify the supplier's performance, as necessary (GLE, 2011a).

Suppliers working to the applicant's QA Program will receive indoctrination or training on the QA Program and the applicable implementing policies, plans, or procedures governing the work being performed by the supplier (GLE, 2011a). Work performed under the applicant's QA Program by suppliers will be subject to the same controls implemented for work performed by facility personnel (GLE, 2011a).

Supplier-generated documents will be reviewed for acceptability using verification methods that are based on quality level, complexity, and quantity of items or services provided (GLE, 2011a). Technical documents used as input to design processes, such as analyses, calculations, or drawings, will require an independent technical review (GLE, 2011a). Supplier furnished material, equipment, or services related to safety will be reviewed for acceptability by performing, as appropriate, one or more of the following, to the items or services being procured: (1) monitoring, witnessing, or observing activities performed by the supplier; (2) performing a receiving inspection, or (3) performing post-installation testing (GLE, 2011a).

The applicant will retain records of supplier nonconformances, which may be identified by facility staff or by the supplier (GLE, 2011a). Except where otherwise controlled and documented by approved implementing procedures, nonconforming items will not be released for use until the nonconforming condition has been reviewed and accepted by the applicant, and the applicant has verified that the disposition of the nonconforming condition has been appropriately performed (GLE, 2011a).

As described in Section 8 of the QAPD (GLE, 2011a), purchased items and services that are relied on for safety will be controlled to provide reasonable assurance of conformance with specified requirements. The applicant described controls for the verification of (1) supplier capability to perform safety-related work or supply safety-related items; (2) documentation provided by the supplier; (3) quality of procured items and services and their conformance to

procurement requirements. The applicant committed to control nonconforming items to prevent their use and to maintain records or supplier nonconformances. The applicant also identified the responsibilities of the sourcing, QA, and design functions for procurement activities. The information provided by the applicant to describe the control of purchased items and services for the proposed facility meets the acceptance criteria contained in Section 11.4.3.8.7 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.9 IDENTIFICATION AND CONTROL OF MATERIALS, PARTS, AND COMPONENTS

NRC staff reviewed the applicant's program to identify and control material, parts, and components in accordance with the acceptance criteria Section 11.4.3.8.8 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.8 of NUREG-1520 (NRC, 2002) address the establishment of provisions to identify and control IROFS and to provide reasonable assurance that incorrect or defective items are not used.

Identification and control of materials, parts, and components is discussed in Section 9 of the QAPD (GLE, 2011a). Identification of QL-1 and QL-2 material, parts, and components will be maintained on the items, in documents traceable to the items, or in a manner that assures identification is established and maintained (GLE, 2011a). To the maximum extent possible, physical identification will be used; however, when physical identification is either impractical or insufficient to control the item, physical separation, procedural controls, or other means will be employed (GLE, 2011a). When markings are used to identify material, parts, or components, measures will be established to ensure that the markings are clear, legible, and machine readable, and are not detrimental to the function or service life of the item (GLE, 2011a). Markings will be transferred to each part of an identified item when subdividing, and the obliteration of markings by surface treatments or coatings will not be permitted unless other means of identification are provided (GLE, 2011a).

Controls will be established for QL-1 and QL-2 items and services to ensure only correct and accepted items and services are installed or used. Items will be identified and controlled, as necessary, from initial receipt and fabrication through installation and use (GLE, 2011a). The installation of incorrect or defective items will be prevented through the implementation of receipt inspections; nonconformance controls; onsite handling and storage controls; and written and approved drawings and specifications for construction, erection, and field fabrication activities. Items having a limited operating or shelf life will be identified and controlled to prevent the installation or use of items for which the operating or shelf life has expired (GLE, 2011a). Traceability of items to specific records will be provided where required by codes, standards, or specifications (GLE, 2011a).

As described in Section 9 of the QAPD (GLE, 2011a), the applicant has established measures to identify and control IROFS and to provide reasonable assurance that incorrect or defective items are not use. Specifically, the applicant will enact controls for the identification of materials, parts, and components that will ensure that items are identifiable on the item (whenever possible) or on documents traceable to the item. The applicant will control all IROFS to ensure only correct and accepted items and services are installed or used. The applicant also committed to identify and control items with a limited operating or shelf life to prevent their use after their useful lifespan has ended. The applicant's program for the identification and control of materials, parts, and components meets the acceptance criteria in Section 11.4.3.8.8 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.10 CONTROL OF SPECIAL PROCESSES

NRC staff reviewed the applicant's program to control special processes in accordance with the acceptance criteria Section 11.4.3.8.9 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.9 of NUREG-1520 (NRC, 2002) address the establishment of measures to maintain the acceptability of special processes used in the course of construction, maintenance, modifications, and testing activities (e.g., welding, heat treating, nondestructive testing, and chemical cleaning) and to assure that they are performed by qualified personnel using qualified procedures and equipment.

Control of special processes is described in Section 10 of the QAPD (GLE, 2011a). The applicant will control special processes that affect the quality of items and services in order to ensure the maintenance of special process parameters and specified environmental conditions (GLE, 2011a). Special processes will be controlled in accordance with policies, plans, procedures, instructions, drawings, checklists, travelers, work orders, or other appropriate means (GLE, 2011a). Policies, plans, or procedures developed for special processes will prescribe the necessary equipment, process parameters, calibration, and acceptance criteria for the process (GLE, 2011a).

Special processes that control or verify quality will be performed by qualified personnel using approved, written policies, plans, or procedures in accordance with specified requirements, codes, or standards (GLE, 2011a). These special processes will include welding, heat treating, and nondestructive examination. Specified requirements will be enacted to: (1) certify personnel for special processes in which personnel skill is critical to the outcome; and (2) pre-qualify the special process and equipment for processes in which control of process parameters is critical to the outcome (GLE, 2011a). Records will be maintained of currently qualified personnel, processes, and equipment for special processes (GLE, 2011a).

As described in Section 10 of the QAPD (GLE, 2011a), the applicant has established measures to maintain the acceptability of special processes used in the course of construction, maintenance, modifications, and testing activities at the proposed facility. The applicant committed to specify requirements to ensure that special processes are performed by qualified personnel using qualified processes and equipment. The applicant committed to control quality-related special processes in accordance with written, approved guidance and to maintain up-to-date records of personnel, processes, and equipment that are qualified for use in special processes. The description of the applicant's program for the control of special processes meets the acceptance criteria in Section 11.4.3.8.9 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.11 INSPECTION

NRC staff reviewed the applicant's inspection program in accordance with the acceptance criteria Section 11.4.3.8.10 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.10 of NUREG-1520 (NRC, 2002) call for inspections required to verify conformance of IROFS with requirements and assure the inspections are planned and executed. The acceptance criteria also call for inspection requirements to be specified in written procedures with provisions included for documenting and evaluating inspection results, and for personnel qualification programs to be established for inspection test personnel.

Inspection is described in Section 11 of the QAPD (GLE, 2011a). Inspections will be performed, as required, to verify conformance of items or activities to specified requirements (GLE, 2011a).

The inspection program will implement the following criteria: (1) inspections will be planned; (2) inspection requirements will be specified in approved written policies, plans, or procedures; (3) inspections will be performed by qualified personnel with appropriate experience, education, or certification; (4) persons performing inspections for acceptance will be independent of the activity being inspected; and (5) inspection results will be documented and evaluated in accordance with approved written policies, plans, or procedures (GLE, 2011a). The training and qualification program is described in Section 11.3 of the LA (GLE, 2011b) and in Section 3.2.3 of the QAPD (GLE, 2011a).

Inspection planning will address criteria that include the characteristics to be inspected, personnel responsibilities, method(s) of inspection, measuring and test equipment to be used, acceptance criteria, and relevant design documents (GLE, 2011a). Inspection planning will be based on: 1) the importance to safety of the item or activity to be inspected; 2) mandatory inspections required by codes, standards, regulatory requirements, and commitments; 3) the complexity of the item or activity; and 4) the quality history of the process (GLE, 2011a).

Hold points will be used as part of the inspection planning process, as needed, to ensure that work does not bypass required inspections (GLE, 2011a). When a sample is used to verify acceptability of a group of items, the sampling policy, plan, or procedure will be documented and will clearly identify the sampling basis (GLE, 2011a). Final inspections will include a review of the records of previous inspection results and resolution of any identified nonconformance(s) (GLE, 2011a). When final inspection is used for acceptance, the inspection will verify that the item conforms to specified requirements (GLE, 2011a). Modifications, repairs, or replacements of items performed subsequent to final inspection will require re-inspection or re-test, appropriate to the circumstances, to verify acceptability (GLE, 2011a).

Inspection records will contain, as a minimum, the inspection plan and documentation identifying the item inspected, date of inspection, inspector, type of observation, results or assessment of acceptability, and action taken in connection with any identified nonconformances (GLE, 2011a).

As described in Section 11 of the QAPD (GLE, 2011a), the applicant will plan and execute inspections to verify conformance of items and activities to specified requirements. The requirements for inspections will be specified in approved written procedures that include provisions for documenting and evaluating inspection results. The applicant committed to ensure that personnel performing inspections are independent of the work activity being inspected and have the requisite experience, education, or certification to be qualified to perform the inspection activities. The applicant established controls for sampling, the use of hold points, and the maintenance of inspection records. The information provided detailing the applicant's inspection program meets the acceptance criteria in Section 11.4.3.8.10 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.12 TEST CONTROL

NRC staff reviewed the applicant's test control program in accordance with the acceptance criteria Section 11.4.3.8.11 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.11 of NUREG-1520 (NRC, 2002) call for tests to verify that IROFS conform to specified requirements and will perform satisfactorily in service. The acceptance criteria in Section 11.4.3.8.11 of NUREG-1520 (NRC, 2002) also call for test requirements to be specified in written procedures with provisions included for documenting and evaluating test results and personnel qualification programs to be established for test personnel.



Test control is discussed in Section 12 of the QAPD (GLE, 2011a). Tests will be planned and executed as required to verify that an IROFS conforms to specific requirements and to demonstrate satisfactory performance for service (GLE, 2011a). Types of tests performed at the proposed facility will include design verification tests, acceptance tests, preoperational and operational tests, and post-maintenance tests (GLE, 2011a). Test results will be documented and their conformance with acceptance criteria will be evaluated (GLE, 2011a). Test records will contain the following information: item tested; test date; tester or data recorder; type of observation; test policy, plan, procedure, or reference; results and acceptability; actions taken in connection with any deviations noted; and person evaluating the results (GLE, 2011a).

Tests will be conducted in accordance with test policies, plans, procedures, or instructions that contain the following information, as appropriate: (1) a description of the test purpose or objectives, responsibilities, characteristics to be tested, test methods, acceptance criteria, and hold points to be employed; (2) identification of references and related documents; (3) provisions for ensuring prerequisites for a given test have been met (i.e., instruments have been calibrated, appropriate equipment is used, personnel are trained, etc.); (4) provisions for ensuring that adequate instrumentation is available and suitable environmental conditions are maintained; (5) provisions for documenting and evaluating test results for conformance with acceptance criteria; and (6) qualifications for test personnel (GLE, 2011a).

