HITACHI

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MFN-10-185
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Attn: Document Control Desk
Brian Smith, Chief
Uranium Enrichment Branch
Fuel Facility Licensing Directorate
Division of Fuel Cycle Safety & Safeguards
Office of Nuclear Materials Safety & Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Subject: **REVISION 2 TO GLOBAL LASER ENRICHMENT LICENSE APPLICATION – PUBLIC VERSION**

Dear Mr. Smith:

GE-Hitachi Global Laser Enrichment LLC (GLE) hereby submits revision 2 of the GLE License Application. Enclosure 1 contains revised Request for Additional Information responses. Enclosure 2 contains revised chapters 1, 2, 3, 5, 7, and 11 of the GLE License Application. Enclosure 3 contains the revised pubic version of the Decommissioning Funding Plan. Non-Public versions of the revised License Application and the Decommissioning Funding Plan have been prepared and will be submitted under separate enclosure.

If there are any questions regarding this letter and its contents, please do not hesitate to contact me at 910-819-4799 or at Julie.Olivier@ge.com.

Sincerely,

Julie A. Olivier

Julie Olivier
GLE Licensing Manager

NMSS01

Enclosures:
1. 5 copies of RAI revised responses, public version
2. 5 copies of Revision 2 to chapters 1, 2, 3, 5, 7, and 11 of the GLE License Application
3. 5 copies of Decommissioning Funding Plan, Revision 1

Cc (without enclosures):
Tim Johnson (NRC)
Tammy Orr (GLE)
Lori Butler (GEH)
Jerry Head (GEH)
Patricia Campbell (GEH)
Bob Crate (GLE)
Ken Givens (GLE)
Tom Owens (GLE)
Lon Paulson (GEH)

Enclosure 1
Revised Request for Additional Information Responses
Public Responses (MFN-010-185)

GI-7 Section 1.1.4.2 and Section 1.1.6

State where and for what liquid waste streams analyses will be made to ensure that liquid effluents meet the release requirements in 10 CFR Part 20 and National Pollution Discharge Elimination System (NPDES) release requirements. State if the effluents from the Radioactive Liquid Effluent Treatment System are monitored to demonstrate compliance with 10 CFR Part 20 liquid effluent release limits before releasing them to the Final Process Lagoon Treatment Facility. State what monitoring will be performed on gaseous effluents to meet 10 CFR Part 20 and the U.S. Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants (NESHAPS) airborne release limits.

Sections 1.1.4.2 and 1.1.6 provide brief discussions of liquid and gaseous waste streams that will be generated at the facility, but do not mention how and where it will be demonstrated that the release limits in 10 CFR Part 20, NPDES, and NESHAPS standards will be met.

Regulations in 10 CFR 70.22(a)(7) and (8) require the applicant to describe the equipment, facilities, and procedures that will be used to protect health and minimize danger to life and property.

GLE Response

During a phone call on April 6, 2010, the NRC asked for clarification on the point of measurement for air effluents. The air effluents will be measured at the stack.

License Documentation Impact

Section 1.1.6.2 was revised as follows:

1.1.6.2 Air Effluents

The laser-based enrichment process is a closed process with no vents needed for routine venting of process gases. Some short-term gaseous releases occur inside the Operations Building during activities associated with operations such as the connection/ disconnection of UF_6 cylinders to process equipment and process equipment maintenance activities. These gaseous releases are routed through the building's ventilation system. The ventilation system air stream passes through a series of emissions-control devices consisting of high-efficiency particulate air (HEPA) filters and high-efficiency gas absorption (HEGA) filters. The exhaust air stream from these emission controls is vented to the atmosphere and monitored at the stack for uranium and fluoride. Table 1-5, *Typical GLE Air Emissions*, shows the typical air effluent concentrations from the Operations Building and the required regulatory limits. GLE will comply with the requirements in 10 CFR Part 20 Appendix B for uranium air effluents, and with the requirements specified in the North Carolina Department of Air Quality permit for monitoring of fluorides (as well as other operational controls/conditions specified in the permit)."

GI-10 Section 1.2.2.1

Provide more detail describing the construction phases to include identifying the facilities and equipment that will be needed for each specific, planned construction phase. In the Integrated Safety Analysis (ISA) Summary, include any accident sequences that may be created because of ongoing construction activities that take place concurrently with operations.

The licensing basis documents, as currently written, describe a facility assuming that full operation will begin at the completion of construction. The licensing basis documents need to specifically define the facilities and equipment, applicable to the individual construction phases, so that the U.S. Nuclear Regulatory Commission (NRC) can verify that construction has been performed in accordance with the license.

Under 10 CFR 40.41(g) and 70.32(k), NRC must conduct a construction inspection before operations can begin to ensure that the facility has been constructed in accordance with the license.

The regulations in 10 CFR 70.65(b)(4) require the ISA Summary to contain information that demonstrate compliance with the requirements in 10 CFR 70.61 and 70.64.

GLE Response

During a phone call on April 6, 2010, the NRC staff requested further details on the response to this RAI, specifically additional information that the defines the facility and equipment at each proposed phase of operation so that the construction inspections required under 10 CFR 40.41(g) and 10CFR 70.32(k) can be conducted. In addition, any new accident sequences applicable to concurrent operations and construction need to be identified and addressed. The revised response is shown below.

The phases of construction/initial operations include Early Construction, Phase 1 Construction (Initial Construction of 1 MSWU facility), Phase 2 Construction (Construction and Component Installation to Ramp up to 6 MSWU), and Full Operations at 6 MSWU. The facility described in the License Application assumes that the facility is operating at 6MSWU. In reality , the facility will be operating at approximately 1 MSWU during year 1, 2 MSWU during year 2, 3 MSWU during year 3, 4 MSWU during year 4, 5 MSWU during year 5, and 6 MSWU during year 6 and every year thereafter. The initial construction plan includes building the Operations Building in its entirety, and equipping it with the necessary equipment to generate 1 MSWU. During year one, while the facility is operating at 1 MSWU, equipment/component installation will be occurring simultaneously. Similarly, for years 2, 3, 4, and 5, operations and equipment/component installation will occur simultaneously.

During Early Construction (prior to receipt of an NRC license), the following activities will occur:

- Clearing of 100 acres for the GLE Facility,
- Site grading and erosion control,
- Installation of storm water retention system,
- Construction of main access roadways,

- Placement of Utilities (electricity, potable water, process water, water for fire suppression, sanitary sewer, natural gas), and
- Construction of parking lots and minor roadways.

{{{Proprietary Information removed – Withhold from Public Disclosure per 10 CFR 2.390}}}

During full operations at 6MSWU, there is not anticipated to be further facility construction or component installation, with the exception of maintenance and repair activities. Any unanticipated construction/component installation will be evaluated per the 10 CFR 70.72 process to determine if an amendment to the license is required prior to initiating the activities.

The accident analysis that was prepared for the License Application was intended to be conservative by assuming a 6 MSWU plant. However that analysis did not include potential accidents from ongoing construction and/or component installation activities that take place concurrently with operations because detailed design, operation, and schedule information is necessary to perform that analysis. GLE commits revising the ISA Summary to include any accident sequences that may be created because of ongoing construction activities that take place concurrently with operations. This revised ISA Summary will be submitted to the NRC 6 months prior to receipt of SNM in order for the NRC to review the analyses. GLE expects the NRC to impose a License Condition to document this commitment. It is worth noting that the current accident analyses did include general industrial safety accidents causing releases of SNM, therefore, GLE does not believe that the accident analyses to be performed will differ greatly from what is currently presented.

Licensing Documentation Impact

GLE will revise Section 1.1.3.1 to include the following:

The phases of construction/initial operations include Early Construction, Phase 1 Construction (Initial Construction of 1 MSWU facility), Phase 2 Construction (Construction and Component Installation to Ramp up to 6 MSWU), and Full Operations at 6 MSWU. The facility described in the License Application assumes that the facility is operating at 6MSWU. In reality, the facility will be operating at approximately 1 MSWU during year 1, 2 MSWU during year 2, 3 MSWU during year 3, 4 MSWU during year 4, 5 MSWU during year 5, and 6 MSWU during year 6 and every year thereafter. The initial construction plan includes building the Operations Building in its entirety, and equipping it with the necessary equipment to generate 1 MSWU. During year one, while the facility is operating at 1 MSWU, equipment/component installation will be occurring simultaneously. Similarly, for years 2, 3, 4, and 5, operations and equipment/component installation will occur simultaneously.

During Early Construction (prior to receipt of an NRC license), the following activities will occur:

- Clearing of 100 acres for the GLE Facility,
- Site grading and erosion control,
- Installation of storm water retention system,

- Construction of main access roadways,
- Placement of Utilities (electricity, potable water, process water, water for fire suppression, sanitary sewer, natural gas), and
- Construction of parking lots and minor roadways.

{{{Proprietary Information removed – Withhold from Public Disclosure per 10 CFR 2.390}}}.

During full operations at 6MSWU, there is not anticipated to be further facility construction or component installation, with the exception of maintenance and repair activities. Any unanticipated construction/component installation will be evaluated per the 10 CFR 70.72 process to determine if an amendment to the license is required prior to initiating the activities.

GI-12 Section 1.2.2.4

American Nuclear Insurers (ANI) currently provides $200 million in coverage for the GE fuel fabrication facility. We understand that this insurance policy of $200 million is all inclusive and covers the entire GE site encompassing both the fuel fabrication facility and the proposed uranium enrichment facility, which are on the same site. The existing GE fuel fabrication facility insurance is sufficient to fulfill NRC regulations. Provide written confirmation of the existing ANI issued insurance policy and its applicability to the proposed uranium enrichment facility for the staff to complete its review.

Section 1.2.2.4 states that nuclear liability insurance will take effect upon the receipt at the GEH facility of source material or SNM. Until such time, GEH will rely on the liability coverage of its parent companies assuming this liability is not to exceed $1 million during the construction period. Self-insurance of standard liability is a standing policy for the three parent organizations, and give the limited materiality ($1M), GEH will utilize the parent organization as back-stops if necessary in lieu of a specific insurance policy.

The regulations in 10 CFR 140.13(b) state that each holder of a license issued under Parts 40 or 70 of this chapter for a uranium enrichment facility that involves the use of source material or special nuclear material is required to have and maintain liability insurance. The liability insurance must be the type and in the amounts the Commission considers appropriate to cover liability claims arising out of any occurrence within the United States (US) that causes, within or outside the US, bodily injury, sickness, disease, death, loss of or damage to property, or loss of use of property arising out of or resulting from the radioactive, toxic, explosive, or other hazardous properties of chemical compounds containing source material or special nuclear material. Proof of liability insurance must be filed with the Commission as required by 10 CFR 140.15 before issuance of a license for a uranium enrichment facility under parts 40 and 70 of this chapter.

GLE Response

During a phone call held on April 6, 2010, the NRC stated that the original response to this RAI was not adequate, and that GLE needs to provide proof of liability insurance, with the GLE Commercial Facility explicitly listed in the insurance policy, prior to the issuance of a license, as required under 10 CFR 140.13(b).

The current site policy for $2 million is all-inclusive and covers the entire GE site encompassing both the fuel fabrication facility and the proposed GLE facility. Determinations by ANI conclude that $2 million continues to be adequate coverage for the site, even once GLE is operating. Written confirmation of this policy coverage will be provided to the NRC as soon as possible, and no later than October 15, 2010. GLE is currently working with ANI to ensure that the facility definition in the policy clearly includes GLE.

License Documentation Impact

Section 1.2.2.4 of the license application was revised to reflect that the policy provides coverage up to $2 million.

GI-15 Section 1.3.1.2; Integrated Safety Analysis Summary Sections 2.1.2 and 2.5.2

Provide the flood-level estimate corresponding to a flood hazard with an annual probability of 10^{-4} for the facility site. Either show that the facility is designed to withstand a flood with an annual probability equal to or smaller than 10^{-4}, or show that the consequences of the flood-induced accident sequence satisfy requirements in 10 CFR 70.61(c).

The applicant excluded flooding as a potential external hazard from further consideration for facility design and from the integrated safety analysis (ISA) for the proposed facility because the proposed facility will be located above the 100- and 500-year flood plains for the region. ISA Summary Table 4.16-1 indicates that natural phenomena causing facility flooding may have intermediate consequences. Consequently, the applicant should either demonstrate that the flood-induced accident event is unlikely (the applicant defines "unlikely" as an event with an annual probability between 1.0×10^{-4} and 1.0×10^{-5}) or that the consequences are within the limits stipulated in 10 CFR 70.61(c). Using the basis that the proposed facility is above the 500-year flood plain alone is not sufficient to exclude the potential flood hazard, because the 500-year flood is a likely, not an unlikely, event based on the applicant's definition.

The regulations in 10 CFR 70.64(a)(2) require the applicant to include adequate protection against natural phenomena in its design of the facility, and 10 CFR 70.62(c)(iv) requires the applicant to conduct and maintain an integrated safety analysis (ISA) that identifies potential accident sequences caused by credible external events. In addition, 10 CFR 70.61(c) requires the applicant to demonstrate an intermediate consequence accident event is either unlikely or its consequences are within acceptable limits.

GLE Response

The natural phenomena information in the License Application and Chapter 2 of the ISA Summary have been revised. For selected NPHs [Natural Phenomena Hazards], deterministically defined events, as opposed to probabilistically identified events have been determined. The deterministically defined events, developed consistent with guidance for nuclear power plants, are being applied to the proposed facility as "highly unlikely" events per the allowances of Interim Staff Guidance-8, *Natural Phenomenona Hazards.*

The approach taken is to define the deterministically "Highly Unlikely" applicable natural phenomena events and consider their potential influence on the facility structures, systems, and components (SSCs). The guidance for nuclear power plants is used to define the deterministically "Highly Unlikely" natural phenomena events.

The deterministically defined Design Basis Floods (DBF) may occur from various types of events. These include rainfall in the Northeast Cape Fear River and the Cape Fear River watersheds (known as the Probable Maximum Flood, [PMF]), local severe site rainfall (known as the Probable Maximum Precipitation [PMP], a component of the PMF), seismically induced upstream dam failures, hurricane surges (known as the Probable Maximum Hurricane Surge [PMHS]), tsunamis (PMT), and seiches (PMS). The DBFs from these events are determined based on the guidance in the Nuclear Regulatory

Commission (NRC) Regulatory Guide 1.59, *Design Basis Floods for Nuclear Power Plants*.

<u>PMF</u>

The topography of the Wilmington Site and the general area is level terrain; therefore, water accumulation (flooding) is expected to be a slow event providing ample warning to Operations personnel. GLE CF processes would be safely shut down prior to any potential threat of flooding. In addition, there are no dams on the Northeast Cape Fear River, but there are several dams upstream on the Cape Fear River. The closest dams and locks on the Cape Fear River are approximately 30, 50, and 70 miles upstream of where the Northeast Cape Fear River comes into the Cape Fear River. Seismic induced failures of these dams and locks could cause flooding at the GLE site due to the general area being an estuary and in general about the same elevation. The lower Cape Fear River estuary has a tidal reach extending all the way up to the first dam and lock. Due to the level terrain the flood potential due to upstream dam and lock failures (e.g., due to seismic activity) would not likely result in a higher level of flooding than the design basis event form probable maximum flood from rainfall on the watershed.

The nearest river to the GLE site is the Northeast Cape Fear River. The Northeast Cape Fear River watershed covers 1750 square miles. Six miles south of the site, the Northeast Cape Fear River joins the Cape Fear River. The Cape Fear River has a watershed of 9149 square miles. The PMF at the site is based on evaluating flooding on the Northeast Cape Fear River and also by evaluating flooding on the Cape Fear River. Flooding on the Cape Fear River has the potential for causing flooding on the Northeast Cape River since the site is only six miles from where the two rivers join together.

The NRC Regulatory Guide 1.59 references ANSI/ANS-2.8, *Determining Design Basis Flooding at Power Reactor Site* for methods to estimate the still water level for the PMF discharges. ANSI/ANS-2.8 provides an approximation method for determining the PMF still water level from the discharge flows. The method is based on estimating the river stage using Manning's equation, average river channel bottom slope, river cross sectional areas, wetted perimeter, Manning' friction factor, and conservative friction factors.

The cross section of the Northeast Cape River is variable at the GLE site. The GLE facility is to be located at about an elevation of 25 feet above mean sea level, which is in generally about the highest elevation east of the Northeast Cape Fear River all the way over to the coast. Several varying cross sections have been used to calculate the discharge capacities of the river based on topographic maps of the area. These cross sections vary from 1 to 2 miles wide with depths up to 20 feet. The channel slope is based on the site being about 20 miles upriver from the coast and assuming elevations of the river bottom from 3 to 6 feet. The Manning's friction value is varied from 0.035 to 0.70, which is based on floodplain values.

Using these ranges of values, the discharge capacities of the Northeast Cape Fear River vary from about 90,000 to 510,000 cps. The PMF discharge is 310,000 cps. Based on this, it is likely that the GLE site will be flooded by the

PMF. As stated above, the GLE facility will be located at about an elevation of 25 feet, which is in general about the highest elevation east of the river. The elevations west of the river are also at about 25 feet for some distance, but they do begin to get higher further to the west. Based on this, it is evident that once the PMF level reaches about elevation 25, the cross section of the river becomes much larger, so that the level will likely not get above elevation 25. The cross sections of the river above elevation 25 have a large degree of variability, so it is difficult to determine the discharge when the water level reaches 25 feet. Therefore for PMF design purposes, the PMF level from the Northeast Cape Fear River is conservatively established as about elevation 28 (3 feet above the GLE facility base slab), which would also consider possible coincident wind wave action as required by the NRC Regulatory Guide.

The PMF discharge from the Cape Fear River is about two times the discharge from the Northeast Cape River, so it has the potential to also flood the site. Again, above elevation 25, the cross sections of the river get very large. The widths of the river cross sections are greater than ten miles once you get above 25 feet. Consideration of this also shows that PMF levels from the Cape Fear River will likely not get above elevation 25. But again, the PMF level from the Cape Fear River is conservatively established as about elevation 28 (3 feet above the GLE facility base slab), which would also consider possible coincident wind wave action as required by the NRC Regulatory Guide.

As shown above, the DBE from the PMF could result in about 3 feet of flooding in the facility structures. This flooding will not impact the design of the structures, but could impact the design of systems and components within the facility. Therefore the design of the systems and components within the facility have been evaluated for the flooding to ensure any accidents that could result from this flooding are "Highly Unlikely", and will not cause any accident scenarios resulting in consequences exceeding the performance criteria in 10 CFR 70.61.

<u>PMT & PMS</u>

The PMT is determined using a deterministic approach that incorporates ideas of transposition and maximization, similar to the methods adopted by the National Oceanic and Atmospheric Administration (NOAA) National Weather Service Hydrometeorological Reports for estimation of Probable Maximum Precipitation. NUREG/CR-6966, *Tsunami Hazard Assessment at Nuclear Power Plant Sites in the United States of America*, provides guidance on determining the design basis event from a tsunami. Information provided in the NUREG links to NOAA historical tsunami data for the area where the GLE site is located. The indication is that the GLE site is not susceptible to flooding from a tsunami.

FEMA defines the geographic threshold for concern for tsunami as 1 mile (1.6 km) inland from the coast and less than 25 ft. (8 m) above mean sea level. The Atlantic Ocean lies approximately 10 miles east and 26 miles south of GLE CF. The surrounding terrain is low-lying; however, GLE CF foundations are designed to be at least 25 feet above mean sea level. According to National Geophysical Data Center historical tsunami database, the maximum horizontal extent of inundation is listed as 3.4 miles (5.5 km) for the December 26, 2004, Indian Ocean tsunami on the Island of Sumatra, Indonesia. Therefore, there is no threat to the GLE Site from the direct effects of a potential tsunami. There are no inland water bodies with the potential to affect the GLE Site from a tsunami.

Tidal bores are similar to traveling hydraulic jumps that move upstream from the mouth of the river. Tidal bores are generally caused by a rapid and large change in the downstream water-surface elevation. Tidal bores can be induced by a tsunami, and were observed in Hawaii in 1946; in Japan in 1983 and 2003; and in Thailand, Malaysia, and Sri Lanka in 2004. Tidal bores propagating upstream from the mouth of a river may be caused by tsunamis under favorable hydraulic conditions and can travel upstream several tens of miles from the estuary. The downstream part of the bore is characterized by subcritical flow with greater depth of flow, and the upstream part is supercritical. The river should be able to support supercritical flow to form the bore. The effect of a tidal bore propagating upstream to a GLE Site is similar to a flood wave propagating downstream. This may result in localized flooding, depending on the height of the bore, but would not affect the GLE Site due to the Site's higher elevation. In addition, bores dissipate as they travel upstream. The Site is a sufficient distance from the estuary (over 20 miles) and the bore has a very low probability of flooding the GLE Site. Siting and protection criteria for tidal bore are similar to those for other flooding mechanisms.

Not only will the tidal bore not flood the GLE Site because the Site is a sufficient distance from the estuary; but moreover, the Site is protected from flooding effects because its level is above 25 feet mean sea level. Using the NUREG/CR-6966 as guidance, the GLE Site may be characterized as "Inland." To generate a major tsunami, a substantial amount of slip and a large rupture area are required. Consequently, only a larger earthquake with a magnitude greater than 6.5 generates observable tsunamis. The GLE structures, systems, and components (SSCs) important to safety are located at an elevation above the maximum wave run-up due to PMT.

Similar to tsunamis, seiches (an enclosed body of water tsunami like occurrence) are considered. There are no large bodies of water, such as lakes or inland seas, in proximity of the GLE site where the body of water is partially constrained. The terrain is very low-lying and would not provide constrain to generate any significant seiches, even if the low-lying area was flooded.

Because the site is about 25 ft above mean sea level and more than 10 miles inland from the Atlantic Ocean, the GLE Site is not subject to tsunamis. Because the site is not in proximity to any enclosed bodies of water, the GLE Site is not subject to seiches. Therefore, it has been deterministically defined that it is "Highly Unlikely" that a tsunami (PMT) and/or a seiches (PMS) would affect the GLE CF in such a way as to cause an accident scenario resulting in consequences exceeding the performance criteria in 10 CFR 70.61.

<u>PMHS</u>

The storm surge potential from hurricanes (PMHS) is estimated and presented in Regulatory Guide 1.59, Design Basis Floods for Nuclear Power Plants. Appendix C of the regulatory guide indicated that the aggregate storm surge (developed from the wind potential, storm pressure, initial rise, and high tide contributor) could be as much as 21.94 ft. This value is bounded by other water level events (e.g., tsunami). Thus, due to the site selection for the proposed facility being at an elevation of 25 ft above mean sea level the deterministically defined storm surge from a hurricane (PMHS) is not expected to result in a consequential impact on the proposed facility.

PMP

The DBF resulting from local severe site rainfall (PMP) at the site is determined following the guidelines in the National Oceanic and Atmospheric Administration (NOAA) Hydrometeorological Report No. 51, *Probable Maximum Precipitation Estimates, United States East of the 105th Meridian* and Report No. 52, *Application of Probable Maximum Precipitation Estimates - United States East of the 105th Meridian*. These reports are referenced in the NRC Regulatory Guide 1.59 for use in determining the PMP estimates at sites.

Based on these reports, the PMP estimates for the site are shown below:

Northeast Cape Fear River Basin	Cape Fear River Basin
1 hour duration – 5 inches	2 inches
6 hour duration – 14 inches	7.5 inches
12 hour duration – 19.5 inches	11.5 inches
24 hour duration – 26 inches	16 inches
48 hour duration – 30 inches	21 inches
72 hour duration – 32.5 inches	23.5 inches

The specific application refinements of Report No. 52 to the site were not applied, since the topography of the site is such that the PMP does not pose any flooding hazards. The GLE facility is located at an elevation of 25 feet above mean sea level and drains in all directions to lower elevations as shown in Figure 3.4-10 in the GLE Environmental Report. The roofs of the facility structures will not have parapets, and therefore there is no potential for ponding on the roofs from the PMP. Based on this, a severe local storm PMP will not flood the GLE facility site, nor impact the design of the structures.

Conclusions

Based on the above, the DBF is controlled by river flooding (PMF) which could result in about 3 feet of flooding in the facility structures. This flooding will not impact the design of the structures, but could impact the design of systems and components within the facility. Therefore the design of the systems and components within the facility have been evaluated for the flooding to ensure any accidents that could result from this flooding are "Highly Unlikely", and will not cause any accident scenarios resulting in consequences exceeding the performance criteria in 10 CFR 70.61.

License Documentation Impact

GLE has revised the ISA Baseline documents to explicitly address the impact of a flooding event on the facility and provide a defensible severity consequence for Table 4.16-1 based on results from this analysis. Additionally, where applicable, the IROFS design attributes have been updated to recognize flooding as an input to design criteria.

This information was incorporated into revision 1 of the ISA Summary. GLE has revised Chapter 2 of the ISA Summary to reflect the deterministically defined DBF described in the above response.

GI-16 Section 1.3.3.3.2 and ISA Summary Section 2.5.7.1

Show that the facility is designed to withstand snow loads from snowfall events with an annual probability of 10^{-5} or smaller or show that the consequences of the snow-load-induced event satisfies 10 CFR 70.61(c).

ISA Summary Table 4.16-1 indicates that snow buildup on the facility roof may have high consequences. The applicant considered the snow-load-induced accident event by including a design basis ground snow load of 1.2 kiloPascals (kPa) (25 pounds per square foot (psf)) for the proposed facility. The applicant suggested that this design basis is sufficient to make the snow-load-induced accident event highly unlikely because the historical ground snow load (0.38 kPa (8 psf)) is substantially smaller than the design basis to be used for the facility design. However, the applicant does not show whether the historical ground snow load corresponds to the 1.0×10^{-5}/year ground snow load. Because the applicant did not characterize the ground snow load with an annual probability of 1.0×10^{-5}, the NRC staff cannot determine whether the design basis ground snow load the applicant proposed is sufficient to make the ground snow-loadinduced accident event highly unlikely.

The regulations in 10 CFR 70.64(a)(2) require the applicant to include adequate protection against natural phenomena in its design of the facility, and 10 CFR 70.62(c)(iv) requires the applicant to conduct and maintain an ISA that identifies potential accident sequences caused by credible external events. In addition, 10 CFR 70.61(b) requires the applicant to demonstrate a high consequence accident event is either highly unlikely or its consequences are within acceptable limits.

GLE Response

ASCE 7-05 provides a methodology for estimating mean recurrence periods for snowfalls beyond those normally considered in design. Using this methodology, the 1 X 10^{-5} snowfall is estimated to be about 17 to 25 psf. Based on this, the Design Basis Snow (DBS) is defined as 25 psf.

The roofs of the proposed facility are currently designed with a live load capacity of 30 psf. The roof design does not include any parapets so that there will be no drift snow loads over the majority of the roof. The exception to this is where the roof elevations change. Adjacent to locations where a lower roof abuts to walls for higher roof areas there is the potential for snow drifts to form. Following the guidelines in ASCE 7-05, the highest drift snow load is approximately 85 psf above the normal snow load, which exceeds the live load roof capacity. The additional drift snow load would be present for approximately 20 feet from the wall of the higher roof areas of the facility. For the roof decking in this area the snow drift load could cause the decking to first sag and eventually fail, allowing snow and water to enter the building. The main roof supports (e.g., steel girders and beams) are not expected to be overloaded because of the failure of the weaker roof decking, thus their failure is not postulated. Therefore, a complete roof failure due to 1X10^{-5} snow load is determined to be "Highly Unlikely."

Failure of the roof decking at the interface between roof elevation changes (over the Laser Area and service corridor) is included in the evaluation of the specific areas of the proposed facility. In general terms, the roof decking failures occur in areas where licensed material, or hazardous chemicals produced from licensed materials, are not present, thus their failure does not represent a high or intermediate consequence event. Thus, the impact of a severe snow event, including up to the DBS, is determined to be "Highly Unlikely" to result in consequences in excess of the performance criteria in 10 CFR 70.61.

License Documentation Impact

The License Application and Chapter 2 of the ISA Summary have been revised to reflect the above response to the RAI.

GI-17 Section 1.3.3.3.7 and ISA Summary Section 2.5.5

Assess the potential hazard of a Category 5 hurricane to the proposed facility.

Section 1.3.3.3.7 indicated that a Category 5 hurricane passing within approximately 138 kilometers (km) (86 miles (mi)) of New Hanover County is a likely event with a return period of 191 to 250 years. Consequently, the likelihood of a Category 5 hurricane causing facility damage, and if necessary, the potential consequences, should be assessed and documented in the ISA Summary.

The regulations in 10 CFR 70.64(a)(2) require the applicant to include adequate protection against natural phenomena in its design of the facility, and 10 CFR 70.62(c)(iv) requires the applicant to conduct and maintain an ISA that identifies potential accident sequences caused by credible external events. In addition, 10 CFR 70.61(b) requires the applicant to demonstrate a high consequence accident event is either highly unlikely or its consequences are within acceptable limits.

GLE Response

The return period of 191 to 250 years for a Category 5 hurricane passing within approximately 138 kilometers (86 miles) of new Hanover County does not reflect the return period of a Category 5 hurricane at the GLE site or any other specific site. In addition, there are no known probabilistic studies that have been performed to determine the annual probabilities of hurricanes at specific sites. Based on that, the Design Basis Wind (DBW) resulting from a hurricane has been determined using deterministic methods. The deterministically defined hurricane, developed consistent with guidance for nuclear power plants, is being applied to the proposed facility as "highly unlikely" events per the allowances of Interim Staff Guidance-8, *Natural Phenomenona Hazards*. The hurricane information in the License Application and Chapter 2 of the ISA Summary has been revised to reflect the deterministically defined hurricane winds.

The deterministically defined hurricane is determined by reviewing the historical hurricane data in the area of the site. Between 1954 and 2004, three hurricanes, which ranged from Category 1 through Category 3, made landfall in the New Hanover County coastal area. Two of these, Hurricane Hazel (1954), and Fran (1996), were Category 3 storms that made landfall with winds between 111 mph and 130 mph, respectively. Based on the above, the largest historical hurricane to occur in proximity to the Wilmington Site is a Category 3 hurricane, but a Category 4 hurricane is used as the deterministic hurricane. The wind speeds for a Category 4 hurricane range from 131 to 155 mph.

The proposed facility is to be designed as a robust structure, using the IBC 2006 requirements as the bases of the design. These refer to the requirements in ASCE 7-05, *Minimum Design Loads for Buildings and Other Structures* for wind design considerations. The wind speed defined in ASCE 7-05 to be applied on the Wilmington Site is 140 mph. Implementation of the wind design requirements in ASCE 7-05 requires the use of a loading factor of 1.6 to wind loads, which is equivalent to using a wind speed of 177 mph for the design. The equivalent design wind of 177 mph is larger than the 155 mph DBW. Therefore, by designing the proposed facility for the requirements of ASCE 7-05, an accident caused by the DBW from a hurricane is considered to be

"Highly Unlikely" and will not cause any accident scenarios resulting in exceeding the performance criteria in 10 CFR 70.61.

License Documentation Impact

GLE has revised the ISA Baseline documents to explicitly address the impact of a hurricane event on the safe shutdown facility and incorporate the hurricane into the initiator events discussion supporting the appropriate IROFS addressed in the current ISA.

GI-18 Section 1.3.5.1

Provide allowable bearing pressure of soil used in the design and the method to estimate it. Also, provide design basis settlement and differential settlement values used in the structural design including the methods used to determine them. This information is needed to assess adequacy of facility design.

The regulations in 10 CFR 70.64(a)(2) require the applicant to include adequate protection against natural phenomena in its design of the facility.

GLE Response

GLE has understands that the NRC may impose a license condition to require GLE to submit the results of the geotechnical design investigation prior to beginning construction. GLE intends to fully comply with such a license condition and will continue to update the NRC on the status and schedule for performing the investigation.

License Documentation Impact

No further changes to the License Application have been identified.

OA-2 Section 2.1.4

Provide a detailed discussion of management transitions during the proposed phased construction and simultaneous operations for multi-year periods.

In Section 1.2.2.1, GEH indicated it would perform construction in phases. However, Section 2.1.4 does not address how the management transitions will be accomplished for each phase of construction.

The regulations in 10 CFR 30.33, 10 CFR 40.32, 10 CFR 70.22, 10 CFR 70.23, and 10 CFR 70.62(d) require a management system and administrative procedures for the effective implementation of HS&E protection functions.

GLE Response

During a phone call held on April 6, 2010, the NRC requested more detailed information on how the transition from construction to operations will be conducted.

License Documentation Impact

Section 2.1.4 of the License Application was revised to include more detail regarding the transition from construction to operations.

D-1 Section 10.1.1 and Figure 10.1

Provide an alternate schedule for decommissioning and provide justification for the longer schedule if decommissioning is expected to take longer than 24 months.

Section 10.1.1 states, and Figure 10.1 indicates, that decommissioning will take about 3.5 years.

Regulations in 10 CFR 70.38(h) require that decommissioning be completed no later than 24 months following the initiation of decommissioning. Regulations in 10 CFR 70.38(i) allow the Commission to approve a request for an alternate schedule for completion of decommissioning if the alternative is warranted by consideration of 5 factors specified in 70.38(i)(1)-(i)(5).

GLE Response

During a phone call held on April 15, 2010, the NRC asked GLE to expand its discussion of the alternate decommissioning schedule to be consistent with the subparts of 10 CFR 70.38(i). The information is shown below.

Decommissioning of the GLE facility will require longer than 24 months, and therefore GLE requests an alternate schedule per 10 CFR 70.38. The reason for the project taking longer than 24 months is due to the complexity and scope of the project, and therefore it is not technically feasible to complete decommissioning within the allotted 24-month period. GLE refers to 10 CFR 70.38(i)(1) allows for this alternate schedule. The schedule proposed in the Decommissioning Funding Plan and Chapter 10 of the License Application took into account two employee shifts per day, and still the schedule calls for greater than 24 months to complete.

10 CFR 70.38(i) states 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 the following:

(1) Whether it is technically feasible to complete decommissioning within the allotted 24-month period;

As stated in the GLE License application, decommissioning is estimated to require approximately 3.5 years from facility shutdown to completion of the final status survey of radiological conditions. The timeline for decommissioning the facility was prepared through consultation with a company that has significant experience in decommissioning nuclear facilities.

The primary reason for the 3.5 year time period is the large quantity of enrichment equipment and the fact that some of this equipment is classified. As a result, special precautions and processes must be utilized to reduce the classified equipment to forms that may be disposed of without revealing any classified information. The 3.5 year time period took into account the extra steps necessary to dispose of classified equipment. In *addition, the large volume of non-classified components adds to the complexity of dismantling, decontaminating, surveying, and ultimately disposing of equipment. GLE intends to maintain its commitment to safety and security as the highest priorities during the decommissioning phase, and not impose unreasonable schedule constraints that could lead to unsafe or unsecure conditions.*

(2) Whether sufficient waste disposal capacity is available to allow completion of decommissioning within the allotted 24-month period;

There is sufficient waste disposal capacity to allow completion within a 24 month period; however, shipment of the projected volume of waste and the resulting large number of shipments in a 24 month period is not practical.

(3) Whether a significant volume reduction in wastes requiring disposal will be achieved by allowing short-lived radionuclides to decay;

There will be no significant volume reduction in wastes requiring disposal achieved by allowing short-lived radionuclides to decay. The decommissioning wastes is assumed to be low-level Class A waste. This waste classification and thereby the waste volume will not change as a result of extending the decommissioning period beyond 24 months.

(4) Whether a significant reduction in radiation exposure to workers can be achieved by allowing short-lived radionuclides to decay; and

The reduction in radiation exposure to workers achieved by allowing short-lived radionuclides to decay will be insignificant. However, the extended period will allow for the optimization of personnel compared with a 24-month period for decommissioning thereby reducing the man-hours expended to decommission, and allowing a more careful and thorough approach to be applied to the decommissioning process in order to maintain worker doses ALARA. This will result in a reduced total dose to workers for decommissioning. The expected reduction has not been quantified at this time.

(5) Other site-specific factors which the Commission may consider appropriate on a case-by-case basis, such as regulatory requirements of other government agencies, lawsuits, ground-water treatment activities, monitored natural ground-water restoration, actions that could result in more environmental harm than deferred cleanup, and other factors beyond the control of the licensee.

GLE has not identified other site-specific factors that would drive the decommissioning schedule to be adjusted, aside from those described above.

License Documentation Impact

No further changes to the License Application have been identified.

MM-8 Section 11.8.2

Explain how the following factors are considered in determining an IROFS' contribution to risk reduction:

1. Degree to which functional compliance can be demonstrated by test, inspection, or maintenance methods;
2. Anticipated lifespan;
3. Importance of data generated; and
4. Reproducibility of results.

Section 11.8.2.2 of the license application describes factors that are considered in implementing a graded QA approach.

The regulations in 10 CFR 70.62(d) state that measures applied to all IROFS may be graded commensurate with the reduction in risk attributable to that IROFS.

GLE Response

During a telephone call held on April 15, 2010, NRC staff requested that GLE clarify what is meant in Section 11.8.2 by the phrase "The QA Program is applied in a graded approach based on an item's importance to safety."

There are two Quality Levels identified for IROFS, QL-1 and QL-2, with QL-1 being the more rigorous of the two levels. NUREG-1520 allows for the applicant to either choose to apply all the QA elements at the highest level to all IROFS, or to grade the application in proportion to the importance of the item to the achievement of safety. GLE has chosen the latter option to use a graded approach to applying QA elements to IROFS. The selection of management measures to be applied to a specific IROFS is dependent upon the specific characteristics of the IROFS being evaluated, and the QA elements that are applicable to the IROFS. The rigor of the management measures applied to an IROFS is commensurate with the reduction of risk attributable to the IROFS. For example, one would expect that an IROFS that prevents a high consequence event would have more rigorous management measures than an IROFS that prevents an intermediate event.

The following QA elements are applied the same way to QL-1 and QL-2 IROFS: 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 actions; and quality assurance records. For the QA elements listed above, the management measures that flow from these elements will be the same, regardless of whether the IROFS is QL-1 or QL-2.