In lieu of test policies, plans, and procedures, appropriate sections of related documents (such as, American Society for Testing and Materials methods, external manuals, maintenance instructions, approved drawings, or travelers with acceptance criteria) may be used provided that the documents include adequate instructions to ensure the required quality of work (GLE, 2011a).

As described in Section 12 of the QAPD (GLE, 2011a), the applicant will conduct tests to verify that IROFS conform to specified requirements and will perform satisfactorily in service. Test requirements will be specified in written procedures with provisions included for documenting and evaluating test results. The applicant identified the types of tests that will be implemented at the proposed facility and committed to document test results. The applicant also committed to include qualifications for test personnel in test policies, plans, and procedures. The applicant's provisions for the planning, conduct, and documentation of tests meets the acceptance criteria in Section 11.4.3.8.11 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.13 CONTROL OF MEASURING AND TEST EQUIPMENT

NRC staff reviewed the applicant's program to control measuring and test equipment in accordance with the acceptance criteria Section 11.4.3.8.12 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.12 of NUREG-1520 (NRC, 2002) is for the applicant to provide assurance that tools, gauges, instruments, and other measuring and testing devices are properly identified, controlled, calibrated, and adjusted at specified intervals to maintain performance within required limits.

Control of measuring and test equipment (M&TE) is described in Section 13 of the QAPD (GLE, 2011a). M&TE used in activities affecting the availability or reliability of IROFS will be controlled, calibrated, and adjusted to maintain equipment performance within required limits (GLE, 2011a). M&TE will be calibrated at specified intervals or prior to use against equipment having a known valid relationship to nationally recognized standards (GLE, 2011a). If no

nationally recognized standard exists, the basis for calibration will be documented (GLE, 2011a). Calibration records will be maintained, and equipment will be marked or otherwise identified to indicate calibration status (GLE, 2011a). A list of devices that are controlled within the calibration control system will be maintained. Calibration control will not be required for rulers, tape measures, levels, and stop watches (GLE, 2011a).

Policies, plans, and procedures will ensure that devices and standards used for measurement, tests, and calibration activities are of the proper type, range, and accuracy (GLE, 2011a). M&TE will be properly handled and stored to maintain accuracy (GLE, 2011a). When M&TE is found to be out of calibration, as-found data will be recorded, and an evaluation will be performed and documented to ascertain the validity of previous inspection and test results and of the acceptability of items previously inspected or tested (GLE, 2011a). Out-of-calibration devices will be tagged or segregated and will not be used until the devices have been re-calibrated (GLE, 2011a). When M&TE is consistently found to be out of calibration, it will be repaired or replaced (GLE, 2011a). Calibrations will also be performed when personnel performing measurements and tests deem the accuracy of the equipment suspect (GLE, 2011a).

As described in Section 13 of the QAPD (GLE, 2011a), the applicant has established provisions that provide reasonable assurance that tools, gauges, instruments, and other measuring and testing devices will be properly identified, controlled, calibrated, and adjusted at specified intervals to maintain performance within required limits. The applicant has identified equipment that will not be subject to calibration and has committed to maintain a list of devices that are part of the calibration control program. The applicant has established controls for dealing with devices that are found to be out of tolerance and has committed to ensure the proper storage and handling of M&TE. The information provided by the applicant with respect to the M&TE program meets the acceptance criteria in Section 11.4.3.8.12 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.14 HANDLING, STORAGE, AND SHIPPING

NRC staff reviewed the applicant's program for the handling, storage, and shipping of IROFS in accordance with the acceptance criteria Section 11.4.3.8.13 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.13 of NUREG-1520 (NRC, 2002) address the establishment of provisions to control the handling, storage, shipping, cleaning, and preservation of IROFS, in accordance with work and inspection instructions, to prevent damage, loss, and deterioration caused by environmental conditions such as temperature and humidity.

Material, storage, and handling is described in Section 14 of the QAPD (GLE, 2011a). Material and equipment will be handled, stored, and shipped in accordance with design and procurement requirements to protect against damage, deterioration, or loss. Instructions for handling, preservation, storage, cleaning, packaging, or shipping will be established and used when essential to maintain acceptable quality (GLE, 2011a).

Special coverings, equipment, and protective environments will be used to protect material and equipment from damage or deterioration as required. When such features are used, their existence will be verified and monitored as necessary to ensure that they continue to fulfill their intended function (GLE, 2011a). Where necessary to ensure that items can be handled safely and without damage, special handling tools and equipment will be used (GLE, 2011a). Special handling tools and equipment will be controlled and maintained in a manner to ensure that they will be able to perform their intended function when needed (GLE, 2011a).

Operators of special equipment will be experienced or trained as required (GLE, 2011a). Attention will be given to marking and labeling items during packaging, shipment, and storage (GLE, 2011a). Items will be marked or labeled commensurate with the level of control required to ensure that items will be properly maintained and preserved (GLE, 2011a).

As described in Section 14 of the QAPD (GLE, 2011a), the applicant committed to control the handling, storage, shipping, cleaning, and preservation of IROFS, to prevent against damage, loss, and deterioration. The applicant committed to establish and use instructions for handling, storage, and shipping as necessary to maintain acceptable quality. The applicant described provisions for the use of special coverings, equipment, environments, and handling tools to protect material and equipment. The applicant committed to pay attention to marking and labeling items during packaging, shipment, and storage. The applicant also stated that it will require that operators of special equipment be adequately trained or experienced. The measures described by the applicant to control the handling, storage, and shipping of material and equipment meet the acceptance criteria in Section 11.4.3.8.13 of NUREG-1520 (NRC, 2002) and are, therefore, acceptable.

#### 11.A.3.15 INSPECTION, CONTROL, TESTING, AND OPERATING STATUS

NRC staff reviewed the applicant's program for inspection control, testing, and operating status in accordance with the acceptance criteria Section 11.4.3.8.14 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.14 of NUREG-1520 (NRC, 2002) address the inspection, test, and operating status of IROFS to prevent inadvertent use of nonconforming items or bypassing of inspection and tests.

Inspection, control, testing, and operating status is described in Section 15 of the QAPD (GLE, 2011a). Policies, plans, and procedures will be established to ensure that the status of inspection and test activities is either marked or labeled on the item or is identified in documents traceable to the item. Indication of inspection and test status will be required as necessary to ensure that required inspections and tests of items are performed, and to ensure items that have not passed the required inspections and tests are not inadvertently installed, used, or operated (GLE, 2011a).

Status indicators such as tags, markings, or inspection records, will be used as appropriate to prevent inadvertent operation of systems and components that are not in an operable status (GLE, 2011a). Authority for the application and removal of tags, markings, labels, and stamps will be specified (GLE, 2011a).

As described in Section 15 of the QAPD (GLE, 2011a), the applicant has committed to establish policies, plans, and procedures to control the inspection, test, and operating status of IROFS to prevent the inadvertent use of nonconforming items or bypassing of inspections and tests. The applicant will use status indicators to indicate the inspection, test, and operability status of items, as necessary, and will specify the required authority for the application and removal of status indicators. The information provided by the applicant ensure the appropriate control of items and identification of inspection, test, and operability status meets the acceptance criteria in Section 11.4.3.8.14 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.16 CONTROL OF NONCONFORMING ITEMS

NRC staff reviewed the applicant's program for control of nonconforming items in accordance with the acceptance criteria Section 11.4.3.8.15 of NUREG-1520 (NRC, 2002). The acceptance

criteria in Section 11.4.3.8.15 of NUREG-1520 (NRC, 2002) address the identification, segregation, disposition, and prevention of installation or use of nonconforming IROFS.

Control of nonconforming items is discussed in Section 16 of the QAPD (GLE, 2011a). Items and related activities that do not conform to specified requirements will be controlled to prevent inadvertent installation or use through the following controls; nonconforming items will be: (1) identified in a manner that does not adversely affect their end use via markings, tagging, and other appropriate methods; (2) segregated, when practical, by placing them in a clearly identified and designated area until properly dispositioned; (3) reviewed and dispositioned as "reject," "rework," "repair," or "use-as-is;" and (4) controlled to prevent further processing, delivery, installation, or use until an evaluation has been completed and a disposition has been identified and approved (GLE, 2011a). Nonconformance documentation will identify the nonconforming item, describe the nonconformance, identify the disposition and any re-inspection requirements, and contain the appropriate signatures approving the disposition. Written notification will be made to GLE organizations that may be affected by nonconformances (GLE, 2011a).

Alternative measures will be employed to preclude inadvertent use of nonconforming items when segregation is impractical or impossible due to physical conditions (for example, size, weight, or access limitations) (GLE, 2011a). Personnel performing evaluations to determine nonconformance dispositions will possess demonstrated competence in the specific area being evaluated, an adequate understanding of the requirements and access to pertinent background information (GLE, 2011a). The disposition of nonconforming items will be identified and documented as required to carry out the disposition (GLE, 2011a). When nonconforming items are dispositioned "repair" or "use-as-is," technical justification for the acceptability of the disposition will be documented. The disposition process will include consideration of the need for design documents to be "as-constructed" to facilitate operations, maintenance, or modification (GLE, 2011a). Repaired or reworked items will be re-examined in accordance with the original acceptance criteria unless the nonconforming item disposition establishes alternate acceptance criteria (GLE, 2011a).

As described in Section 16 of the QAPD (GLE, 2011a), the applicant has established provisions to control the identification, control, segregation, evaluation, and disposition of nonconforming items to prevent their installation or use. The applicant has identified measures to ensure that personnel performing evaluations of nonconformances are appropriately qualified and that justification is documented, as needed, to provide the basis for nonconformances dispositioned as "repair" or "use-as-is." The applicant has established provisions for the notification of affected organizations, maintenance of as-built design records, and documentation of nonconformances. The applicant's program for the control of nonconforming items meets the acceptance criteria in Section 11.4.3.8.15 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.17 CORRECTIVE ACTIONS

NRC staff reviewed the applicant's corrective action program in accordance with the acceptance criteria Section 11.4.3.8.16 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.16 of NUREG-1520 (NRC, 2002) call for provisions for reasonable assurance that conditions adverse to safety are promptly identified and corrected and measures are taken to preclude repetition. These actions should be documented and reported to appropriate levels of management.

In Section 17 of the QAPD (GLE, 2011a), the applicant discusses its corrective action program. Conditions adverse to quality will be identified and corrected as soon as practical (GLE, 2011a). The corrective action program will be implemented in accordance with written, approved policies, plans, or procedures that specify requirements for the identification and classification of conditions adverse to quality and documentation of conditions adverse to quality and corrective actions (GLE, 2011a). Procedures will also specify requirements for management notifications, follow-up actions, and trending (GLE, 2011a).

When a significant condition adverse to quality is identified, the cause of the condition will be determined, corrective action will be taken to preclude recurrence, and follow-up action will be taken to verify implementation of corrective actions (GLE, 2011a). Significant conditions adverse to quality, their causes, and corrective actions will be documented and reported to appropriate levels of management (GLE, 2011a).

As described in Section 17 of the QAPD (GLE, 2011a), the applicant has defined measures to provide reasonable assurance that conditions adverse to quality will be promptly identified and corrected. The applicant will implement approved written policies, plans, and procedures to control the identification, classification, and follow-up of conditions adverse to quality and the trending of significant conditions adverse to quality. For significant conditions adverse to quality, the applicant will take measures to prevent recurrence and will document the condition, causes, and corrective actions and report this information to appropriate levels of management. The information provided by the applicant with respect to measures that will be implemented at the proposed facility to perform corrective actions for conditions adverse to quality (and significant conditions adverse to quality) meets the acceptance criteria in Section 11.4.3.8.16 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.18 QUALITY ASSURANCE RECORDS

NRC staff reviewed the applicant's QA records program in accordance with the acceptance criteria Section 11.4.3.8.17 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.17 of NUREG-1520 (NRC, 2002) address provisions for the identification, retention, retrieval, and maintenance of records that furnish evidence of the control of quality for IROFS.

In Section 18 of the QAPD (GLE, 2011a), the applicant describes its program for QA records. QA records that furnish documentary evidence of quality will be specified, prepared, and maintained in accordance with applicable regulatory requirements and approved written policies, plans, and procedures (GLE, 2011a). QA records will be: (1) legible, identifiable, and retrievable; (2) protected against damage, deterioration, and loss for the specified record retention duration; and (3) retained in accordance with retention periods specified in an approved records retention schedule (GLE, 2011a).

Documents that will become QA records will be specified in procedures, and personnel responsible for the implementation of such procedures will be responsible for ensuring that the QA records required by the procedure are submitted to the Records Center (GLE, 2011a). Records turnover and maintenance agreements will be established to control supplier-produced records that furnish documentary evidence of quality (GLE, 2011a). Documents will not be considered valid records until they have been validated and authenticated (GLE, 2011a). Records will be distributed, handled, and controlled in accordance with written procedures (GLE, 2011a). Records will be indexed to ensure retrievability (GLE, 2011a).

Records may be originals or reproduced copies and will be classified for retention purposes as lifetime records or nonpermanent records (GLE, 2011a). Records classified as lifetime records will be stored in the Records Center under controlled access unless specified otherwise (GLE, 2011a). Records that are classified as nonpermanent records will be controlled by the responsible organization for the designated retention period (GLE, 2011a). The Records Center will protect lifetime records against the risk of loss or deterioration and will be access controlled. Hard copy, electronic, or microfilm storage facilities will meet the requirements of Section 4.4 of Supplement 17S-1 of American Society of Mechanical Engineers (ASME) NQA-1 (ASME, 1994). Lost or damaged records will be replaced unless replacement is deemed impractical and concurrence is obtained from the QA organization (GLE, 2011a). Corrections to records will be reviewed and approved by the originating organization and will include the date and the identification of the individual authorized to issue the correction (GLE, 2011a).

As described in Section 18 of the QAPD (GLE, 2011a), the applicant has established provisions for the identification, retention, retrieval, and maintenance of records that furnish evidence of the control of quality for IROFS. The applicant committed to specify, prepare, and maintain QA records in accordance with applicable regulatory requirements and approved written policies, plans, and procedures. Furthermore, the applicant committed to meet the requirements of Supplement 17S-1 of ASME NQA-1 (ASME, 1994) for QA records. The applicant will ensure that records are identifiable, retrievable, and protected from loss, damage, or deterioration for the requisite retention time. All documents will be authenticated by authorized personnel prior to becoming official records. The applicant described measures that will be implemented: (1) to ensure the readability and usability of older codes and data as computing technology changes; (2) to provide for the correction and replacement of information in QA records; and (3) to control access to records stored in the Records Center. The applicant also identified organizational responsibilities for the identification, maintenance, and storage of both lifetime and nonpermanent records. The applicant's program for the management of records that provide objective evidence of quality meets the acceptance criteria in Section 11.4.3.8.17 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.19 AUDITS

NRC staff reviewed the applicant's audit program in accordance with the acceptance criteria Section 11.4.3.8.18 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.18 of NUREG-1520 (NRC, 2002) address establishment of provisions for planning and scheduling assessments and audits to verify compliance with, and to determine the effectiveness of, QA; to identify responsibilities and procedures for assessing, auditing, documenting, and reviewing results and designating management levels to review assessment and audit results; and to incorporate the status of findings and recommendations in management reports.

Audits are addressed in Section 19 of the QAPD (GLE, 2011a). Audits of organizations performing quality-affecting activities associated with safety-related aspects of the facility will be performed at a frequency commensurate with the status and importance of the activity (GLE, 2011a). Audits will be performed on both internal and external organizations providing products or services to the project to verify compliance with the QA Program and to determine its effectiveness (GLE, 2011a). Audits will be performed: (1) in accordance with policies, plans, procedures, or checklists; (2) by personnel who do not have direct responsibility for performing the activities being audited; and (3) using an audit plan that is prepared for each audit (GLE, 2011a). Auditors (including technical specialists) will have training or experience commensurate with the scope, complexity, or nature of the audit (GLE, 2011a).

Audit results will be documented, reported to, and reviewed by responsible management (GLE, 2011a). Any conditions requiring prompt corrective action will be immediately reported to the audited organization's management (GLE, 2011a). When adverse audit findings are identified, management of the audited organization or activity will investigate the findings, schedule corrective action, and notify the QA organization of the action taken (GLE, 2011a). The QA organization will evaluate the adequacy of audit responses and verify that corrective action has been taken (GLE, 2011a). Verification of corrective action will be documented (GLE, 2011a). Follow-up action will be taken by the QA Organization or management of the audited organization to verify the implementation and effectiveness of the corrective action and to determine if repetitive problems require further corrective action (GLE, 2011a).

Audit records will include audit plans, audit reports, and as applicable, written responses to the audit findings, documentation of corrective action completion, and documentation of corrective action verification (GLE, 2011a).

In Section 19 of the QAPD (GLE, 2011a), the applicant described provisions for the planning and scheduling of audits to verify compliance with and to determine the effectiveness of the QA Program. The applicant identified the responsibilities of audit team members, organizations being audited, and the QA Organization with respect to audit planning, documentation, review of audit results, investigation of audit findings, corrective action scheduling, follow-up actions, and verification of corrective action completion. The applicant described the information that will be captured in audit reports and committed to maintain records of audit activities to include audit plans, audit reports, and applicable documentation related to corrective and follow-up actions taken in response to audit findings. The information provided by the applicant to describe the audit program meets the acceptance criteria in Section 11.4.3.8.18 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.20 PROVISIONS FOR CHANGE

NRC staff reviewed the applicant's change process in accordance with the acceptance criteria Section 11.4.3.8.19 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.19 of NUREG-1520 (NRC, 2002) calls for the establishment of a change control process to address reviews and updates to QA documents based on reorganizations, revised activities, lessons learned, changes to applicable regulations, and other QA program changes.

The change process for the QAPD (GLE, 2011a) is described in Section 20 of the QAPD (GLE, 2011a). The QA Program will be reviewed and revised as necessary to reflect any changes that occur throughout the facility lifetime as warranted by corrective actions, regulatory, organizational, or work scope changes (GLE, 2011a). The QA Program will be maintained current through design, construction, operation, and decommissioning of the facility through revisions that address: (1) lessons learned from audit and assessment findings; (2) program improvements identified from the analysis of trends; and (3) changes due to regulations, commitments, re-organizations, revised project schedules, or program improvements identified as a result of continuous reviews of assessment results and process improvement initiatives (GLE, 2011a).

Changes that decrease the effectiveness of QAPD (GLE, 2011a) commitments will not be made without prior NRC review and approval. Changes that do not result in a degradation of safety commitments found in the license and do not conflict with provisions documented in the license application may be made without NRC review and approval (GLE, 2011a). A description of

such changes, and a copy of affected sections of the QAPD (GLE, 2011a), will be submitted to NRC within 3 months of implementation of the change (GLE, 2011a).

As described in Section 20 of the QAPD (GLE, 2011a), the applicant described provisions to ensure that the QA Program is maintained current based on reorganization, revised activities, lessons learned, regulatory changes, and other QA Program modifications. The applicant further described the process for submitting QAPD changes to NRC. The applicant's program for ensuring that the QA Program will be reviewed and revised as necessary to reflect any changes that occur throughout the life cycle of the facility meets the acceptance criteria in Section 11.4.3.8.19 of NUREG-1520 (NRC, 2002) for the development, implementation, and maintenance of the QA Program and is, therefore, acceptable.

### 11.A.3.21 FIRE SUPPRESSION IROFS

#### 11.A.3.21.1 Fire Suppression QA Controls

NRC staff reviewed the applicant's QA Program for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8 of NUREG-1520 (NRC, 2002). Fire suppression IROFS are described in the SER separate from QA provisions for QL-1 and QL-2 IROFS because the QA treatment of fire suppression IROFS is different from that of other IROFS due to the reliance on compliance with NFPA codes and standards and verification and certification activities performed by testing laboratories such as Underwriters Laboratories (UL).

Appendix A of the QAPD (GLE, 2011a) describes the extent to which Sections 1 through 20 of the QAPD (GLE, 2011a) apply to the fire suppression systems identified as items and activities relied on for safety or defines exceptions and describes alternatives to QAPD (GLE, 2011a) provisions. The fire suppression systems to which Appendix A applies are detailed in the applicant's boundary package documents for fire suppression systems, which also includes a list of applicable NFPA codes and standards (GLE, 2011a).

The following QAPD (GLE, 2011a) sections apply in their entirety to fire suppression systems items and activities relied on for safety: Section 1, "Introduction;" Section 2, "Organization;" Section 3, "QA Program;" and Section 20, "Provisions for Change" (GLE, 2011a). NRC reviewed these sections as discussed in Sections 11.A.3.1, 11.A.3.2, 11.A.3.3, and 11.A.3.20 of this SER and found Sections 1, 2, 3, and 20 of the QAPD (GLE, 2011a) acceptable..

NRC staff reviewed the applicant's design control function for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.3 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.3 of NUREG-1520 (NRC, 2002) call for establishment of a design control function that includes design inputs, process, analyses, verification, interfaces, changes, and design documentation and records.

As described in Section 4, "Design Control," of Appendix A of the QAPD (GLE, 2011a), fire suppression systems identified as IROFS will be designed, fabricated, installed, inspected, and maintained according to the requirements of the design documents, NFPA codes and standards, manufacturer's requirements, and nationally recognized testing lab listing requirements. Determination of the required rigor of design control for fire suppression IROFS will be based upon the design phase and the results of the ISA, which identifies the functions of IROFS and the significance to safety of those functions (GLE, 2011a).



The design of fire suppression IROFS will be based upon sound engineering judgment, scientific principles, and applicable codes and standards (GLE, 2011a). Engineering management will use approved written policies, plans, or procedures to control the design process, including inputs, analysis, outputs, reviews/checks/approvals, change control, technical interfaces, and administrative activities (GLE, 2011a). Design policies, plans, or procedures will ensure that applicable requirements are correctly translated into design documents (GLE, 2011a). Design documents will be prepared, reviewed, checked, and approved by qualified individuals and will include drawings, reports, technical reports, criteria, specifications, analyses, computer programs, system descriptions, requirement documents, and the ISA. Design documents such as drawings, specifications, and calculations will describe fire suppression systems identified as IROFS (GLE, 2011a).