For the rest of the QA elements (instructions, procedures, and drawings; control of special processes; inspection; test control; inspection, control, testing, and operating status; audits; provisions for change) the application of management measures applied in a graded manner. The selection of management measures to implement the above QA elements is dependent on the design, function, and task analysis associated with operating and maintaining the IROFS, and taking into consideration the following:

- Risk significance,

- Applicable regulations, industry codes and standards,
- Complexity or uniqueness of an item/activity and the environment in which it has to function,
- Quality history of the item in service or activity,
- Degree to which functional compliance can be demonstrated or assessed by test, inspection, or maintenance methods,
- Anticipated life span
- Degree of standardization
- Importance of data generated, and
- Reproducibility of results.

The selection of management measures that flow from these QA elements is done during the ISA preparation/change process and documented in the IROFS boundary package.

<u>License Documentation Impact</u>

Section 11.8.2.1 will be revised as shown below for RAI MM-9.

MM-9 Section 11.8.2

Describe the extent to which management measures, including the QA program requirements, will be applied to QL-1, QL-2, and QL-3 IROFS to ensure they are available and reliable to perform their safety function as required by 10 CFR 70.62(d).

Section 11.8.2 does not discuss how management measures will be applied to QL-1, QL-2, and QL-3 IROFS.

The regulations in 10 CFR 70.62(d) require that management measures ensure that engineered and administrative controls and control systems that are identified as IROFS are implemented and maintained to ensure they are available and reliable to perform their function when needed. The application of measures may be graded commensurate with the reduction of risk attributable to the IROFS.

GLE Response

The response to MM-8 above clarifies how management measures will be selected and applied to QL-1 and QL-2 IROFS.

License Documentation Impact

Section 11.8.2.1 will be revised to read as follows:

"The extent that attributes of management measures and QA program elements are applied to QL-1 and QL-2 IROFS will be determined by evaluating the factors that contribute to reliability of each IROFS. The following QA elements are applied the same way to QL-1 and QL-2 IROFS: 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 actions; and quality assurance records. For the QA elements listed above, the management measures that flow from these elements will be the same, regardless of whether the IROFS is QL-1 or QL-2.

For the remaining QA elements (instructions, procedures, and drawings; control of special processes; inspection; test control; inspection, control, testing, and operating status; audits; provisions for change), the management measure(s) and QA element attributes for those aspects of the activity that influence reliability of the IROFS will be determined by evaluating the design, function, and task analyses associated with operating and maintaining the IROFS and by assigning the characteristic to the attribute taking into consideration the following:

- Risk significance,
- Applicable regulations, industry codes, and standards,
- Complexity or uniqueness of an item/activity and the environment in which it has to function,
- Quality history of the item in service or activity,
- Degree to which functional compliance can be demonstrated or assessed by test, inspection, or maintenance methods,
- Anticipated life span,

• Degree of standardization,
• Importance of data generated, and
• Reproducibility of results.

The management measure and QA element attributes assigned to each IROFS will be approved through the CM process associated with ISA baseline documents and specifically through approval of the IROFS Boundary Definition Packages as the design matures, procedures and training are developed, and pre-operational readiness reviews are conducted."

NRC RAI FS-3, Section 7.3.2

Clarify if the Operations Building is NFPA 220, "Standards on Types of Building Construction," Type I.

As described in Section 7.3.2 of the LA, the Operations Building appears to be NFPA 220 Type I construction. However, it is unclear if the building is a mixture of NFPA 220 Type I and Type II fire resistant designs.

The regulations in 10 CFR 70.22(a)(7) require that the license application describe the proposed equipment and facilities to protect health and minimize danger to life or property.

GLE Response

H3 occupancy fire areas will be Type I (442 or 332) as described in NFPA 220. Other occupancy areas will be Type II.

License Documentation Impact

Both paragraphs in Section 7.3.2 of the license application were revised for clarity as follows:

> "The Operations Building is constructed of noncombustible materials meeting the requirements of NFPA 801, Section 5.5, for fire resistant or noncombustible construction (typically Type I or Type II as defined in NFPA 220, Standard on Types of Building Construction (Ref. 7-14)). The Operations Building also meets the requirements of Type IA construction as described in Chapter 6 of IBC-2006. Type IA construction requires structural frame and the exterior and interior bearing wall elements to meet the requirement of 3-hour fire-rated construction.
>
> In accordance with NFPA 101®, the Operations Building is classified as a Special Purpose Industrial Occupancy, with a hazard classification of ordinary hazard. Additionally, the Operations Building is a mixed occupancy of High Hazard Group 2 (H-2), and High Hazard Group 3 (H-3) and High Hazard Group 4 (H-4) as classified by Chapter 3 of IBC-2006. Fire areas classified as H-2, H-3 or H-4 occupancies are constructed to meet the requirements of Type I (442 or 332) construction as described in NFPA 220.

NRC RAI FS-4, Section 7.3.3

Provide the minimum fire resistance of barriers used to separate fire areas and identify if the fire barriers are designated as IROFS in any fire accident scenarios.

Section 7.3.3 of the LA states that fire resistance is commensurate with potential fire severity between the major process areas. However, specific information on the fire resistance of fire barriers and their designation as IROFS is needed.

The regulations in 10 CFR 70.22(a)(7) require that the license application describe the proposed equipment and facilities to protect health and minimize danger to life or property. Regulations in 10 CFR 70.64(b)(1) address in the baseline design criteria the preference for engineered controls over administrative controls.

GLE Response

The minimum fire resistance of fire barriers between fire areas is 2-hours as described in the FHA. The fire resistance of fire barriers within fire areas meets the occupancy separation requirements of IBC (1-hour between sprinklered H-2 and H-3 occupancies,. The minimum fire resistance of interior and exterior bearing walls is 3-hours. No facility fire barriers are credited as IROFS. Prevention of fires is the primary criteria for the establishment of fire protection IROFS. The combustible controls program is credited as an IROFS to prevent large fires from occurring. Mitigation (fire brigade response) is credited as an IROFS to prevent small fires from spreading. Initial design criteria include noncombustible construction in accordance with NFPA 801 and the IBC. IROFS were selected based on an integrated facility safety methodology of consistency and performance.

License Documentation Impact

Section 7.3.3 of the license application was revised to include the following description of fire barriers at the end of the second paragraph:

> "The minimum fire resistance of fire barriers between fire areas is 2-hours as described in the FHA. The fire resistance of fire barriers within fire areas meets the occupancy separation requirements of IBC (1-hour between sprinklered H-2 and H-3 occupancies). The minimum fire resistance of interior and exterior bearing walls is 3-hours."

CHAPTER 1
REVISION LOG

Rev.	Effective Date	Affected Pages	Revision Description
0	04/30/2009	ALL	Initial Application Submittal.
1	03/31/2010	8-9, 17, 19-29, 41, 43-45, 47, 55, 59, 61	Incorporate RAI responses submitted to the NRC via MFN-09-578 dated 09/04/2009 and MFN-09-801 dated 12/28/2009.
2	06/18/2010	14-18, 22, 26, 30, 22, 34, 38-41, 47, 49, 63	Revised Section 1.2.2.4 regarding nuclear liability insurance. Revised Section 1.1.3.1 regarding the transition period between construction and operations. Incorporated the latest natural phenomena information and updated the figures.

TABLE OF CONTENTS

TABLES

FIGURES

1. GENERAL INFORMATION

This application requests a license from the U.S. Nuclear Regulatory Commission (NRC) to possess and use source material, special nuclear material (SNM), and byproduct material to construct and operate a commercial uranium enrichment facility. This application is filed by the GE-Hitachi Global Laser Enrichment LLC (GLE). GLE is requesting a license for a period of 40 years.

This chapter provides an overview of the GLE Commercial Facility. The facility enriches uranium for use in the manufacturing of nuclear fuel used in commercial power plants. This chapter provides a description of the facility and enrichment process along with a description of the GLE Site. Institutional information is provided to identify the applicant, describe the applicant's financial qualifications, and describe the proposed licensed activities.

This license application (LA) is being submitted pursuant to the following:

- Atomic Energy Act of 1954, as amended *(Ref. 1-1)*,
- 10 CFR 70, *Domestic Licensing of Special Nuclear Material (Ref. 1-2)*,
- 10 CFR 40, *Domestic Licensing of Source Material (Ref. 1-3)*, and
- 10 CFR 30, *Rules of General Applicability to Domestic Licensing of Byproduct Material (Ref. 1-4)*.

1.1 FACILITY AND PROCESS DESCRIPTION

This section provides an overview of the GLE Site, the GLE Commercial Facility layout, and a summary of the GLE enrichment process.

1.1.1 Facility Location

The GLE Commercial Facility is located on an existing General Electric Company (GE) industrial site in Wilmington, North Carolina (herein referred to as the Wilmington Site). The Wilmington Site is a 1621-acre tract of land, located west of North Carolina Highway 133 (also known as Castle Hayne Road). The Wilmington Site lies between latitudes (North) 34° 19' 4.0"and 34° 20' 28.9" and longitudes (West) 77° 58' 16.4" and 77° 55' 19.8", and is approximately six miles north of the City of Wilmington in New Hanover County, North Carolina (see Figure 1-1, *Wilmington Site and County Location*, and Figure 1-2, *Wilmington Site, New Hanover County, and Other Adjacent Counties*). The Wilmington Site is also the GLE "controlled area" (or "owner controlled area") for the purpose of meeting the requirements of 10 CFR 70.61(f), *Performance Requirements (Ref. 1-5)*.

The GLE Commercial Facility is located on approximately 100 acres of the Wilmington Site. In addition to the GLE Commercial Facility, the Wilmington Site contains the following GE facilities (see Figure 1-3, *Wilmington Site*):

- Global Nuclear Fuel – Americas, LLC (GNF-A) Fuel Manufacturing Operations (FMO) facility operated under the NRC SNM License-1097 *(Ref. 1-6)*;
- Wilmington Field Service Center (WFSC) in which used reactor control rod drive mechanisms are decontaminated, refurbished, and temporarily stored;
- GE Aircraft Engines (AE) facility which is not involved in nuclear fuel manufacturing operations;
- GE Services Components Operation (SCO) facility in which non-radioactive reactor components are manufactured;
- Fuel Components Operation (FCO) facility in which non-radioactive components for reactor fuel assemblies are manufactured; and
- Miscellaneous administrative and support buildings and site infrastructure such as roads and parking lots.

To the east of the Wilmington Site border is North Carolina Highway 133 and some commercially and residentially developed properties. Located to the east of North Carolina Highway 133, is a GE-owned 24-acre parcel that is undeveloped except for a GE employee park and a leased portion of property used as a transportation terminal. To the southwest of the Wilmington Site border is the Northeast Cape Fear River.

The majority of the north, northwest, and south perimeters are undeveloped forestlands. A small segment (approximately 1,000-feet of the north property line) borders the Wooden Shoe residential subdivision. A portion of the south property line is bordered by Interstate Highway 140 (otherwise known as the Wilmington Bypass). Residential properties are located directly south of the Wilmington Bypass.

The surrounding terrain is typical of coastal North Carolina with an elevation averaging less than 40 feet above mean sea level (msl). The terrain is characterized as gently rolling terrain consisting of forest, rivers, creeks, and swamps/marshlands.

1.1.2 Facility Description

The GLE Commercial Facility is shown on Figure 1-4, *GLE Commercial Facility Site Plan*. The GLE Commercial Facility includes the Operations Building where the enrichment processing systems and enrichment processing support systems are contained, several administrative and support buildings, a parking lot, retention basins, uranium hexafluoride (UF_6) cylinder pads, and connecting roadways. A cleared security buffer surrounds the entire GLE Commercial Facility and defines both the Restricted Area and the Protected Area of the facility. The major structures and areas of the facility are described below.

1.1.2.1 GLE Operations Building

The overall layout of the Operations Building is shown in Figure 1-4. The Operations Building includes the following process and support areas:

- Cylinder Shipping and Receiving Area,
- UF_6 Feed and Vaporization Area,
- Product Withdrawal Area,
- Tails Withdrawal Area,
- Cascade/Gas Handling Area,
- Blending Area,
- Sampling Area,
- Radioactive Waste Area,
- Heating, Ventilation, and Air Conditioning (HVAC) Equipment Area,
- Decontamination/Maintenance Area,
- Laboratory Area, and
- Laser Area.

The main process and support areas of the Operations Building and the associated operations are described below.

1.1.2.1.1 Cylinder Shipping and Receiving Area

The Cylinder Shipping and Receiving Area contains the necessary equipment to perform the following functions:

- Receive 30- and 48-inch cylinders from offsite;
- Weigh cylinders and perform other material control and radiological functions during receiving and when preparing for storage or offsite shipment;
- Provide interim storage of cylinders inside the Operations Building;
- Prepare cylinders and transfer them to onsite transfer vehicles (OSTVs) for transfer between the Operations Building and the UF_6 Cylinder Pads;
- Provide interim storage of product, feed, and sample/blend cylinders;

- Prepare cylinders and transfer them to OSTVs for transfer to other process areas within the Operations Building;
- Prepare product cylinders for offsite shipment and intra-site transfer; and
- Prepare 48-inch tails and heel cylinders for offsite shipment.

UF_6 feed is received at the GLE Commercial Facility in American National Standards Institute (ANSI) N14.1-compliant UF_6 cylinders on semi-trailer trucks, typically with one full 48-inch cylinder per shipping trailer. A compliant 48-inch feed cylinder contains a maximum of 12,501 kg of UF_6 *(Ref: 1-7)*.

When UF_6 cylinders are received at the GLE Commercial Facility, the cylinders are inspected, verified, and processed per approved written Operations, Security, and Radiation Protection (RP) procedures. Empty 30- and 48-inch cylinders are also received at the GLE Commercial Facility.

At the Cylinder Shipping and Receiving Area, cylinders are off-loaded and transferred to an adjacent weighing and scanning area. After acceptance, feed cylinders are moved to an interim cylinder storage area inside the Cylinder Shipping and Receiving Area. From the interim cylinder storage area, feed cylinders may be moved to a feed station to begin processing, or to the In-Process Pad. An overhead bridge crane and transfer cart are used to handle the UF_6 cylinders.

Source material and SNM are used in this area.

1.1.2.1.2 UF_6 Feed and Vaporization Area

The UF_6 Feed and Vaporization Area contains the necessary equipment to perform the following operations:

- Receive UF_6 feed cylinders from the Cylinder Shipping and Receiving Area;
- Purge the light gases contained within the feed cylinders;
- Capture the light gases for disposal;
- Vaporize the UF_6 contained within the feed cylinders;
- Feed the vaporized UF_6 to the feed header between the Vaporization Area and the Cascade/Gas Handling Area within the Operations Building;
- Maintain design basis UF_6 feed rates to the feed header within the design basis temperature and pressure range; and
- Recover residual UF_6 from the feed cylinders to meet U.S. Department of Transportation (DOT) offsite cylinder shipping requirements for empty cylinders.

The UF_6 Feed and Vaporization Area is divided into feed vaporization chambers (FVCs). Each of the FVCs typically contains: solid feed stations (SFS) to vaporize the UF_6 feed; a cold trap purification station (CTPS) to remove light gases from the feed stream; a low temperature take-off station (LTTS) to remove feed cylinder UF_6 down to heel quantities; and a heated flow control valve box (HFCVB) for each SFS that contains the valves and pipe connections from each SFS.

Source material is used in this area.

1.1.2.1.3 Product Withdrawal Area

The Product Withdrawal Area contains the necessary equipment to perform the following functions:

- Receive empty 48 GLE UF_6 cylinders from interim storage within the Cylinder Shipping and Receipt Area;
- Maintain design basis UF_6 product withdrawal rates from the Cascade main discharge header;
- Separate the light gases from the UF_6 for disposal; and
- Provide filled 48 GLE cylinders with ≤ 8.00 wt% ^{235}U for interim storage and later disposition.

The Product Withdrawal Area contains: volume reducing compressor trains (VRCTs) that move UF_6 product material from the Cascade/Gas Handling System to the product Withdrawal Stations; LTTSs to collect the UF_6 product material; a CTPS to remove non-condensable light gases from the product stream; and a HFCVB for each LTTS that contains the valves and pipe connections from each LTTS.

SNM is used in this area.

1.1.2.1.4 Tail Withdrawal Area

The Tail Withdrawal Area contains the necessary equipment to perform the following functions:

- Receive empty UF_6 cylinders from interim storage within the Cylinder Shipping and Storage Area;
- Maintain design-basis UF_6 tails withdrawal rates from the enrichment system main discharge header;
- Separate the light gases from the UF_6 for disposal; and
- Provide filled UF_6 cylinders with ≤ 0.72 wt% ^{235}U for interim storage and later disposition.

The Tail Withdrawal Area contains: VRCTs that move UF_6 tails from the Cascade/Gas Handling System to the Tail Withdrawal Stations; LTTSs to collect the UF_6 tails material; a CTPS to remove non-condensable light gases from the tails stream; and a HFCVB for each LTTS that contains the valves and pipe connections from each LTTS.

Source material is used in this area.

1.1.2.1.5 Cascade/Gas Handling Area

The Cascade/Gas Handling Area contains the equipment necessary to perform the laser-based enrichment process. The UF_6 gas is exposed to laser-emitted light and two process streams are generated; one enriched in ^{235}U and one depleted in ^{235}U.

Technical details of the GLE laser-based enrichment process are proprietary, subject to export control by U.S. laws and regulations, and in many cases may also fall into the categories of security-related, safeguards, or classified information, access to which is further limited per U.S. laws and regulations.

Source material and SNM are used in this area.

1.1.2.1.6 Blending Area

The Blending Area contains the necessary equipment to perform the following functions:

- Receive 30- or 48-inch donor cylinders from interim storage within the Cylinder Shipping and Receiving Area;
- Purge the light gases contained within the cylinders;
- Capture the light gases for disposal;
- Vaporize the UF_6 contained within the donor cylinders;
- Feed the vaporized UF_6 to receiver cylinders;
- Recover residual UF_6 from the donor cylinders to meet DOT cylinder shipping requirements for empty cylinders; and
- Provide empty donor cylinders and filled receiver cylinders for interim storage.

The Blending Area contains blending donor stations (which are similar to the SFS) and blending receiver stations (which are similar to the product withdrawal LTTS) described under the Product Withdrawal Area above.

SNM is used in this area.

1.1.2.1.7 Sampling Area

The Sampling Area contains the necessary equipment to perform the following functions:

- Receive filled UF_6 cylinders from interim storage within the Cylinder Shipping and Receipt Area;
- Purge the light gases contained within the cylinders;
- Capture the reactive light gases for disposal and vent the nonreactive light gases;
- Homogenize and sample the UF_6 contained within the cylinders; and
- Maintain design basis UF_6 cylinder rates to support a six million separative work unit (SWU) facility.

The function of the product liquid sampling system is to obtain an assay sample from filled product cylinders. The sample is used to validate the enrichment level of UF_6 in the filled product cylinders before the cylinders are sent to the fuel processor. This is the only system in the GLE Commercial Facility that converts solid UF_6 to liquid UF_6.