The work scope and responsibilities for design groups and disciplines will be defined. Fire suppression systems will be procured by a bid and award process using qualified licensed contractors (GLE, 2011a). The fire protection installation supplier will prepare fabrication drawings, data sheets, and calculations for submittal and review (GLE, 2011a). Design documents will be prepared, reviewed, checked, and approved by qualified independent individuals (GLE, 2011a). The applicant will independently review and verify the results obtained from software products used to produce or manipulate data directly used in the design, analysis, and operation of the fire suppression systems identified as IROFS. Design activities associated with fire suppression IROFS will be performed in accordance with approved written policies, plans, or procedures that specify applicable engineering and design requirements (GLE, 2011a). Records of the design process will be maintained in accordance with Sections 7 and 18 of the QAPD (GLE, 2011a), as modified by Appendix A to the QAPD (GLE, 2011a).

In Section 4 of Appendix A of the QAPD (GLE, 2011a), Appendix A, the applicant defined a design control process for fire suppression IROFS that will: (1) use written approved policies, plans, or procedures to control design inputs; analyses; outputs; reviews, checks, and approvals; change control; technical interfaces; and administrative activities; (2) use the ISA and other design analysis inputs to determine the rigor needed for design control activities; and (3) ensure that applicable requirements are correctly translated into design documents. The applicant described how documents and records associated with design control will be maintained and committed to design, fabricate, install, inspect, and maintain fire suppression IROFS in accordance with the requirements of design documents, NFPA codes and standards, manufacturer's requirements, and nationally recognized testing lab listing requirements. The information provided meets the guidance contained in Section 11.4.3.8.3 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's procurement control for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.4 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.4 of NUREG-1520 (NRC, 2002) address applicable design bases and other requirements necessary to provide reasonable assurance of quality are included or referenced in documents for procurement of items or services relied on for safety. To the extent necessary, suppliers are required to have QA consistent with the quality level of the item or service to be procured.

As described in Section 5, "Procurement Control," of Appendix A of the QAPD (GLE, 2011a), written approved policies, plans, or procedures will delineate the provisions for the procurement process (sourcing) and control of procurement documents and procured materials, components, and services (GLE, 2011a). Documents for the procurement of items or services relied on for safety will include or make reference to design basis and other requirements necessary to

provide reasonable assurance of quality (GLE, 2011a). Requirements for the content, review, approval, and change of procurement documents for QL-NFPA items and services will be established in approved written policies, plans, or procedures (GLE, 2011a).

Procurement documents for QL-NFPA items or services will specify requirements, as appropriate, such as QA program requirements applicable to the supplier, requirements for controlling nonconformances and changes to products/services, technical requirements, and documents to be provided by the supplier (GLE, 2011a). Changes to procurement documents will be subject to the same degree of control as that applied to the preparation of the original procurement document, and review and approval for changes will be at the same level as the original document (GLE, 2011a).

Suppliers or sub-tier suppliers will not be required to maintain a QA Program other than as specified and necessary to maintain their licenses, certifications, and listings to provide services or equipment associated with the design, erection, inspection, test, and certification of fire suppression systems (GLE, 2011a). Commercial grade items procured for use as QL-NFPA IROFS will be dedicated by the applicant to serve as basic components (GLE, 2011a).

In Section 5 of Appendix A of the QAPD (GLE, 2011a), the applicant committed to include or make reference to applicable design bases and other requirements necessary to provide reasonable assurance of quality in procurement documents issued for fire suppression items or services relied on for safety. As stated in the QAPD (GLE, 2011a), suppliers or sub-tier suppliers for fire suppression IROFS and services will not be required to maintain a QA Program other than as specified and necessary to maintain their licenses, certifications, and listings to provide services or equipment associated with the design, erection, inspection, test, and certification of fire suppression systems. The information provided by the applicant with respect to procurement control meets the guidance in Section 11.4.3.8.4 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's program for instructions, procedures, and drawings for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.5 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.5 of NUREG-1520 (NRC, 2002) address the applicant's methods for ensuring that activities affecting quality are prescribed by and performed in accordance with documented instructions, procedures, or drawings of a type appropriate for the circumstances.

As described in Section 6, "Instructions, Procedures, and Drawings," of Appendix A of the QAPD (GLE, 2011a), activities affecting the availability or reliability of IROFS will be prescribed by and accomplished in accordance with documented specifications, requirements, policies, plans, procedures, instructions, and drawings of a type appropriate to the circumstance (GLE, 2011a). These documents will include or reference appropriate acceptance criteria for determining that prescribed activities have been satisfactorily accomplished (GLE, 2011a). NFPA codes and standards set forth the minimum requirements and standards for the design, installation, inspection, testing, and maintenance of fire suppression systems identified as IROFS (GLE, 2011a). The QA function will review QA implementing policies, plans, and procedures for compliance and consistency with the QA Program and to ensure that the provisions of the QA Program are effectively incorporated into implementing policies, plans, and procedures (GLE, 2011a). Policies, plans, procedures, instructions, and drawings, and changes thereto, will be controlled in accordance with Sections 4 and 7 of the QAPD (GLE, 2011a), as modified by Appendix A.

In Section 6 of Appendix A of the QAPD (GLE, 2011a), the applicant established controls for fire suppression instructions, procedures, and drawings and made the commitment that activities affecting quality will be prescribed by and performed in accordance with documented instructions, procedures, or drawings of a type appropriate for the circumstances. NFPA Codes and Standards will be used to establish the minimum standards and requirements for the design, testing, installation, inspection, and maintenance of fire suppression systems credited as IROFS. The information provided by the applicant to describe instructions, procedures, and drawings that will be used at the facility meets the guidance contained in Section 11.4.3.8.5 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's document control program for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.6 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.6 of NUREG-1520 (NRC, 2002) address the establishment of a process to control the preparation, issuance, and modification of documents that specify quality requirements or prescribe activities affecting quality are controlled to provide reasonable assurance that the appropriate documents are in use. In addition, document changes need to be reviewed for adequacy and approved for implementation by authorized personnel.

As described in Section 7 "Document Control," of Appendix A of the QAPD (GLE, 2011a), documents that prescribe activities affecting the availability or reliability of QL-NFPA IROFS will be controlled in a manner to ensure the use of correct documents (GLE, 2011a). Such documents will be reviewed for adequacy and approved for release in accordance with a defined, management-approved process (GLE, 2011a). Obsolete or superseded documents will be removed or appropriately identified (GLE, 2011a).

Policies, plans, procedures, and instructions will be maintained under revision control. Procedure changes (minor, major, or temporary) will be performed in accordance with controls established in a written, approved procedures (GLE, 2011a). Personnel responsibilities for document preparation, review, approval, and issuance will be identified in policies, plans, and procedures (GLE, 2011a).

In Section 7 of Appendix A of the QAPD (GLE, 2011a), the applicant identified provisions for document control for fire suppression IROFS and stated that documents that prescribe activities affecting the availability or reliability of QL-NFPA IROFS and changes thereto will be controlled in a manner to ensure the use of correct documents. The applicant committed to ensure that documents are prepared and reviewed for adequacy, correctness, and completeness by a qualified individual; approved for release; and used appropriately in performing the activity. The applicant's description of its document control program meets the guidance contained in Section 11.4.3.8.6 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's program to control purchased items and services for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.7 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.7 of NUREG-1520 (NRC, 2002) call for assurance that purchased IROFS and services relied on for safety are controlled to provide reasonable assurance of conformance with specified requirements.

As described in Section 8, "Control of Purchased Items and Services," of Appendix A of the QAPD (GLE, 2011a), the applicant will control the procurement of QL-NFPA items and services to ensure they conform to procurement requirements through the implementation of supplier (source) evaluation and selection; evaluation of objective evidence of quality furnished by the

supplier; source inspection; and examination of items or services upon delivery or completion, as appropriate (GLE, 2011a).

Sourcing activities will be planned and documented to ensure a systematic approach to the procurement process (GLE, 2011a). The activities implemented by the applicant to verify the acceptability of fire suppression systems will be those established by NFPA codes and standards (GLE, 2011a). Supplier furnished material, equipment, or services related to the fire suppression systems identified as IROFS will be reviewed for acceptability by performing one or more of the following activities, as appropriate to the items or services being procured: (1) monitoring, witnessing, or observing activities performed by the supplier; (2) performing a receiving inspection; or (3) performing post-installation testing. Nonconformances associated with QL-NFPA items may be identified either by the applicant or by the supplier, and records of supplier nonconformances will be maintained (GLE, 2011a).

In Section 8 of Appendix A of the QAPD (GLE, 2011a), applicant described measures that will be implemented for the control of purchased items and services for fire suppression IROFS to ensure that purchased items and services conform to specified requirements. The applicant identified controls for supplier evaluation and selection and for the verification of purchased item acceptability. The information provided by the applicant to describe the control of purchased items and services for the proposed facility meets the acceptance criteria contained in Section 11.4.3.8.7 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's program to identify and control material, parts, and components for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.8 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.8 of NUREG-1520 (NRC, 2002) call for the establishment of provisions to identify and control IROFS and to provide reasonable assurance that incorrect or defective items are not used.

As described in Section 9, "Identification and Control of Materials, Parts, and Components," of Appendix A of the QAPD (GLE, 2011a) controls will be established for QL-NFPA items to ensure that only correct and accepted items are used or installed (GLE, 2011a). Identification will be maintained on QL-NFPA items or in documents traceable to the items per the requirements of NFPA codes and standards (GLE, 2011a). Acceptable means of identification for QL-NFPA items will include markings from a nationally recognized testing laboratory or submittal of data sheets indicating listing with a nationally recognized testing laboratory and traceable to the item (GLE, 2011a). Individual fire suppression system components required by NFPA to be listed by a nationally recognized testing laboratory will be listed for the purpose for which they are installed (GLE, 2011a).

The licensed fire protection contractor(s) selected to design, construct, fabricate, test, and certify the fire suppression systems identified as IROFS will be required to demonstrate a satisfactory work history of having successfully installed fire suppression systems, and will be responsible for meeting the requirements of applicable NFPA codes and standards for the identification and control of parts, materials, and components (GLE, 2011a). Design specifications and other documents for the procurement of the fire suppression systems IROFS will specify requirements such as material control, item identification and segregation, and marking (GLE, 2011a).

As described in Section 9 of Appendix A of the QAPD (GLE, 2011a), the applicant has established measures for the identification and control of material, parts, and components to prevent the use of incorrect or defective items. The applicant committed to maintain

identification on QL-NFPA items or in documents traceable to the items per the requirements of NFPA codes and standards. The applicant stated that requirements such as material control, item identification and segregation, and marking will be identified in design specifications and other documents for the procurement of the fire suppression systems IROFS. The applicant's program for the identification and control of materials, parts, and components meets the acceptance criteria in Section 11.4.3.8.8 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's program to control special processes for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.9 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.9 of NUREG-1520 (NRC, 2002) call for the establishment of measures to maintain the acceptability of special processes used in the course of construction, maintenance, modifications, and testing activities (e.g., welding, heat treating, nondestructive testing, and chemical cleaning) and to assure that they are performed by qualified personnel using qualified procedures and equipment.

As described in Section 10, "Control of Special Processes," of Appendix A of the QAPD (GLE, 2011a), special processes that control or verify quality will be performed by qualified personnel using approved written policies, plans, and/or procedures in accordance with specified requirements and applicable NFPA Codes and Standards. The control of special processes will be dictated by policies, plans, procedures, instructions, drawings, checklists, travelers, work orders, or other appropriate means that meet the requirements of applicable NFPA Codes and Standards (GLE, 2011a). Records associated with special processes performed on fire suppression systems will be maintained according to the requirements of applicable NFPA Codes and Standards (GLE, 2011a).

As described in Section 10 of Appendix A of the QAPD (GLE, 2011a), the applicant has established provisions for the control of special processes associated with fire suppression IROFS. Specifically, the applicant committed to ensure that special processes that control or verify quality are performed by qualified personnel using approved written policies, plans, and/or procedures in accordance with specified requirements and applicable NFPA Codes and Standards. The description of the applicant's program for the control of special processes meets the acceptance criteria in Section 11.4.3.8.9 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's inspection program for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.10 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.10 of NUREG-1520 (NRC, 2002) address inspections required to verify conformance of IROFS with requirements and assure the inspections are planned and executed. The acceptance criteria in Section 11.4.3.8.10 of NUREG-1520 (NRC, 2002) also call for inspection requirements to be specified in written procedures with provisions included for documenting and evaluating inspection results and for personnel qualification programs to be established for inspection test personnel. The training and qualification program is described in Section 11.3 of the LA (GLE, 2011b) and in Section 3.2.3 of the QAPD (GLE, 2011a).

As described in Section 11, "Inspection," of Appendix A of the QAPD (GLE, 2011a), inspections will be performed, as required, to verify conformance of items or activities to specified requirements (GLE, 2011a). Inspection requirements will be defined in approved written policies, plans, or procedures, with provisions for documenting and evaluating the inspection results (GLE, 2011a). Inspections will be performed by qualified personnel with licensing

background, experience, education, or certification, as appropriate (GLE, 2011a). Personnel other than those who performed or directly supervised the work being inspected will perform inspections for acceptance (GLE, 2011a). Inspection records will be maintained and will contain, as a minimum, identification of the item inspected, date of inspection, inspector, type of observation, inspection plan, a statement of the inspection results and their acceptability, and any actions taken in connection with any identified nonconformances (GLE, 2011a).

Inspections will be planned and may utilize hold points, where applicable, to ensure that work does not proceed past required inspections (GLE, 2011a). For inspections that are performed as part of maintenance measures required to ensure proper function of a QL-NFPA IROFS, the inspection requirements will be defined by applicable NFPA codes and standards (GLE, 2011a).

The licensed fire protection contractor(s) selected to inspect the fire suppression systems identified as IROFS will be responsible for meeting the inspection requirements specified in applicable NFPA codes and standards (GLE, 2011a). Licensed site personnel with requisite experience and certifications may also perform inspections (GLE, 2011a).

As described in Section 11 of Appendix A of the QAPD (GLE, 2011a), the applicant identified controls for inspections performed to verify conformance of fire suppression items or activities to specified requirements. Requirements for inspections will be specified in approved written procedures that include provisions for documenting and evaluating inspection results. The applicant committed to ensure that personnel performing inspections are independent of the work activity being inspected and have the requisite experience, education, or certification to be qualified to perform the inspection activities. The information provided detailing the applicant's inspection program meets the acceptance criteria in Section 11.4.3.8.10 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's test control program for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.11 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.11 of NUREG-1520 (NRC, 2002) call for tests to verify that IROFS conform to specified requirements and will perform satisfactorily in service. The acceptance criteria in Section 11.4.3.8.11 of NUREG-1520 (NRC, 2002) also call for test requirements to be specified in written procedures with provisions included for documenting and evaluating test results and for personnel qualification programs to be established for test personnel.

As described in Section 12, "Test Control," of Appendix A of the QAPD (GLE, 2011a), tests will be planned, executed, documented, and evaluated according to the requirements of NFPA codes and standards. Test results will be documented and their conformance with acceptance criteria will be evaluated (GLE, 2011a). Tests of QL-NFPA items and services will include design verification tests, acceptance tests, preoperational and operational tests, and post-maintenance tests as defined in applicable NFPA codes and standards (GLE, 2011a). Planning for tests may include mandatory hold points, as required (GLE, 2011a).

The licensed fire protection contractor(s) selected to design, construct, fabricate, install, test, maintain, and certify the fire suppression systems identified as IROFS will be responsible for meeting the requirements of applicable NFPA codes and standards regarding testing (GLE, 2011a). Design specifications and other documents for procurement of the fire suppression systems identified as IROFS will require that contractor personnel performing tests are qualified based on experience, education, or certification, as appropriate (GLE, 2011a). The training and

qualification program is described in Section 11.3 of the LA (GLE, 2011b) and in Section 3.2.3 of the QAPD (GLE, 2011a).

Test policies, plans, or procedures will contain the following information, as appropriate: (1) test purpose or objectives, responsibilities, characteristics to be tested, test methods, acceptance criteria, and hold points to be employed; (2) references and related documents applicable to the test activity; (3) provisions for ensuring that adequate instrumentation is available for test performance and that suitable environmental conditions are maintained throughout testing; (4) provisions for documenting and evaluating the test results for conformance with acceptance criteria; and (5) qualification requirements for test personnel (GLE, 2011a). Appropriate sections of NFPA codes and standards may be used for test guidance in lieu of test policies, plans, and procedures as long as the codes and standards include adequate instructions to ensure the required quality of work (GLE, 2011a). Test records will contain the following information: item tested; test date; tester or data recorder; type of observation; test policy, plan, procedure, or reference; test results and acceptability; actions taken in connection with any deviations noted; and person evaluating the results (GLE, 2011a).

As described in Section 12 of Appendix A of the QAPD (GLE, 2011a), the applicant will conduct tests to verify that IROFS conform to specified requirements and will perform satisfactorily in service. The applicant committed to plan, execute, and document tests according to the requirements of NFPA codes and standards and to document and evaluate the conformance of test results with acceptance criteria. The applicant identified information that will be included in test policies, plans, or procedures and identified that appropriate sections of NFPA codes and standards may be used for test guidance in lieu of test policies, plans, and procedures as long as the codes and standards include adequate instructions to ensure the required quality of work. The applicant also identified the information that will be contained in test records. As described in Appendix A of the QAPD, contractor personnel performing tests for fire suppression systems identified as IROFS will be qualified based on experience, education, or certification and will be responsible for meeting the requirements of applicable NFPA Codes and Standards. The applicant's provisions for the planning, conduct, and documentation of tests meets the acceptance criteria in Section 11.4.3.8.11 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's program to control measuring and test equipment for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.12 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.12 of NUREG-1520 (NRC, 2002) call for assurance that tools, gauges, instruments, and other measuring and testing devices are properly identified, controlled, calibrated, and adjusted at specified intervals to maintain performance within required limits.

As described in Section 13, "Control of Measuring and Test Equipment," of Appendix A of the QAPD (GLE, 2011a), the licensed fire protection contractor(s) selected to design, construct/erect, test, and certify the fire suppression systems IROFS will be responsible for meeting the requirements of applicable NFPA codes and standards with respect to M&TE. Design specifications and other documents for the procurement of IROFS associated with fire suppression systems will specify the M&TE-related NFPA codes and standards and will identify the revision or date of the code or standard (GLE, 2011a).

M&TE used in activities affecting the availability or reliability of fire suppression systems identified as IROFS will be controlled, calibrated, and adjusted at specified intervals in order to maintain equipment performance within required limits (GLE, 2011a). Policies, plans, and

procedures will be implemented to ensure that devices and standards used for measurement, tests, and calibration activities are of the proper type, range, and accuracy (GLE, 2011a). Calibration control will not be required for commercial devices such as rulers, tape measures, levels, and stopwatches (GLE, 2011a). A list of devices will be established to identify M&TE that is maintained within the calibration control system (GLE, 2011a). The list will be established by the calibration requirements of applicable NFPA codes and standards and will include, as a minimum, the due date of the next calibration and any use limitations applicable to equipment that is calibrated for limited use (GLE, 2011a).

M&TE will be calibrated at specified intervals or prior to use against equipment having a known valid relationship to nationally recognized standards; if no nationally recognized standard exists, the basis for calibration will be documented (GLE, 2011a). M&TE will be handled and stored in a manner to maintain equipment accuracy (GLE, 2011a). When M&TE is found to be out of calibration, as-found data will be recorded, and an evaluation will be performed and documented to evaluate the validity of previous inspections, test results, and the acceptability of items previously inspected or tested (GLE, 2011a). Out-of-calibration devices will be tagged or segregated and not used until the equipment has been re-calibrated (GLE, 2011a).

As described in Section 13 of Appendix A of the QAPD (GLE, 2011a), the applicant has established provisions that provide reasonable assurance that tools, gauges, instruments, and other measuring and testing devices will be properly identified, controlled, calibrated, and adjusted at specified intervals to maintain performance within required limits. The applicant has established controls for dealing with devices that are found to be out of tolerance and has committed to ensure the proper storage and handling of M&TE. The applicant stated that the licensed fire protection contractor(s) selected to design, construct/erect, test, and certify the fire suppression systems IROFS will be responsible for meeting the requirements of applicable NFPA codes and standards with respect to M&TE. The information provided by the applicant with respect to the M&TE program meets the acceptance criteria in Section 11.4.3.8.12 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's program for the handling, storage, and shipping of fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.13 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.13 of NUREG-1520 (NRC, 2002) address the establishment of provisions to control the handling, storage, shipping cleaning, and preservation of IROFS, in accordance with work and inspection instructions, to prevent damage, loss, and deterioration caused by environmental conditions such as temperature and humidity.

As described in Section 14, "Handling, Storage, and Shipping," of Appendix A of the QAPD (GLE, 2011a), material and equipment will be handled, stored, and shipped in accordance with design and procurement requirements to protect against damage, deterioration, and loss. Special coverings, equipment, and protective environments will be specified and provided when necessary to prevent damage to or deterioration of fire suppression IROFS (GLE, 2011a). When such special protective features are implemented, monitoring and verification activities will be implemented as necessary to ensure that the features maintain their effectiveness (GLE, 2011a).

As described in Section 14 of Appendix A of the QAPD (GLE, 2011a), the applicant committed to handle, store, and ship material and equipment in accordance with design and procurement requirements to protect against damage, deterioration, and loss. The applicant described provisions for the use of special coverings, equipment, and protective environments to protect



fire suppression material and equipment. The measures described by the applicant to control the handling, storage, and shipping of material and equipment meet the acceptance criteria in Section 11.4.3.8.13 of NUREG-1520 (NRC, 2002) and are, therefore, acceptable.

NRC staff reviewed the applicant's program for inspection control, testing, and operating status for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.14 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.14 of NUREG-1520 (NRC, 2002) address the inspection, test, and operating status of IROFS to prevent inadvertent use of nonconforming items or bypassing of inspection and tests.

As described in Section 15, "Inspection, Control, Testing, and Operating Status," of Appendix A of the QAPD (GLE, 2011a), status indicators such as tags, markings, work-controlling documents, stamps, and inspection records will be used as needed to ensure that required inspections and tests are performed and to ensure items that have not passed the required inspections and tests are not inadvertently installed, used, or operated. Policies, plans, and procedures will be established to ensure that the status of inspection and test activities is either marked or labeled on the item or in documents traceable to the item (GLE, 2011a).