The Sampling Area contains: sample containment autoclaves (SCAs) to support liquefaction, sampling, and solidification of UF_6 in the cylinders; CTPS to remove light gases vented from the cylinders being sampled; LTTSs to capture UF_6 vented from the cylinders during sampling; HFCVB for each SCA that contains the valves and pipe connections between units within the sampling area; an autoclave surge tank (AST) that provides UF_6 surge capacity if an autoclave relief device actuates.

Source material and SNM are used in this area.

1.1.2.1.8 Liquid and Solid Radioactive Waste Areas

Quantities of radiologically contaminated, potentially contaminated, and non-contaminated aqueous liquid effluents are generated in a variety of the GLE Commercial Facility operations and processes. Aqueous liquid effluents are collected in tanks located in the Radioactive Liquid Effluent Collection and Treatment Room. The collected effluent is sampled and analyzed to determine if treatment is required before release.

Operation of the GLE Commercial Facility also generates refuse and other hazardous and non-hazardous solid wastes. These wastes may be designated as Resource Conservation and Recovery Act (RCRA) hazardous wastes, low-level radioactive waste (LLRW), high-activity waste, or low-level mixed waste (LLMW). Solid-waste systems are designed to process both wet and dry low-level radioactive solid waste. Solid radioactive waste material is accumulated, monitored for criticality control and other regulatory requirements, stored in temporary accumulation areas, and then transferred to one of the solid-waste storage buildings located on the GLE Site for storage pending eventual offsite shipment/disposition.

1.1.2.1.9 HVAC Equipment Areas

Various ventilation systems are used to condition the environment inside the buildings and areas to meet requirements for personnel, process equipment, and supporting systems and utilities. The HVAC systems also control the room pressure in different areas or zones of the buildings relative to adjacent areas and relative to the outdoors as part of the radioactive or hazardous material containment function.

The ventilation system requirements of each area are dependent on the process performed, and on variables such as the indoor air temperature, relative humidity, relative room pressure, and safety requirements.

Ventilation systems that have the potential to exhaust radioactive or hazardous materials interface with the Monitored Central Exhaust System (MCES). The MCES functions to remove uranium particulates as well as UF_6 and HF gas from process gas streams and room air during normal and abnormal events. The system maintains areas under negative pressure relative to ambient and adjacent areas. This prevents the release of radioactive or hazardous materials, which protects workers and the public. The MCES discharges through a monitored exhaust stack located in the Operations Building.

The ventilation and MCES equipment serving the Operations Building is located in various locations throughout the Operations Building.

1.1.2.1.10 Decontamination/Maintenance Area

The Decontamination/Maintenance Area provides a place for personnel to remove contamination from, and make repairs to, equipment and process components used in UF_6 systems, waste handling systems, and other areas of the facility.

Source material and SNM are contained in this area.

1.1.2.1.11 Laboratory Area

The Laboratory Area is located just north of the Cylinder Shipping and Receiving Area, on the east side of the Operations Building. Within the Laboratory Area there are areas for mass spectroscopy equipment, wet chemistry activities, safety and regulatory testing and analysis, standard analytical laboratory equipment, and fume collection and exhaust hoods.

Source material and SNM are used in this area.

1.1.2.1.12 Laser Area

The Laser Area contains the necessary equipment to operate the laser systems that are part of the GLE laser-based enrichment technology; and produce the specific wavelength of light required to affect the uranium isotope necessary for the enrichment process.

The Laser Area contains: lasers to generate the required wavelength of light needed for the enrichment process, and a Laser Repair Shop located adjacent to the Laser Area to perform maintenance on the laser systems including calibration, repair, and preventive maintenance.

No source material or SNM is used in this area.

1.1.2.2 UF_6 Cylinder Pads

The UF_6 Cylinder Pads include three outdoor cylinder pads each serving a different function. The three pads are described below. See Figure 1-4 for the location of the UF_6 Cylinder Pads.

1.1.2.2.1 Product Pad

The Product Pad is used to store product in 30-inch cylinders. The Product Pad is approximately 48,000 square feet and constructed similar to the other storage pads to provide for rainwater drainage. Saddles are used to store the cylinders and the cylinders are not typically stacked.

SNM is contained in this area.

1.1.2.2.2 In-Process Pad

The In-Process Pad is used to store feed material, as well as any cylinders containing heels and empty cylinders. It is approximately 130,000 square feet and constructed similar to the other pads to provide for rainwater drainage. Saddles are used to store the cylinders and the cylinders are not typically stacked.

Source material is contained in this area.

1.1.2.2.3 Tails Pad

The Tails Pad is designed to provide storage for 48-inch cylinders containing less than or equal to 0.72 percent weight ^{235}U. The Tails Pad is sized to accommodate the cylinders resulting from ten years of facility operation.

The Tails Pad occupies approximately 465,000 square feet. The pad is sloped to provide drainage to the edges of the pad. The surrounding site is graded to provide collection and drainage of rainwater to an onsite retention basin. The cylinders may be stacked two high and are stored using Saddles.

Source material is contained in this area.

1.1.2.3 Other Facility Buildings and Supporting Infrastructure

See Figure 1-4 for the location of the following buildings and supporting infrastructure.

There are three administrative buildings. Two of the administrative buildings primarily contain office space for the GLE support staff and conference rooms. The third administrative building, the Operations Support Center, contains the personnel Entry Control Facility (ECF) and is located at the entrance to the Protected Area. Personnel requiring access to the Protected Area must pass through the ECF. The ECF is designed to facilitate and control the passage of authorized facility personnel and visitors. General parking is located outside of the Protected Area.

Waste storage buildings are used to store solid LLRW. The waste is packaged in transportation containers and surveyed prior to being stored in the warehouse.

An electrical substation and diesel generators provide electrical power to the GLE Commercial Facility. The diesel generators are used during short-term power losses to support an orderly shutdown of the enrichment processes upon loss of power or until normal electrical service is restored. A loss of GLE Site electrical power does not have any public safety implications.

Potable and process water supply lines run to the GLE Commercial Facility from the existing Wilmington Site water supply infrastructure. Sanitary waste, process wastewater, and treated liquid radiological wastewater are routed from the GLE Commercial Facility via underground lines to lift stations. The lift stations deliver the respective wastewaters to the existing Wilmington Site Sanitary Waste Water Treatment Facility (WWTF) and Final Process Lagoon Treatment Facility (FPLTF) through underground pipes.

Two retention basins receive stormwater runoff from the GLE Commercial Facility. The majority of the runoff from the GLE Commercial Facility, including the Operations Building, drains to a collection basin on the Wilmington Site. The remaining runoff, including runoff from the UF_6 Cylinder Pads, drains to a GLE Site retention basin.

There is a water tower, a firewater retention basin, and associated pumps and piping located on the GLE Site. The water in the tower is designated for process water, but has a reserved level for fire fighting. The firewater retention basin and associated diesel powered firewater pumps are designed as a backup source for fire protection systems.

The road leading to the entrance of the GLE Commercial Facility is located off of Castle Hayne Road (see Figure 1-3). There is also a road exiting the GLE Commercial Facility leading to the GNF-A FMO Facility. Both of these roads are located on the Wilmington Site and are maintained by GE.

1.1.3 Process Description

This section provides an overview of the GLE laser-based enrichment process. A more detailed description of the process is provided in the Integrated Safety Analysis (ISA) Summary. The ISA Summary also contains a description of the other systems supporting the GLE Commercial Facility including the utility systems; HVAC systems, process water system, and the various cylinder-handling systems used to move UF_6 cylinders.

1.1.3.1 Process Overview

The GLE Commercial Facility is a uranium enrichment facility that utilizes laser-based enrichment technology. The GLE Commercial Facility is designed to separate a feed stream containing the naturally occurring proportions of uranium isotopes into a product stream (enriched in the ^{235}U isotope) and a tails stream (depleted in the ^{235}U isotope).

The GLE Commercial 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, and the blending of UF_6 gas of different enrichments to create specific desired product enrichments.

The GLE Commercial Facility uses the laser-based enrichment technology within an area of the facility known as the Cascade/Gas Handling Area. The process enriches natural UF_6, containing approximately 0.72 weight percent ^{235}U, to a UF_6 product containing ^{235}U enriched up to 8 weight percent. The nominal capacity of the facility is six million SWU per year.

The uranium enrichment process utilized by the GLE Commercial Facility utilizes lasers tuned to specific frequencies to selectively excite UF_6 gas molecules to enable separation of the ^{235}U isotope in UF_6 feed stock. The result is a UF_6 product stream enriched in the ^{235}U isotope and a UF_6 tails stream in which the fraction of ^{235}U isotope is reduced or depleted. Technical details of the GLE laser-based enrichment technology are proprietary, subject to export controls by U.S. laws and regulations, and in many cases also fall into the categories of security-related, safeguards, or classified information, access to which is further limited per U.S. laws and regulations.

The phases of construction/initial operations include Early Construction, Phase 1 Construction (Initial Construction of one MSWU facility), Phase 2 Construction (Construction and Component Installation to Ramp up to six MSWU), and Full Operations at six MSWU. The facility described in this License Application assumes that the facility is operating at six MSWU. However, the facility will be operating at approximately one MSWU during the first year, two MSWU during the second year, three MSWU during the third year, four MSWU during the fourth year, five MSWU during the fifth year, and six MSWU during the sixth year and every year thereafter. The initial construction plan includes building the Operations Building in its entirety, and equipping it with the necessary equipment to generate one MSWU. During the first year, while the facility is operating at one MSWU, equipment/component installation will be occurring simultaneously. Similarly, for the second, third, fourth, and fifth years, operations and equipment/component installation will occur simultaneously.

During Early Construction (prior to receipt of an NRC license), the following activities will occur:

- Clearing 100 acres on the GLE Site,
- Site grading and erosion control,
- Installation of storm water retention system,
- Construction of main access roadways,
- Placement of Utilities (electricity, potable water, process water, water for fire suppression, sanitary sewer, natural gas), and
- Construction of parking lots and minor roadways.

During Phase 1 Construction, the following activities will occur:

- Construction of the Operations Building,
- Construction of the UF_6 Cylinder Pads,
- Construction of the Guardhouses,
- Construction of Ancillary buildings (includes waste storage facilities, vehicle maintenance facilities, warehouses, storage yards, utility buildings, etc.),
- Installation of Security Systems,
- Construction of the Administrative Buildings,
- Installation of the fire protection and other safety systems, and
- Installation of components within Operations Building to support one MSWU production.

{{{Proprietary Information withheld from disclosure per 10 CFR 2.390}}}

During full operations at six MSWU, there is not anticipated to be further facility construction or component installation, with the exception of maintenance and repair activities. Any unanticipated construction/component installation will be evaluated per the 10 CFR 70.72, *Facility Changes and Change Process (Ref. 1-8),* process to determine if an amendment to the license is required prior to initiating the activities.

1.1.3.2 Process System Descriptions

The GLE Commercial 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

An overview of each process system or support system is provided below.

1.1.3.2.1 UF_6 Feed and Vaporization System

The major function of the UF_6 Feed Vaporization System is to provide a continuous supply of gaseous UF_6 from the feed cylinders to the Cascades. The nominal UF_6 feed flow rate is based on a six million SWU/year facility capacity. Approximately 900 48-inch cylinders are processed annually.

The major equipment used in the UF_6 Feed Vaporization Process are the SFSs. Feed cylinders are loaded into SFSs; vented for removal of light gases, primarily air and hydrogen fluoride, and heated to sublime the UF_6. The light gases and UF_6 gas generated during feed purification are routed to the Feed Purification Subsystem where the UF_6 is desublimed. The Feed Purification Subsystem consists of UF_6 cold traps, a vacuum pump/chemical trap set, and a LTTS. The Feed Purification Subsystem removes any light gases such as air and hydrogen fluoride from UF_6 prior to introduction into the Cascade/Gas Handling Area. The UF_6 is captured in UF_6 cold traps and ultimately recycled as feed, while hydrogen fluoride is captured on chemical traps.

1.1.3.2.2 Cascade / Gas Handling System

After purification, UF_6 from the SFS is routed to the Cascade/Gas Handling Area. The gas is exposed to laser-emitted light, and the UF_6 gas is separated into two streams, one enriched in ^{235}U and one depleted in ^{235}U.

1.1.3.2.3 Product Withdrawal System

Enriched UF_6 from the Cascade/Gas Handling Area is desublimed in the Product Withdrawal LTTS. Pumps and compressors transport the UF_6 from the Cascade/Gas Handling Area to the Product Withdrawal LTTS. The heat of desublimation of the UF_6 is removed by cooling air routed through the LTTS. Filling of the product cylinders is monitored with a load cell system, and filled cylinders are transferred to the Product Cylinder Sampling System for sampling.

1.1.3.2.4 Tail Withdrawal System

Depleted UF_6 from the Cascade/Gas Handling Area is desublimed in the Tail Withdrawal LTTS. Pumps and compressors transport the UF_6 from the Cascade/Gas Handling Area to the Product LTTS. The heat of desublimation of the UF_6 is removed by cooling air routed through the LTTS. Filling of the tail cylinders is monitored with a load cell system, and filled cylinders are transferred to the Tails Pad.

1.1.3.2.5 Blending System

The primary function of the Blending System is to blend UF_6 donor cylinders with differing enrichments into a receiver cylinder. The assay in the receiver cylinder is one that meets customer specifications as well as transportation standards.

1.1.3.2.6 Sampling System

UF_6 sampling operations are performed in the Sampling Area. Current American Society for Testing and Materials (ASTM) International standards require that UF_6 samples be taken from homogenized UF_6. Therefore, the design criteria require liquefaction of UF_6 during sampling operations. In addition, sampling of a statistical basis set of feed and tails cylinders is required to support Material Control and Accounting (MC&A) requirements.

Autoclaves with heating and cooling capability are used to liquefy UF_6 in the cylinders, homogenize the liquefied material, obtain a representative sample of the contents of the cylinders, and then solidify the UF_6 in the cylinders before they are removed from the autoclave. The cylinders may be any approved UF_6 cylinder, per ANSI N14.1, *Nuclear Materials – Uranium Hexafluoride – Packaging for Transport (Ref. 1-9)*, which meets nuclear criticality safety (NCS) requirements. The autoclaves are designed to contain a UF_6 release in the autoclave. Electrically heated air is the heating medium and cold air is used for cooling.

1.1.4 Waste Management

1.1.4.1 Solid Wastes

Operation of the GLE Commercial Facility generates refuse and other nonhazardous solid waste, wastes designated as RCRA hazardous wastes, and LLRWs. No high-level radioactive wastes are generated by GLE Commercial Facility operations. GLE does not intend to generate mixed wastes. Low-level waste is expected to be Class A waste. The types, sources, and estimated quantities of solid wastes generated by GLE Commercial Facility operations are summarized in Table 1-1, *Typical Types, Sources, Quantities of Solid Wastes Generated by GLE Commercial Facility Operations*, and Table 1-2, *Management of Solid Wastes.*

GLE Commercial Facility operations generate an estimated 380 tons of municipal solid waste (MSW) per year. This waste is collected and placed in roll-off type containers. A commercial refuse collection service regularly collects the filled containers and transports the waste to a RCRA permitted Subtitle D landfill for disposal.

In addition to MSW, an estimated 107 tons of non-hazardous solid wastes are generated per year as a result of equipment maintenance for GLE Commercial Facility operations. Examples of these wastes are spent coolant and used filter media. These wastes are collected and temporarily stored in containers appropriate for the waste type. Depending on the composition of the non-hazardous waste, these materials are either shipped directly to a permitted RCRA Subpart D landfill for treatment and burial, or routed to other approved facilities for reuse, reclamation, or treatment.

The GLE Commercial Facility generates approximately 12 tons of RCRA hazardous waste per year. This waste is collected, packaged in DOT-approved shipping containers, and temporarily stored onsite for shipment to a RCRA-permitted Subtitle C treatment, storage, and disposal facility.

The sources and typical quantities of LLRW generated by GLE Commercial Facility operations are summarized in Table 1-1. LLRW is collected in containers appropriate for the waste form and shipped by truck to an approved disposal facility as indicated in Table 1-2.

1.1.4.2 Liquid Wastes

The sources and estimated quantities of wastewater generated by GLE Commercial Facility operations are summarized in Table 1-3, *Typical Types, Sources, and Quantities of Wastewater Generated by GLE Commercial Facility Operations*, and Table 1-4, *Management of Wastewater Generated by GLE Commercial Facility Operations*.

The liquid radioactive wastes generated in the Operations Building are collected in closed drain systems that discharge to an accumulator tank. The liquid is treated to remove uranium through precipitation; the liquid is then treated to remove fluoride through evaporation. The resulting solids are dried and disposed of as LLRW.

The treated wastewaters from the Radiological Liquid Effluent Treatment System (RLETS) are discharged to the existing Wilmington Site Sanitary WWTF and FPLTF. The FPLTF receives Wilmington Site process wastewater, including the treated effluent from the GNF-A Radiological Waste Treatment System. The treated effluent from the FPLTF is discharged via National Pollutant Discharge Elimination System (NPDES)-permitted Outfall 001 to the Wilmington Site effluent channel where it is combined with stormwater, discharging groundwater, and treated sanitary wastewater effluent. The effluent channel flows to the unnamed Tributary No. 1 to the Northeast Cape Fear River.

The cooling tower for the GLE Commercial Facility is a closed loop system that does not contact any uranium materials or uranium-contaminated wastewater streams. To minimize the amount of dissolved solids and other impurities in the circulating water, standard operating practice is to regularly remove a portion of the circulating water from the cooling tower loop and discharge the water to an evaporation pond (adding fresh water to the cooling tower loop to make up for corresponding water loss). Approximately 30,000 gallons per day (gpd) is removed and pumped directly to the existing Wilmington Site FPLTF.

Operation of the GLE Commercial Facility generates approximately 10,500 gpd of sanitary waste. The sanitary wastes are collected in a sewer system connected to the existing

Wilmington Site Sanitary WWTF. This facility uses an Activated Sludge Aeration Process. The treated effluent from the Wilmington Site Sanitary WWTF is re-used as process water.

Stormwater runoff from outdoor impervious surfaces within the GLE Commercial Facility is collected in drainage conduits and channels flowing into retention basins used for collection of runoff. The retention basins are routed to the unnamed Tributary No. 1, which flows into the Northeast Cape Fear River.

1.1.5 Depleted Uranium Management

Depleted uranium (also referred to as UF_6 tails) from GLE Commercial Facility operations is temporarily stored at the GLE Commercial Facility in 48-inch cylinders before being shipped offsite to a depleted uranium conversion facility. There is no onsite disposal of the UF_6 tails at the Wilmington Site. Section 3113 of the United States Enrichment Corporation (USEC) Privatization Act *(Ref. 1-10)* directs the U.S. Department of Energy (DOE) to "accept for disposal" depleted uranium, such as the UF_6 tails generated by the GLE Commercial Facility.

The Tails Pad is designed to provide storage capacity for approximately 9,000 48-inch cylinders, which is equivalent to ten years of facility operation. It is anticipated that DOE will have begun accepting possession of the UF_6 tails before the storage pad capacity is reached. The pad design layout permits double stacking of the 48-inch cylinders and allows the cylinders to be moved with gantry cranes and flatbed trucks. The storage pad occupies approximately 465,000 square feet. To provide stormwater drainage, the pad is sloped at the edges. The terrain surrounding the storage pad is graded to provide collection and drainage of stormwater to a retention basin.