The marking, labeling, or documenting of the inspection, test, maintenance, and impairment status of systems and components will be performed in accordance with the requirements of applicable NFPA codes and standards (GLE, 2011a). Authority for the application and removal of tags, markings, labels, and stamps will be specified (GLE, 2011a).

As described in Section 15 of Appendix A of the QAPD (GLE, 2011a), the applicant committed to establish policies, plans, and procedures to ensure that the status of inspection and test activities is either marked or labeled on the item or in documents traceable to the item to prevent the inadvertent use of nonconforming items or bypassing of inspections and tests. The applicant will use status indicators to indicate the inspection, test, and operability status of items, as necessary, and will specify the required authority for the application and removal of status indicators. The applicant committed to perform the marking, labeling, or documentation of the inspection, test, maintenance, and impairment status of systems and components in accordance with the requirements of applicable NFPA codes and standards. The information provided by the applicant ensure the appropriate control of items and identification of inspection, test, and operability status meets the acceptance criteria in Section 11.4.3.8.14 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's program for control of nonconforming items for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.15 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.15 of NUREG-1520 (NRC, 2002) call for control of the identification, segregation, disposition, and prevention of installation or use of nonconforming IROFS.

As described in Section 16, "Control of Nonconforming Items," of Appendix A of the QAPD (GLE, 2011a), items and activities that do not conform to specified requirements will be controlled to prevent inadvertent installation or use (GLE, 2011a). The responsibility and authority for the evaluation and disposition of nonconforming items will be defined. Fire suppression systems items identified as IROFS will be inspected for conformance to the requirements of applicable NFPA codes and standards (GLE, 2011a). Items determined to be non-conforming will be: (1) identified and controlled according to the requirements of NFPA codes and standards; (2) marked, tagged, or otherwise identified in a manner that does not

adversely affect the end use of the item; and (3) segregated, when practical, by placing them in a clearly identified and designated area until properly dispositioned (GLE, 2011a).

Applicant personnel or suppliers performing evaluations to disposition nonconformances will be competent in the specific area being evaluated, have an adequate understanding of the requirements, and have access to pertinent background information (GLE, 2011a). The disposition of nonconforming items will be identified and documented as required to carry out the disposition (GLE, 2011a). Nonconformance documentation will include identification of the nonconforming item, a description of the nonconformance, identification of the nonconformance disposition and any re-inspection requirements, and appropriate signatures approving the disposition per the applicable requirements of NFPA codes and standards. (GLE, 2011a)

As described in Section 16 of the QAPD (GLE, 2011a), the applicant has established provisions to control the identification, control, segregation, evaluation, and disposition of fire suppression items that do not conform to the requirements of applicable NFPA codes and standards to prevent their installation or use. The applicant has identified measures to ensure that personnel performing evaluations of nonconformances are appropriately qualified and that nonconforming conditions and their dispositions are adequately documented. The applicant's program for the control of nonconforming items meets the acceptance criteria in Section 11.4.3.8.15 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's corrective action program for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.16 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.16 of NUREG-1520 (NRC, 2002) call for reasonable assurance that conditions adverse to safety are promptly identified and corrected and measures are taken to preclude repetition. These actions should be documented and reported to appropriate levels of management.

As described in Section 17, "Corrective Actions," of Appendix A of the QAPD (GLE, 2011a), conditions adverse to quality will be identified and corrected as soon as practical. Approved written policies, plans, or procedures will specify requirements for identifying, documenting, classifying, and correcting conditions adverse to quality as well as for notifying appropriate levels of management when necessary (GLE, 2011a). Conditions requiring corrective action in fire suppression IROFS will be identified, corrected, and documented as soon as practical and in accordance with the requirements of applicable NFPA codes and standards (GLE, 2011a).

When a significant condition adverse to quality is identified, the cause of the condition will be determined, and corrective action will be taken to preclude recurrence (GLE, 2011a). Significant conditions, their causes, and corrective actions will be documented and reported to appropriate levels of management (GLE, 2011a). For significant conditions adverse to quality, follow-up action will be taken to verify implementation of corrective actions and trending will be required to monitor any trends in adverse conditions (GLE, 2011a).

As described in Section 17 of Appendix A of the QAPD (GLE, 2011a), the applicant committed to identify and correct conditions adverse to quality as soon as practical. The applicant will implement approved written policies, plans, and procedures to ensure that conditions adverse to quality are identified, classified, corrected, and documented in accordance with the requirements of applicable NFPA codes and standards and that appropriate management notifications are made. For significant conditions adverse to quality, the applicant will take measures to prevent recurrence and will document the condition, causes, and corrective actions and report this information to appropriate levels of management. The information provided by

the applicant with respect to measures that will be implemented at the proposed facility to perform corrective actions for conditions adverse to quality (and significant conditions adverse to quality) meets the acceptance criteria in Section 11.4.3.8.16 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's QA records program for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.17 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.17 of NUREG-1520 (NRC, 2002) address provisions for the identification, retention, retrieval, and maintenance of records that furnish evidence of the control of quality for IROFS.

As described in Section 18, "Quality Assurance Records," of Appendix A of the QAPD (GLE, 2011a), QA records that furnish documentary evidence of quality will be specified, prepared, and maintained in accordance with applicable regulatory requirements and approved written policies, plans, and procedures. QA records for fire suppression systems identified as IROFS will include documents required by applicable NFPA codes and standards, record drawings (as-built drawings, including calculations), and records of acceptance testing (GLE, 2011a). Requirements and responsibilities for the generation, classification, retention, receipt, storage, and preservation of QA records will be established in approved written policies, plans, or procedures (GLE, 2011a).

QA records will be legible, identifiable, and retrievable, and will be protected against damage, deterioration, and loss for the specified record retention period (GLE, 2011a). Applicable design specifications, procurement documents, test procedures, operating procedures, or other documents and procedures will specify records that must be generated, supplied, or maintained in association with fire suppression IROFS (GLE, 2011a). Documents will be considered valid records only if authenticated (e.g., stamped, initialed, or signed and dated by authorized personnel, or otherwise authenticated) and validated (verified to be legible, retrievable) (GLE, 2011a). Records will be indexed to ensure retrievability and will be distributed, handled, and controlled in accordance with written procedures (GLE, 2011a).

The Records Center will protect against the risk of loss or deterioration of lifetime records (GLE, 2011a). The Records Center will be access controlled, and the Records Center will not be left unattended unless it is properly secured (GLE, 2011a). Hard copy or microfilm storage facilities will meet the requirements of ASME NQA-1 (ASME, 1994), Supplement 17S-1, Section 4.4, "Supplementary Requirements for Quality Assurance Records." In the event that records are lost or damaged, they will be replaced unless deemed impractical; in situations in which it is not practical to replace lost or damaged records, concurrence of the QA organization will be required (GLE, 2011a).

Records maintained by a supplier at its facility or other locations will be accessible to the applicant directly or through the sourcing function and will not be disposed of until contractual requirements have been satisfied (GLE, 2011a).

As described in Section 18 of Appendix A of the QAPD (GLE, 2011a), the applicant has established provisions for the identification, retention, retrieval, and maintenance of records that furnish evidence of the control of quality for fire suppression IROFS. The applicant committed to specify, prepare, and maintain QA records in accordance with applicable regulatory requirements, NFPA codes and standards, and approved written policies, plans, and procedures. Furthermore, the applicant committed to meet the requirements of Supplement 17S-1 of ASME NQA-1 (ASME, 1994) for hard copy and microfilm storage facilities. The

applicant will ensure that records are identifiable, retrievable, and protected from loss, damage, or deterioration for the requisite retention time. All documents will be validated and authenticated by authorized personnel prior to becoming official records. The applicant's program for the management of records that provide objective evidence of quality meets the acceptance criteria in Section 11.4.3.8.17 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

NRC staff reviewed the applicant's audit program for fire suppression IROFS in accordance with the acceptance criteria Section 11.4.3.8.18 of NUREG-1520 (NRC, 2002). The acceptance criteria in Section 11.4.3.8.18 of NUREG-1520 (NRC, 2002) address the establishment of provisions for planning and scheduling assessments and audits to verify compliance with, and to determine the effectiveness of, QA; to identify responsibilities and procedures for assessing, auditing, documenting, and reviewing results and designating management levels to review assessment and audit results; and to incorporate the status of findings and recommendations in management reports.

As described in Section 19, "Audits," of Appendix A of the QAPD (GLE, 2011a), audits will be performed on internal organizations performing quality-affecting activities associated with safety-related aspects of the facility to verify compliance with the QA Program and to determine its effectiveness. Audits will be performed: (1) in accordance with policies, plans, procedures, or checklists; (2) at a frequency commensurate with the status and importance of the activity; and (3) by personnel who do not have direct responsibility for performing the activities being audited (GLE, 2011a). Auditors (including technical specialists) will have training or experience commensurate with the scope, complexity, or special nature of the audit (GLE, 2011a). Audit results will be documented, reported to, and reviewed by responsible management (GLE, 2011a). Whenever conditions requiring prompt corrective action are discovered, they will be immediately reported to the audited organization's management (GLE, 2011a).

Audit records will include audit plans, audit reports, and, as applicable, written responses to the audit findings, the documentation of corrective action completion, and documentation of corrective action verification (GLE, 2011a). Management of the audited organization or activity will investigate adverse audit findings, schedule corrective action, including measures to prevent recurrence (if appropriate), and notify the QA organization of the action taken (GLE, 2011a). In response, the QA organization will evaluate the adequacy of audit responses and verify the implementation of corrective actions (GLE, 2011a). Follow-up action will be taken by the audited organization to verify the implementation and effectiveness of the corrective action and to determine if repetitive problems require further corrective action (GLE, 2011a).

Audits will not be performed on suppliers or sub-tier suppliers of fire suppression systems identified as IROFS as these suppliers will not be required to maintain a QA Program other than as specified and necessary to maintain their licenses, certifications, and listings to provide services or equipment associated with the design, erection, inspection, test, and certification of fire suppression systems (GLE, 2011a).

In Section 19 of Appendix A of the QAPD (GLE, 2011a), the applicant committed to plan and schedule audits to verify compliance with and to determine the effectiveness of the QA Program. Audits will be performed in accordance with policies, plans, procedures, or checklists at a frequency commensurate with the status and importance of the activity by personnel who do not have direct responsibility for performing the activities being audited. The applicant described the information that will be captured in audit reports and committed to maintain records of audit activities. The information provided by the applicant to describe the audit

program meets the acceptance criteria in Section 11.4.3.8.18 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.3.21.2 Summary of Fire Suppression QA Controls

Appendix A of the QAPD (GLE, 2011a) establishes the QA requirements applicable to fire suppression IROFS. As described in Appendix A, the following aspects of the QAPD (GLE, 2011a) will be managed consistently for all IROFS (QL-1, QL-2, and QL-NFPA): Section 1, "Introduction"; Section 2, "Organization"; and Section 20, "Provisions for Change." Section 3 of the QAPD (GLE, 2011a), "Quality Assurance Program," will be applied to QL-NFPA IROFS consistent with the processes applied to QL-1 and QL-2 IROFS, or as indicated when the processes differ.

As described in Appendix A of the QAPD (GLE, 2011a), measures will be implemented to provide reasonable assurance of the reliability and availability of fire suppression IROFS. These measures include quality assurance provisions as well as reliance on nationally recognized codes and standards and testing laboratories. Further description of the basis for the acceptability of the use of NFPA codes and standards and testing laboratories such as UL and Factory Mutual is provided in Section 7.3.1.3 of this SER. Furthermore, in Chapter 2 of the LA (GLE, 2011b), the applicant committed to perform an annual review of fire suppression IROFS to identify any recalls that have been issued that may affect installed components or systems. The information provided by the applicant for the implementation of other QA elements for fire suppression IROFS meets the guidance contained in Section 11.4.3.8 of NUREG-1520 (NRC, 2002) and is, therefore, acceptable.

#### 11.A.4 EVALUATION FINDINGS

Based on its review of the QAPD (GLE, 2011a), the NRC staff has concluded that the applicant has adequately described the application of other QA elements (and the applicable QA elements of its principal contractors). The staff concludes further that:

1. The applicant has established and documented a commitment to an organization responsible for developing, implementing, and assessing the management measures for providing reasonable assurance of safe facility operations.
2. The applicant has established and documented a commitment to QA elements, and the administrative measures for staffing, performance, assessing findings, and implementing corrective action are in place.
3. The applicant has developed a process for preparation and control of written administrative plant procedures, including procedures for evaluating changes to procedures, IROFS, and tests. A process for review, approval, and documentation of procedures will be implemented and maintained.
4. The applicant has established and documented surveillances, tests, and inspections to provide reasonable assurance of satisfactory performance of IROFS. Specified standards or criteria and testing provisions have been provided.

5. Periodic independent audits will be conducted to determine the effectiveness of management measures. Management measures will provide for documentation of audit findings and implementation of corrective actions.
6. Training requirements have been established and documented to provide employees with the skills to perform their jobs safely. Measures have been provided for evaluation of the effectiveness of training against predetermined objectives and criteria.
7. The organizations and persons performing QA element functions have the required independence and authority to effectively carry out their QA element functions without undue influence from those directly responsible for process operations.
8. QA elements cover the IROFS, as identified in the ISA Summary, and measures are established to prevent hazards from becoming pathways to higher risks and accidents.

Accordingly, the staff concludes that the applicant's application of other QA elements (and the applicable QA elements of its principal contractors) meets the requirements of 10 CFR Part 70.62 and provides reasonable assurance of protection of public health and safety and of the environment.

#### **11.A.5 REFERENCES**

(ASME, 1994). American Society of Mechanical Engineers (ASME). NQA-1, "Quality Assurance Requirements for Nuclear Facility Applications," 1994.

(GLE, 2011a) General Electric-Hitachi Global Laser Enrichment (GLE). "Quality Assurance Program Description for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility." Revision 7. 2011.

(GLE, 2011b) General Electric-Hitachi Global Laser Enrichment (GLE). "GE-Hitachi Global Laser Enrichment LLC Commercial Facility License Application," Revision 6. 2011.

(NRC, 2002) U.S. Nuclear Regulatory Commission (NRC). NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility." 2002.

## 12.0 MATERIAL CONTROL AND ACCOUNTING

### 12.1 INTRODUCTION

The purpose of this review was to verify that the applicant, General Electric-Hitachi Global Laser Enrichment LLC (GLE), provided sufficient information in its Fundamental Nuclear Material Control Plan (FNMCP) (GLE, 2010) to determine that the Material Control and Accounting (MC&A) program meets the applicable regulatory requirements in Title 10 of the *Code of Federal Regulations* (CFR) Part 74, "Material Control and Accounting of Special Nuclear Material." The Nuclear Regulatory Commission staff's review of the FNMCP contains Proprietary, Security-Related, and Export Control Information and is addressed in the non-public version of this Safety Evaluation Report (SER).

### 12.2 EVALUATION FINDINGS

The staff concluded that the applicant provided an acceptable FNMCP for the proposed facility that will meet the applicable 10 CFR 74 requirements. The FNMCP (GLE, 2010) described acceptable methods for achieving the performance objectives in 10 CFR 74.33(a) and the system capabilities of 10 CFR 74.33(c). In addition, the applicant's MC&A program elements satisfy the guidelines specified in NUREG/CR-5734, "Recommendations to the NRC on Acceptable Standard Format and Content for the Fundamental Nuclear Material Control Plan Required for Low-Enriched Uranium Enrichment" (NRC, 1991); Regulatory Guide 5.67, "Material Control and Accounting Requirements for Uranium Enrichment Facilities Authorized to Produce Special Nuclear Material of Low Strategic Significance" (NRC, 1993); and reporting requirements described in NUREG/BR-0006, "Instructions for Completing Nuclear Material Transaction Reports (DOE/NRC Forms 741 and 740M)" (NRC, 2009a); NUREG/BR-0007, "Instructions for the Preparation and Distribution of Material Status Reports (DOE/NRC Forms 742 and 742C)" (NRC, 2009b); and NUREG/BR-0096, "Instructions and Guidance for Completing Physical Inventory Summary Reports (NRC Form 327)" (NRC, 1992).

The regulations in 10 CFR 74.33(c)(5) require that a licensee establish, document, and maintain a detection program, independent of production, that provides high assurance of detecting:

- i. Production of uranium enriched to 10 percent or more in the  $U^{235}$  isotope, to the extent that special nuclear material of moderate strategic significance could be produced within any 370 calendar day period;
- ii. Production of uranium enriched to 20 percent or more in the  $U^{235}$  isotope; and
- iii. Unauthorized production of uranium of low strategic significance.

In Section 9 of the FNMCP (GLE, 2010a), the applicant described a program for precluding and detecting unauthorized production of enriched uranium, including monitoring of the enrichment within the process system and monitoring of material quantities against possession limits.

However, because the final facility design is not yet in-place, the applicant has not analyzed potentially credible diversion scenarios by which unauthorized enrichment activities can take

place. The staff determined that the applicant needs to provide a detailed analysis of potentially credible diversion scenarios by which unauthorized enrichment activities and unauthorized production of enriched uranium could occur. In addition, the applicant needs to conduct a detailed analysis of the processes and determine, based on the credible diversion scenarios, the management measures that are best suited to satisfy the detection program goals. Therefore, NRC is granting an exemption to 10 CFR 74.33(c)(5) and is imposing the following license condition requiring the submittal of the detailed analyses for review and approval as follows:

*The Licensee is granted an exemption to the requirements in 10 CFR 74.33(c)(5) to require that a licensee establish, document, and maintain a materials control and accounting detection program, independent of production. To meet the requirements of 10 CFR 74.33(c)(5) for establishing a detection program for unauthorized enrichment activities, the Licensee shall submit for review and approval 90 days prior to receipt of licensed material, a description of its detection program for unauthorized enrichment activities to include a detailed analysis of conceptual and credible diversion scenarios for unauthorized production of enriched uranium, and related management measures that provide high assurance of detecting unauthorized production of enriched uranium. NRC approval of the detection program, as required under 10 CFR 74.33(c)(5), is required prior to the Licensee's receipt of licensed material.*

This exemption is also discussed in Section 1.2.3.7.9 of this SER.

As required by 10 CFR 70.32(c)(1), the following license condition will also be imposed:

*The licensee shall maintain and follow the Fundamental Nuclear Material Control Plan for control and accounting and measurement control of uranium source material and special nuclear material at the facility pursuant to 10 CFR 74.33. The licensee shall make no change to material control procedures essential for the safeguarding of uranium source material or special nuclear material that would decrease the effectiveness of the material control and accounting program implemented pursuant to 10 CFR 74.33 without prior approval of the Commission. If the licensee desires to make changes that would decrease the effectiveness of its material control and accounting program or its measurement control program, the licensee shall submit an application for amendment to its license pursuant to 10 CFR 70.34.*

*The licensee shall maintain records of changes to the material control and accounting program made without prior Commission approval a period of five years from the date of the change. The licensee shall furnish to the Director, Office of Nuclear Material Safety and Safeguards, using an appropriate method listed in 10 CFR 70.5(a), a report containing a description of each change within six months of the change if it pertains to uranium enriched less than 20 percent in the uranium-235 isotope.*

### **12.3 REFERENCES**

(GLE, 2010) "Fundamental Nuclear Material Control Plan for GE-Hitachi Global Enrichment LLC Commercial Facility," Revision 2. 2010.



(NRC, 1991) U.S. Nuclear Regulatory Commission (NRC). NUREG/CR-5734. "Recommendations to the NRC on Acceptable Standard Format and Content for the Fundamental Nuclear Material Control Plan Required for Low-Enriched Uranium Enrichment," 1991.

(NRC, 1992) U.S. Nuclear Regulatory Commission (NRC). NUREG/BR-0096, "Instructions and Guidance for Completing Physical Inventory Summary Reports (NRC Form 327)," 1992.

(NRC, 1993) U.S. Nuclear Regulatory Commission (NRC). Regulatory Guide 5.67, "Material Control and Accounting Requirements for Uranium Enrichment Facilities Authorized to Produce Special Nuclear Material of Low Strategic Significance," 1993.

(NRC, 2009a) U.S. Nuclear Regulatory Commission (NRC). NUREG/BR-0006, "Instructions for Completing Nuclear Material Transaction Reports (DOE/NRC Forms 741 and 740M)," Revision 7, 2009.

(NRC, 2009b) U.S. Nuclear Regulatory Commission (NRC). NUREG/BR-0007, "Instructions for the Preparation and Distribution of Material Status Reports (DOE/NRC Forms 742 and 742C)," Revision 6, 2009.



## **13.0 PHYSICAL SECURITY**

### **13.1 INTRODUCTION**

The purpose of this review is to verify that the applicant, General Electric-Hitachi Global Laser Enrichment LLC (GLE), provided sufficient information in its “Physical Security Plan (PSP) for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility” (PSP) (GLE, 2010a) to conclude, with reasonable assurance, that there is an adequate physical protection plan for special nuclear material (SNM) of low strategic significance and classified matter at the proposed laser-based uranium enrichment facility to be located in Wilmington, North Carolina. The Nuclear Regulatory Commission staff’s review of the PSP contains Proprietary, Security-Related, and Export Control Information and is addressed in the non-public version of this Safety Evaluation Report.

The protection of classified matter is described in the “Standard Practice Procedures Plan for the Protection of Classified Matter for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility” (GLE, 2010b). Evaluation of this plan is discussed in Section 1.2.3.7 of this Safety Evaluation Report.

### **13.2 EVALUATION FINDINGS**

NRC staff reviewed the applicant’s PSP (GLE, 2010a) for fixed site physical protection of SNM of low strategic significance. The methods and procedures outlined in the PSP (GLE, 2010a) satisfy the performance objectives, systems capabilities, and reporting requirements specified in 10 CFR 73.67 and 73.71. The PSP (GLE, 2010a) for the facility is acceptable and provides reasonable assurance that the requirements for the physical protection of SNM of low strategic significance will be met.

### **13.3 REFERENCES**

(GLE, 2010a) General Electric-Hitachi Global Laser Enrichment LLC (GLE). “Physical Security Plan (PSP) for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility,” Revision 1, 2010.