Saddles are used to stack and store the cylinders above the Tails Pad surface. To transfer the UF_6 tails between the Cylinder Shipping and Receiving Area and the Tails Pad, dedicated diesel-powered flatbed trucks are used. At the Tails Pad, a diesel-powered, self-propelled gantry crane is used to unload the cylinder from the flatbed truck, move the cylinder to the appropriate storage location on the pad, and place the cylinder on its pad cradle. 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 cylinder maintenance procedures.

1.1.6 Liquid and Air Effluents

1.1.6.1 Process Wastewaters

Uranium enrichment operations performed inside the Operations Building generate process wastewater from decontamination, cleaning wash water, and laboratory wastes. The waste streams contain small concentrations of uranium and are collectively referred herein as liquid radioactive waste. Liquid radioactive waste is treated to remove uranium and fluoride as described in Section 1.1.4, *Waste Management.*

The treated wastewaters from the RLETS are discharged to the existing Wilmington Site FPLTF. This facility currently receives Wilmington Site process wastewater, including the treated effluent from the GNF-A FMO Facility Radiological Waste Treatment System. The treated effluent from the FPLTF is discharged via NPDES-permitted Outfall 001 to the

Wilmington Site effluent channel where it is combined with stormwater, discharging groundwater, and treated sanitary wastewater effluent. The effluent channel flows to the unnamed Tributary No. 1 to the Northeast Cape Fear River. The liquid leaving RLETS is monitored to ensure compliance with the 10 CFR 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 (Ref. 1-11)*, limit. In addition, the liquid leaving the RLETS system is monitored to ensure compliance with the NDPES permit levels for fluoride, as well as other constituents specified in the permit. Other constituents may include total suspended solids, biological oxygen demand, oil and grease, total nitrogen, dissolved oxygen, and pH.

1.1.6.2 Air Effluents

The laser-based enrichment process is a closed process with no vents needed for routine venting of process gases. Some short-term gaseous releases occur inside the Operations Building during activities associated with operations such as the connection/ disconnection of UF_6 cylinders to process equipment and process equipment maintenance activities. These gaseous releases are routed through the building's ventilation system. The ventilation system air stream passes through a series of emissions-control devices consisting of high-efficiency particulate air (HEPA) filters and high-efficiency gas absorption (HEGA) filters. The exhaust air stream from these emission controls is vented to the atmosphere and monitored at the stack for uranium and fluoride. Table 1-5, *Typical GLE Air Emissions*, shows the typical air effluent concentrations from the Operations Building and the required regulatory limits. GLE shall comply with the requirements in 10 CFR 20, Appendix B, for uranium air effluents, and with the requirements specified in the North Carolina Department of Air Quality permit for monitoring of fluorides (as well as other operational controls/conditions specified in the permit).

1.1.7 Raw Materials, By-Products, Wastes, and Finished Products

The raw materials used in the laser-based enrichment process include UF_6 feed, gases used to support laser operation, oils used to support mechanical operations, process water, and solvents used in cleaning equipment. The by-product of the laser-based enrichment process is depleted uranium tails in the form of solid UF_6. The wastes from the laser-based enrichment process include solid wastes, process wastewaters, and air effluents. Further description of these wastes is contained in Section 1.1.4. The finished product from the laser-based enrichment process is solid UF_6 enriched in ^{235}U. GLE will not use or possess any moderator or reflector with special characteristics, such as beryllium or graphite.

GLE utilizes commercial natural UF_6 feed stock meeting the requirements of ASTM C787-06, *Standard Specification for Uranium Hexafluoride for Enrichment (Ref. 1-12)*. At this time, GLE does not intend to use "reprocessed UF_6" as feed stock, and consistent with ASTM C787-06, GLE requires that suppliers possessing feed cylinders contaminated with reprocessed UF_6 feedstock provide additional evidence of uranium purity that is backed up by statistical sampling of feed stock at GLE. As such, impurities in the feed are expected to be consistent with, or less than, those quantities specified in this standard. GLE shall produce enriched uranium meeting the requirements of ASTM C996-04, *Standard Specification for Uranium Hexafluoride Enriched to Less than 5 % ^{235}U (Ref. 1-13)*, for enriched commercial grade UF_6 and any additional customer specifications.

1.2 INSTITUTIONAL INFORMATION

This section describes the corporate identity, financial qualifications, type of license, and the requested special authorizations and exemptions.

1.2.1 Corporate Identity

The applicant name and address, corporate structure and ownership control, and physical location of the facility are provided below.

1.2.1.1 Applicant Name and Address

This application for an NRC license is filed by GE-Hitachi Global Laser Enrichment LLC. GLE is headquartered in Wilmington, North Carolina.

The full address of the applicant is as follows:

Mailing Address:

Global Laser Enrichment
P.O. Box 780, Wilmington, North Carolina 28402

Physical Address:

Global Laser Enrichment
3901 Castle Hayne Road, Wilmington, North Carolina 28401.

1.2.1.2 Organization and Management of Applicant

The corporate ownership structure is shown in Figure 1-5, *GLE Ownership*. GLE is a Delaware limited liability company and currently the only subsidiary of majority owner GE-Hitachi Nuclear Energy Americas LLC (GEH), a global supplier of nuclear energy-related equipment and services, and which is itself a Delaware limited liability company and a wholly-owned subsidiary of GE-Hitachi Nuclear Energy Holdings LLC (Holdings). Holdings, a Delaware limited liability company, is a subsidiary of majority owner GENE Holding LLC (GENE), which is a Delaware limited liability company wholly owned by General Electric Company (GE), a U.S. corporation organized under the laws of the State of New York, and of minority owner Hitachi America, Ltd., which is a wholly owned subsidiary of Hitachi Ltd., a Japanese corporation. GLE also has two minority owners, Cameco Enrichment Holdings, LLC ("Cameco Enrichment"), with 24% ownership interest in GLE, and GENE, which owns 13.5% of GLE. Cameco Enrichment is a Delaware limited liability company wholly owned by Cameco US Holdings, Inc., a Nevada corporation, which is in turn wholly owned by Cameco Corporation, a Canadian corporation.

In this ownership structure, GE maintains an indirect majority, that is 51% ownership, 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 information. Foreign ownership, control, and influence (FOCI) information is initially submitted, and periodic updates thereto are provided, to the NRC in accordance with 10 CFR 95, *Facility Security Clearance and Safeguards of National Security Information and Restricted Data (Ref. 1-14).*

The current principal officers of GLE and their citizenship are listed below:

- Tammy G. Orr, President and Chief Executive Officer — United States
- Craig M. Steven, Chief Financial Officer — United States
- Harold J. Neems, Secretary and General Counsel — United States

GLE's immediate parent, GEH, is the parent company of NRC licensees that are licensed under 10 CFR 50, *Domestic Licensing of Production and Utilization Facilities (Ref. 1-15)*, 10 CFR 70, and 10 CFR 72, *Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor Related Greater Than Class C Waste (Ref. 1-16)*, at facilities in Sunol, California and Morris, Illinois. GLE's affiliate, GNF-A, also a controlled subsidiary of GE, is the current holder of an NRC license under 10 CFR 70 for an existing facility on the Wilmington Site.

1.2.1.3 Address of Facility and Site Location Description

The address of the facility is the same as the physical address of the applicant. A description of the facility site location is provided in Section 1.1.1, Facility Location.

1.2.2 Financial Qualifications

1.2.2.1 Capital Cost Estimate

GLE estimates that the total capital investment required to construct a six million SWU facility is approximately **{{{Proprietary Information withheld from disclosure per 10 CFR 2.390}}}** (in 2009 dollars), excluding capital depreciation, UF_6 tails disposition, decommissioning and any replacement equipment required during the life of the facility. The basis for the cost estimate is provided in Table 1-6, *GLE Commercial Facility Capital Cost Estimate*

The cost estimate is based on a phased construction approach that is expected to take approximately six years from the time the license is issued to reach the full six million SWU capacity. The first phase of the GLE Commercial Facility will be a three million SWU facility (Unit 1) that will be deployed in one million SWU and two million SWU incremental production capacity. GLE is expected to start production on Unit 1 approximately three years from the issuance of the NRC license that GLE is seeking through this application. The second phase will be a three million SWU facility (Unit 2) deployed in a similar step fashion as Unit 1. The Unit 2 phase is expected to leverage efficiencies gained from the initial deployments to expedite the construction process and increase the SWU capacity that can be deployed at one time.

1.2.2.2 Funding Commitments

Construction of the first phase (Unit 1) shall not commence before funding is fully committed. Of this full funding (equity and/or debt), GLE will have: (1) minimum equity contributions of 30% of project costs from the parents and affiliates of the partners; and (2) firm commitments ensuring funds for the remaining project costs. The construction of the second phase (Unit 2) will have the same requirements listed for the first phase, except, that expected profits from Phase 1 sales may be used as a funding source.

GLE shall not proceed with the project unless it has in place long-term conditional enrichment contracts (that is, five years or longer) with price expectations sufficient to cover operating costs (including facility depreciation and decommissioning), with a return on investment.

The foregoing funding commitments, which will be in place prior to GLE Commercial Facility construction and operation, as applicable, are consistent with the license condition approved by the NRC in previous uranium enrichment facility licensing proceedings. See CLI-97-15, 46 NRC 294, 309 (1997) (Claiborne Enrichment Center); CLI-04-3, 59 NRC 10, 23 (2004) (National Enrichment Facility); and CLI-04-30, 60 NRC 426, 437 (2004) (American Centrifuge Plant).

GLE LA Chapter 10, *Decommissioning,* describes how reasonable assurance is provided that funds will be available to decommission the facility as required by 10 CFR 70.22(a)(9), *Contents of Applications (Ref. 1-17)*, 10 CFR 70.25, *Financial Assurance and Recordkeeping for Decommissioning (Ref. 1-18)*, and 10 CFR 40.36, *Financial Assurance and Recordkeeping for Decommissioning (Ref. 1-19)*.

1.2.2.3 Financial Resources

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. GLE currently expects to fund the construction costs through additional equity contributions provided by the parent companies. However, GLE may explore other funding options including, but not limited to additional equity owners (pending approval of the current parent companies) or long-term debt instruments.

A summary of the parent companies' total assets and net income for 2008 are provided below. All three of the parent organizations are publicly traded and additional information, including annual reports, are available on the companies' respective websites.

For the year ending December 31, 2008, GE had total assets (U.S. Dollars) of $797,769,000,000, with cash assets of $48,187,000,000. GE's net income in 2008 was $17,335,000,000.

For the year ending December 31, 2008, Hitachi had total assets (Japanese Yen) of JPY10,530,847,000,000, with cash assets of JPY622,249,000,000. Hitachi had a net loss in 2008 of JPY58,125,000,000.

For the year ending December 31, 2008, Cameco had total assets (Canadian Dollars) of C$7,010,601,000, with cash assets of C$269,176,000. Cameco's net income in 2008 was C$450,117,000.

1.2.2.4 Liability Insurance

GLE shall, in accordance with 10 CFR 140.13b, *Amount of Liability Insurance Required for Uranium Enrichment Facilities (Ref. 1-20)*, and prior to and throughout operation of the GLE Commercial Facility, have and maintain nuclear liability insurance in the amount of up to $200 million to cover liability claims arising out of any occurrence within the United States, causing, within or outside the United States, bodily injury, sickness, disease, or death, or loss of or damage to property, or loss of use of property arising out of or resulting from the radioactive, toxic, explosive, or other hazardous properties of chemical compounds containing source material or SNM.

The amounts of nuclear energy liability insurance required may be furnished and maintained in the form of:

- An effective facility form (non-indemnified facility) policy of nuclear energy liability insurance from nuclear facility underwriters;
- Such other type of nuclear energy liability insurance as the NRC may approve; or
- A combination of the foregoing.

GLE will provide proof of insurance to the NRC no later than October 15, 2010.

1.2.3 Type, Quantity, and Form of Licensed Material

GLE proposes to acquire, deliver, receive, possess, produce, use, transfer, and/or store source material and SNM meeting the criteria of SNM of low strategic significance as described in 10 CFR 70.4, *Definitions (Ref. 1-20)*. Details of the SNM are provided in Table 1-7, *Type, Quantity, and Form of Licensed Special Nuclear Material*. It is anticipated that other source and by-product materials will be used for instrument calibration purposes. These materials will be identified during subsequent design phases and the LA will be revised, as necessary.

GLE utilizes commercial natural UF_6 feed stock meeting the requirements of ASTM C787-06. At this time, GLE does not intend to use "reprocessed UF_6" as feed stock, and consistent with ASTM C787-06, GLE shall require that suppliers possessing feed cylinders contaminated with reprocessed UF_6 feed stock provide additional evidence of uranium purity that is backed up by statistical sampling of feed stock at GLE. As such, GLE expects to possess only trace amounts of other radionuclides consistent with the natural decay of uranium.

1.2.4 Requested Licenses and Authorized Uses

GLE is engaged in the production and sale of uranium enrichment services to electric utilities or fuel fabrication facilities for the purpose of manufacturing fuel to be used to produce electricity in commercial nuclear power plants. GLE also may purchase and enrich uranium for direct sale to fuel fabrication facilities. In addition, GLE may provide enrichment services for the U.S. government under certain contractual agreements.

This GLE LA is necessary for licenses issued under 10 CFR 30, 10 CFR 40, and 10 CFR 70 to construct, own, use, and operate facilities described herein as an integral part of the GLE Commercial Facility. This includes licenses for byproduct material, source material, and SNM. The license requested is for a 40-year period. See Section 1.1, *Facility and Process Description*, for a summary description of the GLE activities.

1.2.5 Special Authorizations and Exemptions

1.2.5.1 Authorized Guidelines For Contamination-Free Articles

GLE requests authorization to use the guidelines, contamination, and exposure rate limits developed by the NRC and included as Appendix A of this chapter titled *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material,* for decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. These guidelines are included as a regulatory acceptance criterion in NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility (Ref. 1-22).*

1.2.5.2 Exemption to Posting Requirements

GLE requests authorization to post areas within Radiological Controlled Areas (RCAs) in which radioactive materials are processed, used, or stored with a sign stating "Every container in this area may contain radioactive material," in lieu of the labeling requirements in 10 CFR 20.1904, *Labeling Requirements (Ref. 1-23).*

The requested exemption is authorized by law because there is no statutory prohibition on the proposed posting of a single sign indicating that every container in the posted area has the potential for internal contamination. Indeed, to reduce unnecessary regulatory burden, the NRC issued a final rule in 2007 that, in part, modified 10 CFR 20.1905, *Exemptions to Labeling Requirements (Ref. 1-24)*, thereby exempting certain containers holding licensed material from the labeling requirements of 10 CFR 20.1904 if certain conditions are met. Although the 2007 rulemaking only applied to facilities licensed under 10 CFR 50 and 10 CFR 52, *Licenses, Certifications, and Approvals for Nuclear Power Plants (Ref. 1-25)*, the rationale underlying the rule supports the exemption request. Exempting GLE from this requirement will reduce licensee administrative and information collection burdens, but serve the same health and safety functions as the current labeling requirements. Therefore, the exemption does not affect the level of protection for either the health and safety of workers and the public or for the environment; nor does it endanger life or property or the common defense and security.

The NRC approved a similar exemption from 10 CFR 20.1904 requested by a prior uranium enrichment facility license applicant. In approving the exemption, the NRC concluded:

"Under 10 CFR 20.2301, the Commission may grant exemptions from the requirements of the regulations, if it determines that the request will be authorized by law and will not result in undue hazard to life or property. Also, 10 CFR 20.1905(c) already exempts containers from 10 CFR 20.1904, if the containers are attended by an individual who takes the precautions necessary to prevent the exposure of individuals in excess of the limits established. The staff agrees that it would be impractical to label each and every container in restricted areas at this facility because of the large number of potential containers. Labeling each container may also reduce radiation safety by desensitizing the worker to radiation warning signs. Since there is no statutory provision prohibiting the granting of this exemption, the staff concludes that the request is authorized by law. Also, the exemption request is consistent with those approved previously at the gaseous diffusion plants and other fuel cycle facilities. Experience at facilities that have received the exemption from the labeling requirement demonstrates that the applicant's request will provide an equivalent amount of safety, and will not result in an undue hazard to individuals. Accordingly, the staff finds that the request will not be an undue hazard to life or property. Therefore, exemption to the requirements of 10 CFR 20.1904 is recommended." (Ref. 1-24)

1.2.5.3 Exemption to Decommissioning Funding Requirements

The following proposed exemption from the requirements of 10 CFR 70.25(e) and 10 CFR 40.36(d) addressing the decommissioning funding requirements is identified in the Decommissioning Funding Plan (DFP) and GLE LA Chapter 10, *Decommissioning.*

10 CFR 70.25(e) and 10 CFR 40.36(d) require, in part, that *"The decommissioning funding plan must also contain a certification by the licensee that financial assurance for decommissioning has been provided in the amount of the cost estimate for decommissioning..."*. In accordance with the DFP, GLE will incrementally fund that portion of its total decommissioning costs associated with the disposition of UF_6 tails generated by facility operation. Specifically, GLE will provide financial assurance for the disposition of UF_6 tails based on the expected amount of UF_6 tails to be generated annually, in a forward-looking manner. The NRC has previously approved the same incremental decommissioning financial assurance approach for USEC's American Centrifuge Project (ACP) and Louisiana Energy Services', L.P. (LES) National Enrichment Facility (NEF).

This exemption is justified for the following reasons:

- It is authorized by law because there is no statutory prohibition on incremental funding of decommissioning costs.
- The requested exemption will not endanger life or property or the common defense and security because UF_6 tails are generated incrementally over the life of the plant. GLE will provide financial assurance for UF_6 tails already generated that require disposal and the projected UF_6 tails to be generated in the next year. As such, requiring financial assurance for the disposition of UF_6 tails to be generated over the full licensed operating life of the enrichment facility – at the time of initial license issuance – would impose an unnecessarily large financial burden on the licensee.
- Granting this exemption is in the public interest for the same reasons stated above. Moreover, by eliminating an unnecessarily large financial burden on the licensee, the exemption will facilitate the deployment of an advanced, next-generation enrichment technology in the United States, in furtherance of important national energy objectives.

Finally, providing financial assurance for UF_6 tails disposition on an incremental basis is justified in view of GLE's commitments to: (1) provide full financial assurance for facility decommissioning (assuming a six MSWU facility) at startup (startup refers to when GLE receives licensed material); (2) update its UF_6 tails dispositioning cost estimate annually, on a forward-looking basis, to ensure that the financial assurance reflects the current projected inventory of UF_6 tails at the facility (including any previously-generated tails still requiring disposition); and (3) adjust other decommissioning costs periodically, and no less frequently than every three years. This approach will allow GLE to consider available operating experience and other relevant information, including actual UF_6 tails inventory values and generation rates, and to ensure that sufficient decommissioning financial assurance is available at any point during the licensed operating life of the facility.

1.2.5.4 Authorization to Use ICRP 68

GLE requests 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 (Ref. 1-26)*, in lieu of the values in Appendix B of 10 CFR 20, in accordance with approved written procedures.