(GLE, 2010b) General Electric-Hitachi Global Laser Enrichment LLC (GLE). “Standard Practice Procedures Plan for the Protection of Classified Matter for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility,” Revision 2, 2010.



## **14.0 PHYSICAL SECURITY OF THE TRANSPORTATION OF SPECIAL NUCLEAR MATERIAL OF LOW STRATEGIC SIGNIFICANCE**

### **14.1 INTRODUCTION**

The purpose of this review is to verify that the applicant, General Electric-Hitachi Global Laser Enrichment LLC (GLE), provided sufficient information in its “Nuclear Material Transportation Security Plan (NMTSP) for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility” (TSP) (GLE, 2010) to conclude, with reasonable assurance, that there is an adequate physical protection plan for the transportation of special nuclear material of low strategic significance (SNM-LSS) to, or from, the applicant’s proposed uranium enrichment facility, to be located in Wilmington, North Carolina. The Nuclear Regulatory Commission staff’s review of the TSP contains Proprietary and Security-Related Information and is addressed in the non-public version of this Safety Evaluation Report.

### **14.2 EVALUATION FINDINGS**

U.S. Nuclear Regulatory Commission staff reviewed the applicant’s TSP (GLE, 2010) for SNM-LSS shipments originating from, or arriving at, the facility. The approaches and procedures outlined in the TSP (GLE, 2010) satisfy the performance objectives, systems capabilities, and event and advance notification requirements specified in 10 CFR 73.67(a), 73.67(f)(g)(1)-(5), 73.71, 73.73, and 73.74. The TSP (GLE, 2010) for the facility is acceptable and provides reasonable assurance that the requirements for the in-transit physical protection of SNM-LSS will be met.

### **14.3 REFERENCES**

(GLE, 2010) General Electric-Hitachi Global Laser Enrichment LLC (GLE). “Nuclear Material Transportation Security Plan (NMTSP) for the GE-Hitachi Global Laser Enrichment LLC Commercial Facility,” Revision 1, 2010.



## **15.0 HUMAN FACTORS ENGINEERING**

### **15.1 INTRODUCTION**

This chapter describes the human factors engineering (HFE) review of the General Electric-Hitachi Global Laser Enrichment LLC (GLE or applicant) License Application (LA) (GLE, 2011a) for a proposed laser-based uranium enrichment facility. The purpose of this review is to determine whether the applicant has identified and committed to incorporate appropriate HFE guidance and practices into their safety program. Specifically, this review addresses the standards, guidance, and practices that specify the design and implementation of the human-system interfaces (HSIs) (e.g., alarms, displays, and controls) for Items Relied On For Safety (IROFS) that require operator actions at the proposed facility. The Nuclear Regulatory Commission staff's review of the HFE program contains Proprietary Information and is documented in the non-public version of this Safety Evaluation Report.

### **15.2 EVALUATION FINDINGS**

The staff reviewed the applicant's LA (GLE, 2011a), the HFE Plan (GLE, 2011b), Integrated Safety Analysis Summary (GLE, 2011c), the Quality Assurance Program Description (GLE, 2011d), and the application of HFE to personnel activities for the proposed facility.

The LA (GLE, 2011a) and the HFE Plan (GLE, 2011b) provide acceptable objectives/purposes, expected results, and plans for documentation. The staff concludes that the applicant has committed to incorporate into its safety program accepted HFE guidance and practices to design and implement those HSIs that support IROFS requiring operator actions. The guidance and practices, when implemented properly, should result in HSIs that will perform their intended function and meet the requirements of 10 CFR Part 70.

Since the HFE program is not complete, follow-up review activities will be needed as part of the inspection program conducted under 10 CFR 40.41(g) and 70.32(k) to ensure that the applicant's commitments to HFE provided by the documents reviewed and found acceptable in this SER Section have been successfully completed.

### **15.3 REFERENCES**

(GLE, 2011a) General Electric-Hitachi Global Laser Enrichment (GLE). "GE-Hitachi Global Laser Enrichment LLC Commercial Facility License Application," Revision 6. 2011.

(GLE, 2011b) General Electric-Hitachi Global Laser Enrichment (GLE). "Human Factors Engineering Program Plan," NEDE-33539P, Revision 1. 2011.

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## **16.0 ELECTRICAL POWER AND INSTRUMENTATION AND CONTROL SYSTEMS**

### **16.1 INTRODUCTION**

This chapter of the Safety Evaluation Report (SER) contains a summary of the U.S. Nuclear Regulatory Commission (NRC) staff's review and evaluation of the electrical power and instrumentation and control (I&C) systems for the proposed General Electric-Hitachi Global Laser Enrichment LLC (GLE or applicant) uranium enrichment facility. The objective of this review was to verify whether the aspects of the design of the electrical and I&C systems will meet the regulatory requirements specified in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 70, Subpart H, "Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material." To conduct this review, the NRC staff evaluated the adequacy of the proposed conceptual design and intended operations of these systems as reflected in the applicant's commitments and goals with respect to that design. Staff evaluated the applicant's commitments for completing the design of the electrical and I&C systems in a manner that addresses specific regulatory requirements and acceptance criteria applicable to electrical and I&C systems. The applicant's proposed electrical power and I&C system designs are described within the applicant's License Application (LA) (GLE, 2011a) and the Integrated Safety Analysis (ISA) Summary (GLE, 2011b). The NRC staff's review of the electrical and I&C systems contains Proprietary, Security-Related, and Export Control Information and is documented in the non-public version of this SER.

### **16.2 EVALUATION FINDINGS**

The NRC staff concludes that the applicant's commitments to electrical and I&C design and management measures will be adequate to provide reasonable assurance that Items Relied on for Safety (IROFS) will be available and reliable to perform their intended safety function(s) when needed and in the context of the performance requirements of 10 CFR 70.61. In addition, the NRC staff concludes that the applicant's proposed designs for the electrical and I&C systems meet the applicable Baseline Design Criteria in 10 CFR 70.64(a) and the defense-in-depth criteria in 10 CFR 70.64(b).

The applicant has not proposed the use of IROFS that use software, firmware, microcode, Programmable Logic Controllers, or any digital device, including hardware devices which implement data communication protocols. However, in the future, if the applicant uses such components, prior NRC approval will be necessary. The NRC staff is, therefore, imposing the following license condition:

*Currently, there are no IROFS that have been specified as using software, firmware, microcode, programmable logic controllers, or any digital device, including hardware devices which implement data communication protocols (such as fieldbus devices and Local Area Network controllers), etc. Should the design of any IROFS be changed to include any of the preceding features, the licensee shall obtain Commission approval*

*prior to implementing the change(s). The licensee's design change(s) shall comply with accepted best practices in software and hardware engineering, including software quality assurance controls as discussed in the Quality Assurance Program Description throughout the development process and the applicable guidance of the following industry standards and regulatory guides:*

- *American Society of Mechanical Engineers (ASME) NQA-1-1994 Edition, "Quality Assurance Requirements for Nuclear Facility Applications," Part II, Subpart 2.7, "Quality Assurance Requirements of Computer Software for Nuclear Facility Applications," as revised by the NQA-1a-1995 Addenda of ASME NQA-1-1994 Edition, Part 1, Supplement 11S-2, "Supplementary Requirements for Computer Program Testing;"*
- *Electric Power Research Institute (EPRI) NP-5652, "Guideline for the Utilization of Commercial Grade Items In Nuclear Safety Grade Applications," June 1988;*
- *EPRI Topical Report (TR)-102323, "Guidelines for Electromagnetic Interference Testing in Power Plants," Revision 1, December 1996;*
- *EPRI TR-106439, "Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications," October 1996;*
- *Regulatory Guide 1.152, "Criteria for Digital Computers in Safety Systems in Nuclear Power Plants," Revision 3, July 2011*
- *Regulatory Guide 1.168, Revision 1, "Verification, Validation, Reviews, and Audits for Digital Software Used in Safety Systems of Nuclear Power Plants," October, 2004;*
- *Regulatory Guide 1.169, "Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," September 1997;*
- *Regulatory Guide 1.170, "Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," September 1997;*
- *Regulatory Guide 1.172, "Software Requirements Specifications for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," September 1997; and*
- *Regulatory Guide 1.173, "Developing Software Life Cycle Processes for Digital Computer Software Used in Safety Systems for Nuclear Power Plants," September 1997.*

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## 17.0 SAFETY EVALUATION REPORT PREPARERS

The individuals and organizations listed below are the principal contributors to the preparation of this Safety Evaluation Report. The U.S. Nuclear Regulatory Commission's (NRC's) staff directed the effort and contributed to the technical evaluations. The staff also used contractor support from Brookhaven National Laboratory, the Center for Nuclear Waste Regulatory Analyses, and ICF Consulting in the preparation of this document.

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## **APPENDIX - ACCIDENT ANALYSIS**

### **A.1 INTRODUCTION**

The U.S. Nuclear Regulatory Commission (NRC) staff's analysis of the approach, assumptions, data, and results for the potential impacts on individual workers and members of the public resulting from routine or normal operations and accidents from the proposed General Electric-Hitachi Global Laser Enrichment LLC (GLE or the applicant) uranium enrichment facility, including a description of how radioactive material, such as uranium, results in radiation doses and a comparison of these doses to applicable standards, contains Proprietary, Security-Related, and Export Control Information and is presented in the non-public version of this Safety Evaluation Report.

### **A.2 ACCIDENT ANALYSIS SUMMARY**

Staff selected and evaluated a representative subset of the potential accidents that could occur at the proposed facility. The accident consequences vary in magnitude, and include accidents initiated by operator error and equipment failure. Analytical results indicate that accidents at the facility pose acceptably low risks. The facility design reduces the risk (likelihood) of these events. In each accident sequence evaluated, the applicant has applied IROFS that present a proven historical record. The NRC staff concludes that through the combination of plant design, passive and active engineered IROFS, and administrative controls, accidents at the facility pose an acceptably low risk to workers, the environment, and the public.



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11. ABSTRACT (200 words or less)

The report documents the U.S. Nuclear Regulatory Commission (NRC) staff review and safety and safeguards evaluation of the General Electric-Hitachi Global Laser Enrichment LLC (the applicant) application for a license to construct a laser-based uranium enrichment facility and possess and use special nuclear material (SNM), source material, and byproduct material in a laser-based uranium enrichment facility. The applicant proposes that the laser-based uranium enrichment facility be located in Wilmington, North Carolina, at the site of General Electric-Hitachi Global Nuclear Fuel – Americas nuclear fuel fabrication site. The facility will possess natural, depleted, and enriched uranium, and will enrich uranium up to a maximum of 8 weight percent uranium-235.

The objective of this review is to evaluate the potential adverse impacts of operation of the facility on worker and public health and safety under both normal operating and accident conditions. The review also considers physical protection of SNM and classified matter, material control and accounting of SNM, and the management organization, administrative programs, and financial qualifications provided to ensure safe design and operation of the facility.

In this safety evaluation report, the NRC staff concludes that the applicant's descriptions, specifications, and analyses provide an adequate basis for safety and safeguards of facility operations and that operation of the facility does not pose an undue risk to worker and public health and safety.

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