The ICRP 68 guidance was promulgated after the 10 CFR 20, Appendix B criteria were established, and provides an updated and revised internal dosimetry model. Use of the ICRP 68 models provide more accurate dose estimates than the models used in 10 CFR 20, and allows GLE to implement an appropriate level of internal exposure protection. The NRC has established precedent for this exemption request from 10 CFR 20 in SECY-99-077.

1.2.5.5 Authorization to Make Changes to License Commitments

1.2.5.5.1 Changes Requiring Prior Approval

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

1.2.5.5.2 Changes Not Requiring Prior Approval

Upon documented completion of a change request for a facility or process, GLE may make changes in the facility or process as presented in the License Application, or conduct test 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 Application.

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.

1.2.5.6 Exemption from 10 CFR 21.3 Definitions

GLE requests authorization to replace the definitions of basic component, commercial-grade items, critical characteristics, dedication, and dedicating entity as they apply to facilities licensed pursuant to 10 CFR 70 with the following:

Basic Component: A structure, system, or component (SSC) designated as an item relied on for safety (IROFS), or part thereof 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 or this chapter, order, or license issued by the U.S. Nuclear Regulatory Commission (NRC) would create a substantial safety hazard (i.e., exceed the performance requirements of 10 CFR 70.61). In all cases, basic components include 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.

Commercial-Grade Item: A structure, system, or component (SSC), or part thereof that affects its 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.)

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 IROFS function.

Dedication Process: An acceptance process undertaken to provide reasonable assurance that a commercial-grade item or service to be used as a basic component will perform its intended item relied on for safety (IROFS) function and, in this respect, is deemed equivalent to an item designed and manufactured under a 10 CFR 50, Appendix B, Quality Assurance Program. 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 10 CFR 50, Appendix B. The process is considered complete when the item is designated for use as a basic component.

Dedicating Entity: The organization that performs the dedication process. 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), *Notification of Failure to Comply or Existence of a Defect and its Evaluation (Ref. 1-27),* 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.

1.2.5.7 CAAS Exemption on the Cylinder Storage Pads

GLE requests exemption from the use of a Criticality Accident Alarm System (CAAS) to cover the UF_6 Cylinder Storage Pads (MPF-106, -107, and -108), Trailer Storage Area, and UF_6 Cylinder Staging Area. The exemption is based on the full discussion presented in GLE LA Section 5.3.5.1 and is summarized as follows:

In the UF_6 Cylinder Storage Yards, most of the storage is provided for source material, not special nuclear material (SNM). Only 30B model cylinder containing SNM at 5 wt% ^{235}U, or less, is stored on the Product Pad. Storage of 30B model cylinders is short term and involves fewer cylinders than Tails or In-Process Storage thus further reducing the total likelihood for mishaps. Installation of CAAS to cover these storage yards will require detection clusters mounted high over the pads and require increased traffic into the storage yards for maintenance, functional testing, and calibration activities. This introduces additional hazards to the worker working at heights and presents an increased cylinder damage hazard from falling items and collapsing lift equipment.

1.2.6 Security of Classified Information

GLE has requested a facility security clearance, in accordance with 10 CFR 95, in a separate submittal. The use, processing, storage, reproduction, transmission, transportation or handling of classified information necessary to support this license application is currently controlled under the NRC authorized GNF-A facility security clearance at the Secret Restricted Data (SRD) level. As a result, access to restricted data (RD) or national security information (NSI) for the GLE Commercial Facility shall continue to be controlled by GNF-A in accordance with 10 CFR 25, *Access Authorization (Ref. 1-28)*, 10 CFR 95, and any other requirements that the NRC imposes through the issuance of Orders, until such time NRC processes GLE for an approved facility security clearance at the SRD level. Classified information associated with this LA, but not part of the facility security clearance request has been transmitted in a separate submittal.

1.3 SITE DESCRIPTION

This section contains a summary description of the Wilmington Site and surrounding areas. The GLE Environmental Report (ER) *(Ref. 1-29)* contains more detailed information regarding the site and its environs.

1.3.1 Site Geography

This section contains information regarding the site location, including nearby highways, bodies of water, and other geographical features.

1.3.1.1 Site Location Specifics

The GLE Commercial Facility is located on an existing industrial site in Wilmington, North Carolina. The existing Wilmington Site is situated on a 1621-acre tract of land, located west of North Carolina Highway 133 (also known as Castle Hayne Road). The Wilmington Site lies between latitudes (North) 34° 19' 4.0"and 34° 20' 28.9" and longitudes (West) 77° 58' 16.4" and 77° 55' 19.8", and is approximately six miles north of the City of Wilmington in New Hanover County, North Carolina (see Figure 1-1 and Figure 1-2). For further information, see Section 1.1.1.

The southeastern corner of the Wilmington Site is adjacent to the interchange of Interstate 140 with Castle Hayne Road. Current access to and from the Wilmington Site by trucks and other vehicle traffic is from Castle Hayne Road. Northbound Castle Hayne Road from the Interstate 140 interchange bordering the Wilmington Site is a four-lane road that continues for approximately one-half mile before narrowing to two lanes. The Wilmington Metropolitan Planning Organization designated Castle Hayne Road as an urban principal arterial south of Interstate 140 and as an urban minor arterial north of the Interstate 140 interchange.

1.3.1.2 Features of Potential Impact to Accident Analysis

The surrounding terrain is typical for coastal North Carolina. The terrain has an average elevation of less than 40 feet above msl and is characterized by gently rolling land, with rivers, creeks, swamps, and marshlands. Approximately 182 acres of the southwest portion of the Wilmington Site are classified as swamp forest. There are no mountain ranges nearby. The terrain of the GLE Site is very gently sloping (gradients less than 2 percent) with little relief; therefore, landslides are not credible events. There is no volcanic or glacial activity in the region or vicinity of the Wilmington Site.

The elevation of the GLE Site is above the 500-year coastal still water flood elevation (coastal still water elevations factor in potential impacts from storm surge, including tidal and wind setup effects). The GLE Commercial Facility is located outside both the 100- and 500-year flood plains and there are no dams in the vicinity that could contribute to a rapid flood event. The site may be subject to a maximum probable flood event resulting from combined river flooding of the Cape Fear and Northeast Cape Fear Rivers. This type of event would be very slow moving thus allowing ample warning for safe shutdown. Additionally, the design of systems and components within the facility are evaluated for the flooding to ensure any accidents that could result are "Highly Unlikely", and will not cause any accident scenarios resulting in consequences exceeding the performance criteria in 10 CFR 70.61.

Due to the curvature of the coastline in the area, the ocean lies approximately 10 miles east and 26.4 miles south of the Wilmington Site. The Federal Emergency Management Agency defines the geographic threshold for concern regarding a tsunami as one mile inland from the coast with an elevation of 25 ft above msl. Given the distance of the Wilmington Site from the ocean, there are no direct threat effects of a potential tsunami. Because of the distance of the Wilmington Site upstream from the Atlantic Ocean (approximately 23 river miles) and the height of the GLE Site above the 500-year floodplain, the indirect effects of flooding from a tidal bore in the Northeast Cape Fear River induced by a tsunami are minimal.

The Mid-Atlantic Coastal Plain province counties in North Carolina are in a low potential zone for the presence of radon gas relative to other regions in the state.

Soil samples collected at the GLE Site typically do not have high amounts of natural organic material. In addition, no peat deposits that could be a potential source of methane gas have been identified at the GLE Site. There are no municipal landfills on or in the immediate vicinity of the Wilmington Site that could generate methane gas; therefore, methane gas buildup beneath the Wilmington Site is not credible.

The projected lowering of the potentiometric surface at the GLE Site, as a result of the groundwater withdrawals from the aquifer on and in the vicinity of the Wilmington Site, is minimal, and no greater than the historical seasonal fluctuations observed in groundwater levels. In addition, the absence of a thick or regionally continuous confining bed at the GLE Site further minimizes the potential for subsidence as a result of lowered groundwater levels; therefore, subsidence due to dewatering is not credible. Likewise, there are no active mines adjacent to the Wilmington Site or known economic deposits of minerals, stone, or fuel materials that could cause subsidence at the GLE Site.

1.3.2 Demographics

This section provides the current census results (calendar year [CY] 2000) for the area surrounding the Wilmington Site, to include specific information about populations, public facilities, and industrial facilities. Land use and nearby bodies of water are also described.

1.3.2.1 Latest Census Results

According to the U.S. Census Bureau's 2000 Decennial Census *(Ref. 1-30)*, a total of 321 census blocks fall within a five-mile radius of the Wilmington Site. The majority of these census blocks (261) is within New Hanover County and includes 12,997 persons and 4,953 households. A total of 57 Pender County census blocks are within the five-mile radius, with a combined population of 3,305 persons and 1,274 households. An examination of census block data from CY 2000 reveals a total of three census blocks in Brunswick County with some portion of the total area inside the five-mile radius. The total population of these three census blocks is 36 persons in 17 households. Blocks with any portion of their area inside the five-mile radius were included in this population count. (See GLE ER Section 3.10.1 for additional information.)

1.3.2.2 Description, Distance, and Direction to Nearby Population Area

The region around the site is lightly settled with large areas of heavily timbered tracts of land. Farms, single-family dwellings, and light commercial activities are located along North Carolina Highway 133. In the eastern and southern vicinities of the Wilmington Site, residential uses are dominant due to the presence of the Wrightsboro (south), Skippers Corner (east), and Castle Hayne (northeast) communities. Wrightsboro has a population of approximately 4500, Skippers Corner has a population of approximately 1200, and Castle Hayne has a population of approximately 1100. (See GLE ER Section 3.1 for additional information.)

1.3.2.3 Proximity to Public Facilities

Figure 1-6, *Community Characteristics Near the Wilmington Site*, shows the location of schools and parks with respect to the five-mile Wilmington Site radius. There are a total of 90 public and private elementary, middle, and high schools in the three-county region. In addition to these primary and secondary schools, colleges such as the University of North Carolina at Wilmington (UNC-W), Brunswick Community College, and Cape Fear Community College are located in the region. Out of the 90 schools in the region, one is within a four-mile radius of the GLE Site (Wrightsboro Elementary) and 21 schools are within an eight-mile radius of the GLE Site. The nearest hospital, New Hanover Regional Medical Center, is approximately six miles from the Wilmington Site.

No state or federal parks are located within five miles of the Wilmington Site. There are 18 parks, three trails, and three gardens maintained by New Hanover County. Four of the parks are located within a five-mile radius of the Wilmington Site.

1.3.2.4 Nearby Industrial Facilities

The Northeast Cape Fear River borders the Wilmington Site to the west, and industrial land uses are dominant on the opposite (west) side of the river. The BASF Corporation, Elementis Chromium Facilities, and the L.V. Sutton coal-fired power plant operated by Progress Energy are examples of industrial operations located in this area. The industrial area sits between the Northeast Cape Fear River and the main branch of the Cape Fear River.

1.3.2.5 Land Use within a Five Mile Radius

The land use in the vicinity of the Wilmington Site is discussed below and generally covers the five-mile radius around the Wilmington Site. The Wilmington Site is a 1,621-acre parcel, owned by the GE, located west of Castle Hayne Road (otherwise known as North Carolina Highway 133). The property is currently zoned I-2, which is described in the New Hanover County zoning code as intended for heavy industrial uses. No portion of the property is currently used for agricultural purposes.

Immediately north of the Wilmington Site is a large parcel of approximately 4,069 acres owned by Hilton Properties. The current zoning designation for this property is Rural Agricultural, which is designed for low-density residential development with an emphasis on farming and open-space preservation. This parcel is locally known as the Sledge Forest and is currently used for timber management and as a private hunting area. Access to the Sledge Forest is provided via a private, unpaved road that intersects with Castle Hayne Road and closely follows the northern property line of the Wilmington Site.

The Northeast Cape Fear River borders the Wilmington Site to the west, and industrial land uses are dominant on the opposite (west) side of the river. The BASF Corporation, Elementis Chromium facilities, and the L.V. Sutton coal-fired power plant operated by Progress Energy are examples of industrial operations located in this area. The industrial area sits between the Northeast Cape Fear River and the main branch of the Cape Fear River. In the eastern and southern vicinities of the Wilmington Site, residential uses are dominant due to the presence of the Wrightsboro (south), Skippers Corner (east), and Castle Hayne (northeast) communities.

Three public schools are located within five miles of the Wilmington Site: Wrightsboro Elementary School, Emma B. Trask Middle School, and Emsley A. Laney High School. Trask Middle School also serves as an emergency shelter for New Hanover County.

The Wilmington International Airport (ILM) is located approximately five miles south-southeast from the Wilmington Site. The New Hanover County Landfill is located approximately four miles southwest of the Wilmington Site.

1.3.2.6 Land Use Within One Mile of the Facility

As described above, the Wilmington Site is bordered on the north by the Sledge Forest and on the west by the Northeast Cape Fear River. Castle Hayne Road borders the eastern portion of the site. Further north along Castle Hayne Road, are four mobile homes located on the opposite side of the street from the Wilmington Site. Adjacent to the site on the northeast side is the Wooden Shoe residential subdivision. Located adjacent to the Wilmington Site's eastern boundary across Castle Hayne Road, are the North Carolina State University Horticultural Crops Research Station, a truck parking lot, and a small recreational park for use by Wilmington Site employees (owned by GE). Directly south of the site is the Interstate 140, and beyond the interstate is a small residential area.

1.3.2.7 Uses of Nearby Bodies of Water

A portion of the Wilmington Site borders the Northeast Cape Fear River. Both commercial and recreational fishing occur on the Northeast Cape Fear River. Commercial fishing is more prevalent downstream of the Wilmington Site and in the Cape Fear River Estuary.

1.3.3 Meteorology

1.3.3.1 Primary Wind Directions and Average Wind Speeds

On an annual basis, the wind direction (direction from where the wind is blowing) at Wilmington International Airport is predominantly southwesterly *(Ref. 1-31)*; thus, reflecting the general synoptic scale wind pattern. In contrast, the predominant wind direction during the fall and winter is often northerly, due largely to the influence of invading polar air masses and changes in global circulation *(Ref. 1-31*; *Ref. 1-32)*. Figure 1-7, *Wind Rose for Wilmington International Airport*, shows the overall wind rose for Wilmington International Airport. The annual prevailing wind speed at the airport is 10.4 mph (9 knots) *(Ref. 1-31)*.

1.3.3.2 Annual Precipitation – Amounts and Forms

The mean annual precipitation in eastern North Carolina is heaviest in the southeast corner of the state and steadily decreases toward the north and west. The higher precipitation amounts are due to higher levels of moisture provided by the Atlantic Ocean. The area along the North Carolina coast experiences afternoon showers and thunderstorms often during the summer months. These storms form along a sea breeze front as it moves inland from the coast. The mean annual precipitation for the area around the GLE Commercial Facility is approximately 55.0 inches/year according to the 1948 to 1995 dataset *(Ref. 1-31)* and 57.1 inches/year according to the 1971 to 2000 dataset *(Ref. 1-33)*.

Due to the moderate climate, Wilmington receives very little snowfall, except on rare occasions. On average, only about 2.1 inches of snowfall occurs annually. December and January are expected to receive the most average snowfall, at 0.6 inches *(Ref. 1-33)*. Wilmington also receives only a small amount of sleet. The mean recurrence interval for measurable sleet in Wilmington, North Carolina, is approximately 4.6 years, or an annual probability about 22 percent. Sleet greater than 0.25 inches has a mean recurrence interval of only once every 46 years, or an annual probability of about 2 percent *(Ref. 1-34)*. Freezing rain usually poses a higher risk to power systems and trees than sleet. Freezing rain does not occur often in Wilmington, although it occurs more often than sleet *(Ref. 1-34)*. Measurable accumulations occur in Wilmington with a mean recurrence interval of about 1.5 years, or an annual probability of 67 percent. More significant accumulations of less than 0.25 inches occur with a mean recurrence interval of 7.7 years, or an annual probability of 13 percent. Accumulations of less than 0.5 inches, which are very likely to affect power lines and trees, are expected to occur in Wilmington at a mean recurrence interval of 46 years, or an annual probability of 2 percent.

1.3.3.3 Severe Weather

1.3.3.3.1 Extreme Temperature

The highest recorded temperature at Wilmington International Airport for the period of record is 104.0°F, which occurred during June 1952 *(Ref. 1-33)*. The lowest recorded temperature of 0.0°F occurred in December 1989 *(Ref. 1-33)*. This shows that the maximum annual temperature range at the Wilmington Site is about 104.0°F.

1.3.3.3.2 Extreme Precipitation

Tropical storms and hurricanes occur in and around the southeastern United States, making Wilmington prone to high amounts of rainfall over a short time period. The highest recorded 24-hour rainfall amount of 13.38 inches at Wilmington International Airport occurred during September 1999 due to the effects of Hurricane Floyd making landfall on the North Carolina Coast *(Ref. 1-33)*. The maximum one-time extreme rainfall resulting from Hurricane Floyd is considered the deterministically defined maximum extreme rainfall event. Considering the expected precipitation intensity, Wilmington International Airport has a 1 in 50 annual exceedance probability (AEP) of receiving precipitation at a rate of 11.86 inches/hour for a duration lasting five minutes. The AEP for precipitation with a rate of 16.05 inches/hour occurring for five minutes is about 1 in 1,000. Generally, the intensity of rainfall that could occur for a given AEP decreases as the duration of the precipitation event increases *(Ref. 1-35)*. Based on GLE site elevation and facility design, a severe local storm that meets the deterministically defined maximum extreme rainfall event would not flood the GLE facility site, nor impact the design of the structures.

On rare occasions, Wilmington can receive large snowfall amounts. During a storm event in late December 1989, the area received 9.6 inches of snow in a 24-hour period *(Ref. 1-32 and 1-36)*. This December 1989 storm also matched a previous record snow depth of 13 inches and is used as the deterministic design basis snow load event. The roof design parameters for the GLE Commercial Facility as required by the International Building Code (IBC) for the region exceed the expected loadings from snow and ice. However, the highest drift snow load may exceed the normal snow load, which could impact the live load roof capacity at roof locations where there is an interface between roof elevation changes. For the roof decking in these interface areas, the snowdrift load could cause the decking to first sag and eventually fail, allowing snow and water to enter the building. It is important to note that in the locations where these failures could occur, licensed material or hazardous chemicals are not present, thus this type of roof failure does not represent a high or intermediate consequence event. As a result, the impact of a severe snow event, including up to the snow loads in the design basis snow load event, is determined to be "Highly Unlikely" to result in consequences in excess of the performance criteria in 10 CFR 70.61.

1.3.3.3.3 Extreme Winds

Extreme winds may occur at Wilmington International Airport due to localized events, such as thunderstorm downdrafts, microbursts, or tornadoes. In addition, the airport lies in a particularly vulnerable location for hurricane-force winds. As of 1995, the highest wind gust measured at the airport was approximately 78 mph (68 knots) *(Ref. 1-31)*; however, since that time, Wilmington has experienced Hurricanes Fran (1996), Floyd (1999), and Charley (2004). Hurricane Fran had a peak gust of approximately 86 mph (75 knots) measured at the Wilmington International Airport. Hurricane Floyd similarly caused a wind gust of approximately 86 mph (75 knots) at the airport *(Ref. 1-37)*. Hurricane Charley had somewhat lower wind gusts of approximately 74 mph (64 knots) at the airport *(Ref. 1-38)*. The likelihood and consequences of design basis wind velocities are discussed further in Section 1.3.3.3.7.

1.3.3.3.4 *Thunderstorms*

Rainfall in the region during the summer months comes primarily from thunderstorms. These storms occur on approximately 33 percent of days during June through August in the vicinity of the Wilmington Site and are scattered and uneven in coverage *(Ref. 1-31)*. Although the inland advance of the sea breeze front often causes summer thunderstorms, other primary causes of thunderstorms in the Wilmington area are tropical storms or hurricanes approaching from the south and southeast, and large-scale synoptic fronts approaching from the north and west. The latter two causes of thunderstorms also increase the chance of severe weather. For example, hail is observed in the Wilmington area on an average of about once per year *(Ref. 1-31)* and is most likely to be associated with synoptic frontal thunderstorms. Severe thunderstorms may produce damaging straight-line winds greater than 57 mph (50 knots). According to the National Severe Storms Laboratory (NSSL) *(Ref. 1-39)*, the area surrounding the Wilmington Site experiences approximately four days per year of damaging thunderstorm winds or winds less than 57 mph (50 knots) due to a thunderstorm.

1.3.3.3.5 *Lightning*

Another hazard of thunderstorms is lightning, which can strike miles from a thunderstorm and often occurs without warning. Besides the obvious danger to personnel working outside, lightning can disrupt electrical circuits and cause fires. The region surrounding the Wilmington Site has experienced a lightning flash density ranging from 4 to 8 flashes/km^2/year over the period from 1996 through 2000.

1.3.3.3.6 *Tornados*

Fifteen tornadoes are known to have touched down in New Hanover County, North Carolina, between 1950 and 2004, including waterspouts in the sound and on the Atlantic Ocean. The strongest of these 15 tornadoes occurred on June 13, 1962 in the western part of the county and measured F2 on the Fujita scale (meaning it was capable of producing considerable damage). Wind speeds associated with an F2 tornado are between 113 - 157 miles per hour (mph).

Based on evaluation of data from the National Severe Storms Laboratory *(Ref. 1-39)*, a tornado would be expected to occur within 25 miles of the Wilmington Site on 0.4 to 0.6 days per year. The ocean covers a significant portion of the area within 25 miles of the Wilmington Site; therefore, some of these tornadoes could occur as waterspouts. From a probabilistic perspective, tornado design basis guidance indicates that tornadoes in the Wilmington area would be expected to have up to 230-mph maximum winds at an exceedance probability of 10^{-7} per year *(Ref. 1-40)*. This change in expected intensity would not be abrupt, but due to the coarse nature of the grid cells used in Regulatory Guide 1.76, *Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants (Ref. 1-41)*, to calculate the intensity regions, there is a sharp demarcation between regions. Nevertheless, using this approach, the likelihood of a tornado of this magnitude is "Highly Unlikely".

Because there is no record of an F4 or F5 tornado in NC, and none of the tornadoes in the Wilmington area were stronger than a F1 tornado, from a deterministic perspective, a conservative tornado for the GLE site would be a F3 tornado (118 to 161 mph 3-second gust speed equivalent). NUREG/CR-4461, *Tornado Climatology of the Contiguous United States (Ref. 1-42),* indicates that the tornado wind speed with an annual probability of 10^{-5} is 140 mph (3-second gust speed) for the region (Region II) in which the GLE site is located. In accordance with the performance requirements of 10 CFR 70.61 in Subpart H a tornado with an annual probability of 10^{-5} can be considered as a "Highly Unlikely" event. Since the 140 mph tornado wind speed compares with the wind speeds associated with the deterministic F3 tornado for the site, the deterministic tornado wind speed for the site is 140 mph (3-second gust speed). This magnitude wind is bounded by the wind speed identified for hurricanes as described below.

1.3.3.3.7 Tropical Storms and Hurricanes

The area of New Hanover County could expect the following return periods for each category of hurricane passing within approximately 86 miles (75 nautical miles):

- Category 1, 6 to 10 years;
- Category 2, 23 to 30 years;
- Category 3, 33 to 44 years;
- Category 4, 79 to 120 years; and
- Category 5, 191 to 250 years (*Ref. 1-40*).

Because winds are stronger on the right side of the storm's eye, causing more wind damage and higher storm surges, the greatest meteorological threat to New Hanover County comes from hurricanes that strike land in the approximate area between the South Carolina border and the outlet of the Cape Fear River. In addition, the strongest bands of rain occur in front of a hurricane as it approaches, resulting in a great deal of heavy, flooding rain in New Hanover County when a storm approaches this area of coastline. Between 1954 and 2004, three hurricanes, ranging from Category 1 through Category 3, made landfall in the area. Two of the hurricanes, Hurricanes Hazel (1954) and Fran (1996), were Category 3 storms that made landfall with winds between 111 to 130 mph.

Based on the above, the most severe hurricane recorded in proximity to the Wilmington Site is a Category 3 hurricane, however a Category 4 hurricane is used as the deterministic hurricane for GLE facility design. The wind speeds for a Category 4 hurricane range from 131 to 155 mph. When comparing the various contributors to wind speeds (thunderstorms, tornados, hurricanes), the hurricane is the source of the highest wind speed of up to 155 mph, thus this value is the design basis wind velocity. The wind speed defined in ASCE 7-05, *Minimum Design Loads for Buildings and Other Structures (Ref. 1-43)*, to be applied for the GLE facility on the Wilmington Site is 140 mph. Implementation of the wind design requirements in ASCE 7-05 requires the use of a loading factor of 1.6 to wind loads, which is equivalent to using a wind speed of 177 mph for the design. Because the equivalent design wind of 177 mph for the GLE facility is larger than the design basis wind velocity of 155 mph, the design basis wind event is considered to be "Highly Unlikely" and will not cause any accident scenarios resulting in exceeding the performance criteria in 10 CFR 70.61.

According to the examination of NOAA storm surge data *(Ref. 1-44)*, most portions of the Wilmington Site at an elevation of 25 feet above msl, including the GLE Commercial Facility would not be directly affected by the highest storm surge. This is further supported by the storm surge potential from hurricanes being estimated at 21.94 feet as presented in Regulatory Guide 1.59, *Design Basis Floods for Nuclear Power Plants (Ref. 1-45)*. As a result, the event potential from a hurricane induced storm surge event as "Highly Unlikely."

1.3.3.3.8 Floods

The GLE Site does not fall within 100-year or 500-year floodplains *(Ref. 1-46)*; however, some of the low-lying areas on the Wilmington Site contain swamp forest that borders the Northeast Cape Fear River. Much of this swamp forest is in the floodplain and may flood upstream during extreme rain events. As a result, the GLE site may be subject to a maximum probable flood event as discussed in Section 1.3.1.2.

1.3.4 Hydrology

The section contains descriptions of nearby water bodies, groundwater on and near the Wilmington Site, and design basis flood events.

1.3.4.1 Characteristics of Nearby Rivers, Streams, and Other Bodies of Water

Bodies of water in the vicinity of the Wilmington Site are the Northeast Cape Fear River (which borders the Wilmington Site to the west) and its associated tributaries and creeks. The Northeast Cape Fear River is a blackwater river with relatively low levels of dissolved oxygen and higher turbidity than the Cape Fear River. The Northeast Cape Fear River and its tributaries have a naturally low pH and are classified as swamp water by the North Carolina Department of Environment and Natural Resources Division of Water Quality. At the Wilmington Site, the river is tidally influenced. Salinity concentrations vary with the rate of freshwater input and the amount of tidal exchange.

On the Wilmington Site, there are three streams that provide habitat to aquatic wildlife. Two of the streams, unnamed Tributaries No. 1 and No. 2 (located in the Swamp Forest community in the Western Site Sector), drain to the Northeast Cape Fear River. The remaining stream is located on the Eastern Site Sector and drains northward to Prince George Creek. The first two are unnamed tributaries to the Northeast Cape Fear River and are classified as freshwater streams, but their lower reaches are tidally influenced by the river. The third stream, the unnamed tributary to Prince George Creek, is a freshwater stream and is not tidally influenced within the Wilmington Site. All three streams are capable of accommodating the aquatic species associated with the neighboring Northeast Cape Fear River. However, the tidal variations in dissolved oxygen and salinity may affect the suitability of the habitat for some species.

In addition, there are three (3) small ephemeral ponds in the Western Site Sector and North-Central Site Sector, along with wetland areas throughout the Site that provide habitat. These areas provide a water source for wildlife found on the Wilmington Site.

1.3.4.2 Depth to the Groundwater Table

On the Wilmington Site, the water table is generally located near the land surface averaging approximately 9 feet below ground surface (bgs) with a range from 0 to 20 feet bgs.

1.3.4.3 Groundwater Hydrology

The Wilmington Site is within the North Carolina Coastal Plain physiographic province, which extends from the Piedmont eastward to the North Carolina coast. The coastal aquifer system is an eastward-dipping and eastward-thickening wedge of depositional sediments and sedimentary rock underlain by a crystalline, eroded surface of igneous and metamorphic rock (Precambrian or Early Paleozoic age). Six regional aquifers are present in the region surrounding the Wilmington Site, including the Surficial Aquifer, Castle Hayne Aquifer, Peedee Aquifer, Black Creek Aquifer, and the Upper and Lower Cape Fear Aquifers. The aquifers are water-yielding formations that are more permeable than the finer-grained formations (confining units) that are typically above and/or beneath these coastal aquifers. In most areas, a less-permeable confining unit, with the exception of the Surficial Aquifer, overlies each aquifer that is under water-table conditions. The aquifers and confining units consist of sands, conglomerates, silts, clays, shell hash, and fossiliferous limestones deposited in nearshore and deltaic to offshore marine environments *(Ref. 1-47)*.

1.3.4.4 Characteristics of the Uppermost Aquifer

The Surficial Aquifer includes undifferentiated, stratified sediments. These sediments typically include terraced and barrier beach deposits, fossil sand dunes, and stream channel deposits. The sediment texture varies from medium- to fine-grained sands to silts and clays. This aquifer is recharged directly by rainfall, and the water table is generally located relatively near the land surface (approximately averaging 9 feet bgs with a range from 0 to 20 feet bgs). The hydraulic conductivity of the Surficial Aquifer has been estimated to be approximately 130 feet/day.

The Surficial Aquifer discharges into streams, drainage canals/ditches, and the low-lying swampy areas on the Wilmington Site. In addition, the Surficial Aquifer recharges groundwater into the underlying Peedee Aquifer (referred to as the Principal Aquifer). Due to yield limitations, water supply from the Surficial Aquifer is primarily restricted to domestic use.

The Wilmington Site wells produce from the Peedee Aquifer, which is the principal aquifer under the site. Groundwater is used at the existing Wilmington Site for industrial process water and drinking water. The average annual withdrawal is approximately 1.0 million gpd. Water levels measured in wells that tap the Peedee Aquifer at the Wilmington Site were evaluated in terms of the long-term sustainability of the water resource. The water levels in the aquifer do not show a long-term downward trend. A review of potential future changes to the withdrawal rates indicate that the existing water use and future estimates (approximately 10 percent increase) do not exceed the sustainable yield of the aquifer in this area (See GLE ER). The hydraulic conductivity of the Peedee Aquifer has been estimated to be approximately 38 feet/day.

1.3.4.5 Design Basis Flood Events Used for Accident Analysis

The GLE Commercial Facility is located on a high bluff, outside the 100-year (10^{-2}) and 500-year (2×10^{-3}) floodplains (that is, 0.2% chance of a catastrophic flood occurring at the level of a 500-year floodplain during any year). These flood levels occur at approximately 20 – 25 feet above msl. The Operations Building first floor elevations are above 25 feet msl.

1.3.5 Geology and Seismology

This section describes the geology and seismology at the Wilmington Site, including soil characteristics, earthquake magnitudes and return periods, and other geologic hazards.

1.3.5.1 Characteristics of Soil Types and Bedrock

Generally flat topography characterizes most of the Wilmington Site's physiography; however, the GLE Site is positioned on a topographic high compared to the adjacent land in that area of the Wilmington Site. The ground surface begins to gently roll into small low hills in the Northwestern Wilmington Site Sector, suggesting the presence of possible sand dune or remnant terrace deposits from shoreline migration in the recent geologic past. The Northeast Cape Fear River and its floodplain are the most prominent physiographic features bordering the Western and Northwestern Wilmington Site sectors. High bluffs and extensive estuarine areas along this reach of the river help protect the GLE Site from flooding events. The area west of the river channel scar, which is clearly visible in aerial images, marks an ancient flow boundary of the Northeast Cape Fear River. The abandoned part of the channel is today an estuarine area of low topographic relief bordering the current river's edge.

Surficial sedimentary deposits at the Wilmington Site are interpreted to be mostly a result of deposition in the geologic past associated with the ancient Northeast Cape Fear River system. These surficial deposits overlie the Peedee Formation at the Site and are largely undifferentiated and unconsolidated alluvial sands, clayey sands, and clays. Some of these deposits are previously deposited marine sediments that were reworked and re-deposited by alluvial processes.

The sedimentary sequence in the GLE Site is comprised of 10 to 30 feet of thin layers of silty fine sands, silty fine clayey sands, fine sandy silts, and fine sandy clays that overlie the Peedee Formation. Surficial sands are present in the area with an apparent average thickness of less than 5 feet. Thicker surficial sand deposits of approximately 10 feet thick are present in some areas. Surficial sediments in the uppermost 4 to 10 feet of this sector range from dark brown and black sand with some organic material to gray and tan fine- to medium-grained sand with minimal gravel. Beneath these sands, a dark gray, very silty and clayey fine sand is present in some locations.

At the base of the surficial deposits in many locations on the Wilmington Site lies a substantial marine clay layer considered to be part of the Peedee Formation. The Peedee Clay layer is encountered at a typical depth range of 20 to 30 feet. Hydraulically, the Peedee Clay forms an important semi-confining unit overlying the Peedee Aquifer, which is the source of process water for the existing Wilmington Site. The presence of glauconite throughout the Peedee Clay and the absence of reworked sediments more characteristic of shallower alluvial deposits suggest the Peedee Clay is of marine origin; therefore, this marine clay layer is stratigraphically considered part of the Peedee Formation. The Peedee Clay varies in both thickness and distribution across the Site.

Field observations of samples collected during investigations of the GLE Site indicate that the consistency of the Peedee Clay is generally firm, but can be softer if located near the ground surface. In general, this clay layer contains more silt than sand and is easily distinguished from other surficial alluvial clays present in some areas of the GLE Site by the uniform presence of glauconite and the Peedee Clay's characteristic gray to dark gray color.

The potential for differential settlement, or the difference in settlement across a foundation, was considered when preparing facility and roadway engineering designs. No soil types on the GLE Site pose any construction concerns.

Previous geotechnical investigations on the Wilmington Site found that soil conditions required the use of a specialized structural in-ground support system. A geotechnical design investigation to determine the structural in-ground support system necessary to support the estimated heavy loading will be completed prior to commencement of construction. The geotechnical design investigation will be performed using the applicable regulatory guidance in Regulatory Guide 1.132, *Site Investigations for Foundations of Nuclear Power Plants (Ref. 1-48).*

1.3.5.2 Earthquake Magnitudes and Return Periods

Earthquake epicenters in the southeastern United States generally extend in a northeasterly orientation along the axis of the Appalachian Mountain range. In North Carolina, the vast majority of seismic activity is concentrated in the western mountainous regions, where sutures and faults are predominantly associated with North American collisional tectonics. There are clusters of events scattered throughout South Carolina, and a few isolated occurrences of singular events along the coast. A small number of events are recorded along the Mid-Atlantic Coastal Plain physiographic province. In summary, seismicity levels are low outside of the Charleston region and the mountains to the west. In the Wilmington Site region, seismicity levels are relatively low.

Since the mid-1990s, the U.S. Department of the Interior has published probability of exceedance maps for ground shaking at one and five hertz (Hz) for a 50-year time span *(Ref. 1-36)*. A spectral acceleration of one Hz represents low frequency ground shaking (appropriate for Rayleigh and Love surface waves), whereas a five-Hz spectral acceleration represents high-frequency ground shaking related to body waves (P-waves and S-waves). For many cases of interest, the primary controlling earthquake is the postulated event that governs the spectral accelerations in the five-to ten-Hz range *(Ref. 1-49)*. The maps are developed for peak horizontal ground acceleration or spectral accelerations with two percent, five percent, or ten percent probability of being exceeded in 50 years on uniform firm-rock site conditions (Vs30 = 760 m/s). These data present the peak acceleration for earthquakes believed to be likely near a given site. The Wilmington Site has a peak acceleration of approximately 0.1 g at two percent probability for five Hz wave over 50 years. This corresponds to a peak acceleration of approximately 0.03 g for a ten percent probability of exceedance in 50 years (500-yr earthquake).

There are no significant geological features in the Wilmington region that would produce a major earthquake. The IBC has identified this area as Zone 1 and considers seismic events of minor magnitude (Mercalli VI, Richter 5.5 – 6.0).

The Charleston, S.C., earthquake of 1886 was felt in Wilmington, producing effects equivalent to Mercalli V– VI (Richter 4.8 – 5.4). Since then there have been nine recorded seismological events in the Wilmington area, all of which have been minor in nature, producing effects no greater than Mercalli IV (Richter 4.5). The U.S Geological Survey predicts the probability of a Richter 4.75 event at 2 x 10-4 and a Richter 5.0 at 2 x 10–5.

Based on the U.S. Geological Survey, documented historical events, the IBC design criteria, and the design margins used both in establishing the IBC criteria and the building designs to meet the IBC, it is improbable that an earthquake would affect the structures on the GLE Commercial Facility Site in such a way as to cause an accident scenario resulting in consequences exceeding the performance criteria in 10 CFR 70.61.

1.3.5.3 Other Geologic Hazards

As described in Section 1.3.1.2, other geologic hazards are not present at the Wilmington Site. There are no mountain ranges nearby. The terrain of the GLE Site is very gently sloping (gradients less than two percent) with little relief; therefore, landslides are not credible events. There is no volcanic or glacial activity in the region or vicinity of the Wilmington Site.

Soil samples collected at the Wilmington Site typically do not have high amounts of natural organic material. In addition, no peat deposits that could be a potential source of methane gas have been identified within the GLE Site.

The projected lowering of the potentiometric surface in the GLE Site as a result of the groundwater withdrawals from the aquifer on and in the vicinity of the Wilmington Site is minimal, and no greater than the historical seasonal fluctuations have been observed in groundwater levels. In addition, the absence of a thick or regionally continuous confining bed on the GLE Site further minimizes the potential for subsidence as a result of lowered groundwater levels; therefore, subsidence due to dewatering is not credible.

There are no active mines adjacent to the Wilmington Site or known economic deposits of minerals, stone, or fuel materials that could cause subsidence at the GLE Site.

Using the soil information from the geotechnical design investigation mentioned in Section 1.3.5.1, the following activities will be conducted:

- The assessment of liquefaction potential of subsurface soils will be completed using the applicable guidance contained in Regulatory Guide 1.198, *Procedures and Criteria for Assessing Seismic Soil Liquefaction as Nuclear Power Plant Sites (Ref. 1-50).* The Ground Motion Response Spectra used for the liquefaction analysis will be based on guidance contained in the *International Building Code (Ref. 1-51).*

- Allowable bearing pressures for shallow and deep foundations will be evaluated using established geotechnical engineering methods. Methods anticipated for use include those contained in the following publications: NAVFAC DM 7, *Naval Facilities Engineering Command Design Manual (Ref. 1-52)*; *Foundation Engineering Handbook (Ref. 1-53)*; *Foundation Analysis and Design (Ref. 1-54)*; and FHWA-IF-99-025, *Drilled Shafts: Construction Procedures and Design Methods (Ref. 1-55).*

The evaluation of total and differential settlement for structure foundations will be completed using established geotechnical engineering methods. Methods anticipated for use include those contained in the following publications: NAVFAC DM 7, Foundation Engineering Handbook; and Foundation Analysis and Design.

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Table 1-1. Typical Types, Sources, Quantities of Solid Wastes Generated by GLE Commercial Facility Operations.

Waste Type	Waste Source	Estimated Average Annual Quantity Generated
Municipal Solid Waste (MSW)	General worker operations, maintenance, and administrative activities not involving the handling of or exposure to uranium	380 ton/yr
Non-hazardous Industrial Wastes	Non-hazardous wastes from equipment cleaning and maintenance activities (for example, used coolant, non-hazardous caustic, and filter media) that are recyclable or not accepted by MSW landfill	107 ton/yr
Resources Conservation and Recovery Act (RCRA) hazardous waste	Wastes designated as RCRA hazardous wastes from equipment and maintenance activities (for example, used cleaning solvents and used solvent-contaminated rags)	12 ton/yr
Low-Level Radioactive Waste (LLRW)	Laboratory waste from UF_6 feed sampling and analysis	97 lb/yr
	Combustible, uranium-contaminated used items (for example, worker personal protection equipment, swipes, step-off pads)	92 ton/yr
	Noncombustible, uranium-contaminated, used items (for example, spent filters from HVAC systems, liquid radiological waste treatment system, and area monitors) and corrective maintenance items (defective pigtails, valves, and other safety equipment that needs replacement)	863 yd^3/yr
	Liquid radiological waste treatment system filtrate/sludge	670 lb/yr

Table 1-2. Management of Solid Wastes.

Solid Waste Source	Onsite Waste Management	Offsite Waste Treatment/Disposal
Municipal solid waste (MSW)	Collected and temporarily stored in roll-off containers	Filled roll-off containers transported by commercial refuse collection service to an approved disposal site
Non-hazardous wastes from operations equipment cleaning and maintenance activities that are recyclable or not accepted by MSW landfill	Collected and temporarily stored in containers	Filled containers transported by truck to an approved disposal site[a]
Wastes designated as Resource Conservation and Recovery Act (RCRA) hazardous wastes	Collected and temporarily stored in containers	Filled containers transported by truck to an approved disposal site[b]
Laboratory waste from UF_6 feed sampling and analysis	Collected and temporarily stored in containers	Either transported by truck to an approved disposal site or transported to an approved uranium recovery vendor.
Combustible used or spent uranium-contaminated materials	Collected and temporarily stored in containers	Either transported by truck to an approved disposal site or transported to an approved uranium recovery vendor.
Non-combustible used or spent uranium-contaminated materials	Collected and temporarily stored in boxes	Filled boxes transported by truck to an approved disposal site[c]
Liquid Radiological Waste Treatment System filtrate/sludge	Collected and temporarily stored in metal cans	Filled cans transported by truck to an approved disposal site

[a] Licensed RCRA Subpart D landfill.

[b] Licensed RCRA Subpart C Treatment, Storage, and Disposal Facility (TSDF).

[c] Licensed Low-Level Radioactive Waste Disposal Facility.

Table 1-3. Typical Types, Sources, and Quantities of Wastewater Generated by GLE Commercial Facility Operations.

Wastewater Type	Wastewater Source	Typical Average Daily Quantity Generated
Process liquid radiological waste	Wastewaters from the Operations Building Decontamination/Maintenance Area; process area floor drains, sinks, sumps, and mop water; Laboratory Area floor drains, sinks, sumps, and mop water; change room showers and sink; and aqueous process liquids that have the potential to contain uranium	5,000 gpd
Cooling tower blowdown	Operations Building HVAC cooling tower	30,000 gpd
Sanitary Waste	Sanitary waste from building areas used by GLE personnel (for example, restrooms, break rooms)	10,500 gpd
Stormwater	Stormwater runoff from impervious surfaces (for example, building roofs, parking lots, service roads, outdoor storage pads, and other maintained areas)	Variable depending on local precipitation

Table 1-4. Management of Wastewater Generated by GLE Commercial Facility Operations.

Wastewater Type	Onsite Waste Management	Offsite Waste Treatment/Disposal
Process liquid radiological waste	Wastewaters collected in closed drain system connected to Radiological Liquid Waste Treatment System (RLETS). Treated radiological waste effluent discharged to existing Wilmington Site process wastewater aeration basin and Final Process Lagoon Treatment Facility (FPLTF)	Treated effluent from the Wilmington Site FPLTF is discharged at NPDES-permitted Outfall 001 to the onsite effluent channel
Cooling tower blowdown	Blowdown pumped from cooling tower to existing Wilmington Site FPLTF	Treated effluent from the Wilmington Site FPLTF discharged at NPDES-permitted Outfall 001 to the onsite effluent channel
Sanitary Waste	Sanitary waste collected in sewer system connected to existing Wilmington Site Sanitary Wastewater Treatment Plant. Waste stream treated by activated sludge aeration process.	Treated effluent from the Wilmington Site Sanitary Wastewater Treatment Plant is discharged at NPDES-permitted Outfall 002 to the onsite effluent channel
Stormwater	Stormwater runoff collected in drainage conduits and channels flowing to onsite retention basins.	Stormwater from onsite retention basins is discharged per requirements of NPDES storm water permit.

Table 1-5. Typical GLE Air Emissions.

Constituent	Amount	Regulatory Limit
Uranium	$8x10^{-15}$ µCi/mL [a]	$3x10^{-12}$ µCi/mL [b]
Hydrogen Fluoride	< 0.50 lb/day	~0.50 lb/day [c]

a. Per Global Laser Enrichment Environmental Report, December 2008.

b Per 10 CFR 20, Appendix B.

c Best estimate provided as the actual limit is specified on the North Carolina Department of Environment and Natural Resources air permit to be issued prior to operations.

Table 1-6. {{{Proprietary Information withheld from disclosure per 10 CFR 2.390}}}

Table 1-7. Type, Quantity, and Form of Licensed Special Nuclear Material.

Source and/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 Chemical: UF_6, UF_4, UO_2F_2, oxides and other compounds	140,000,000 kg
Uranium enriched in isotope ^{235}U up to 8 percent by weight and uranium daughter products	Physical: solid, liquid, and gas Chemical: UF_6, UF_4, UO_2F_2, oxides and other compounds	2,600,000 kg
^{99}Tc, transuranic isotopes and other contamination	Any	Amount that exists as contamination as a consequence of historical feed of recycled uranium at other facilities.

Figure 1-1. Wilmington Site and County Location.

Figure 1-2. Wilmington Site, New Hanover County, and Other Adjacent Counties.

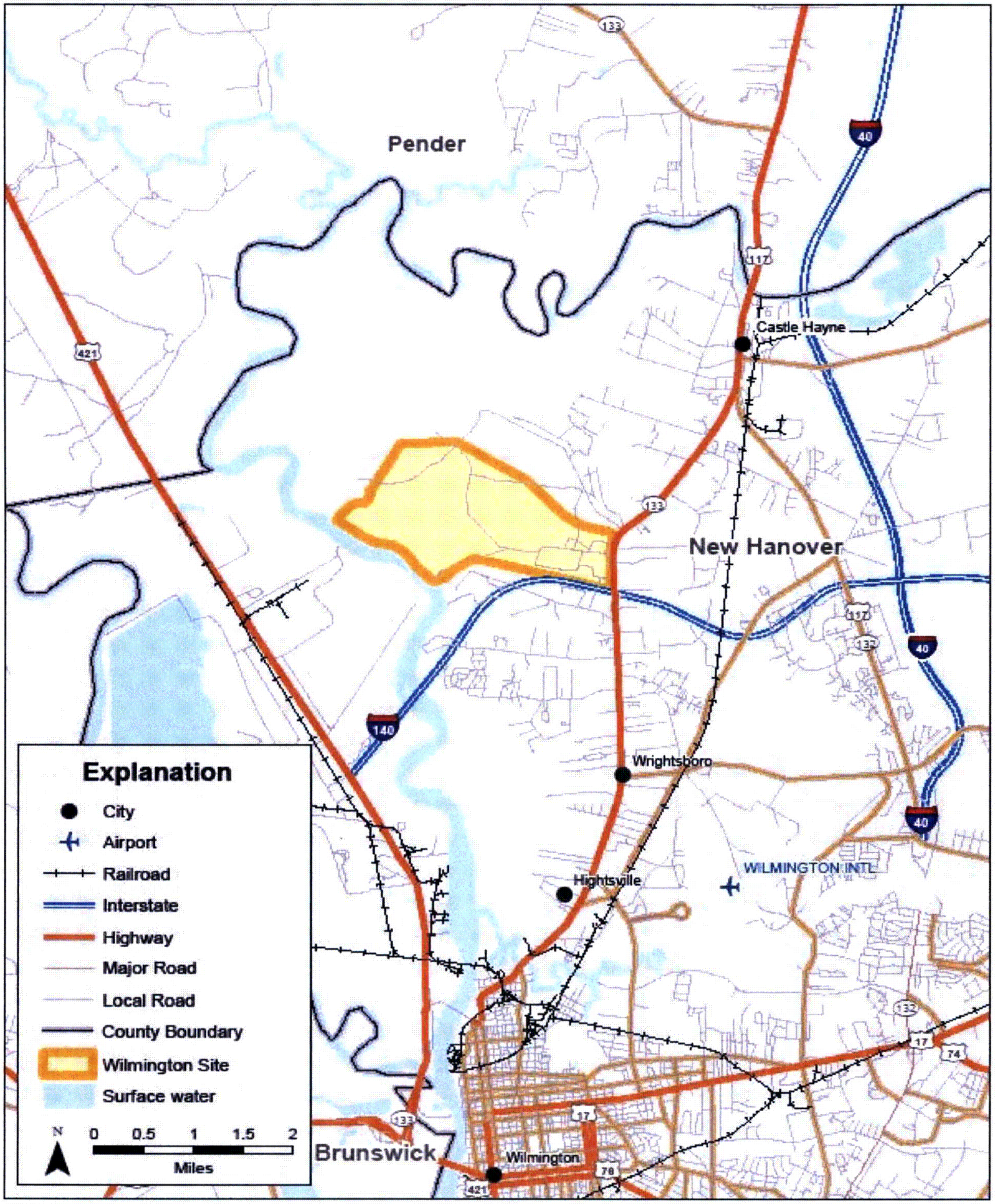
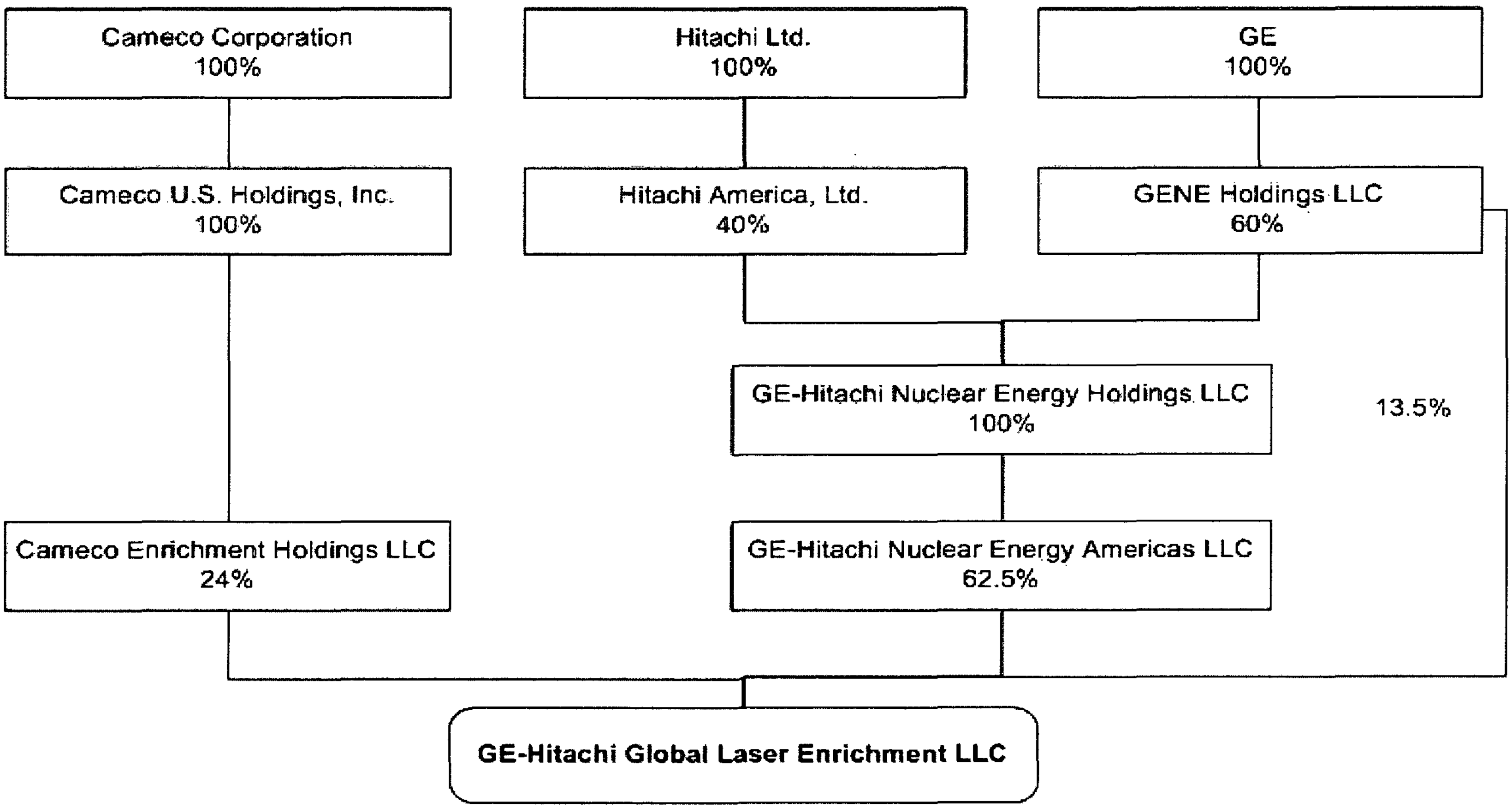


Figure 1-3. {{{Proprietary Information withheld from disclosure per 10 CFR 2.390}}}

Figure 1-4. {{{Proprietary Information withheld from disclosure per 10 CFR 2.390}}}

Figure 1-5. GLE Ownership.



GE Indirect Membership Interest:	51%	(60% x 62.5% + 13.5%)
Hitachi, Ltd. Indirect Membership Interest:	25%	(40% x 62.5%)
Cameco Corporation Indirect Membership Interest:	24%	

Figure 1-6. Community Characteristics Near the Wilmington Site.

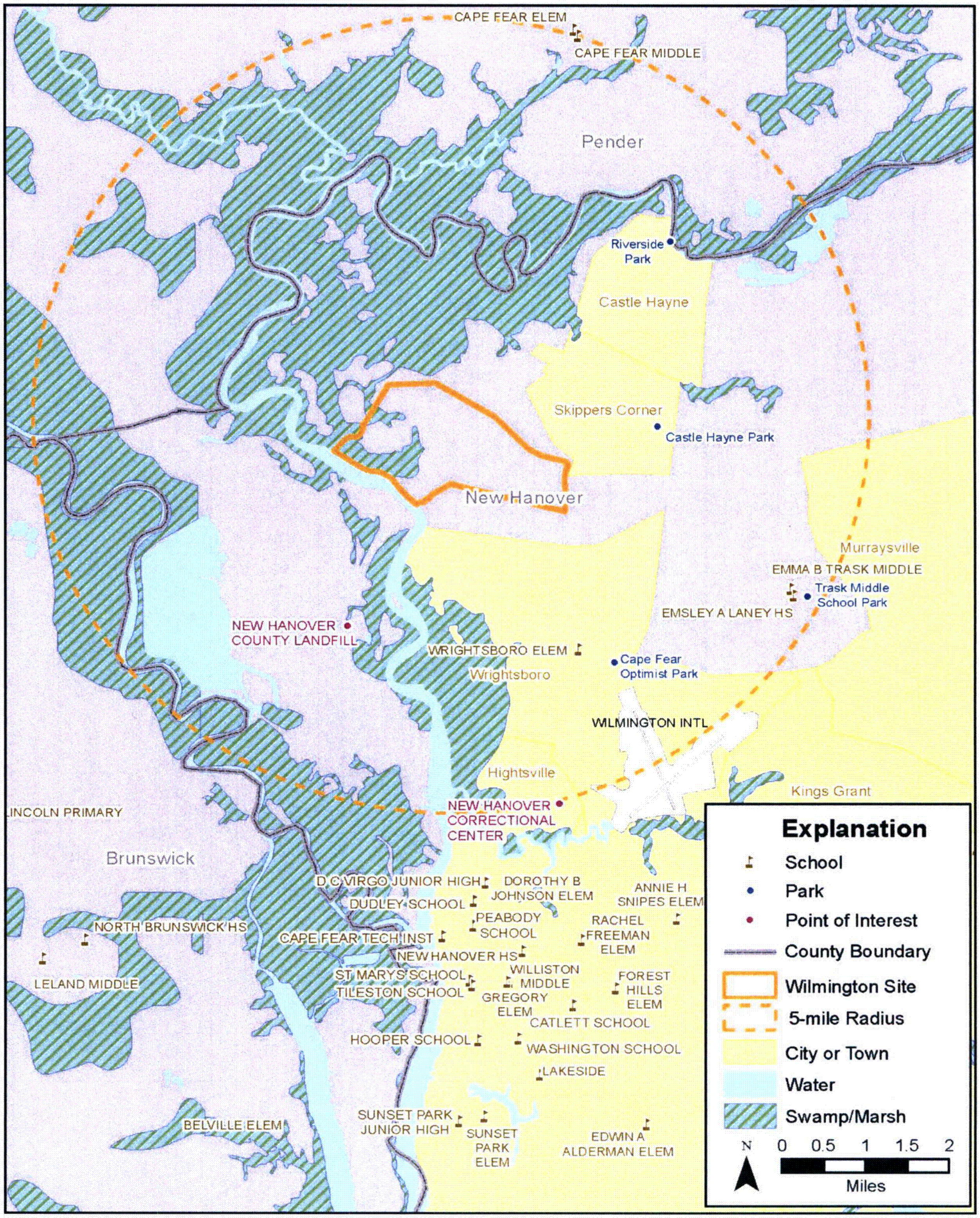
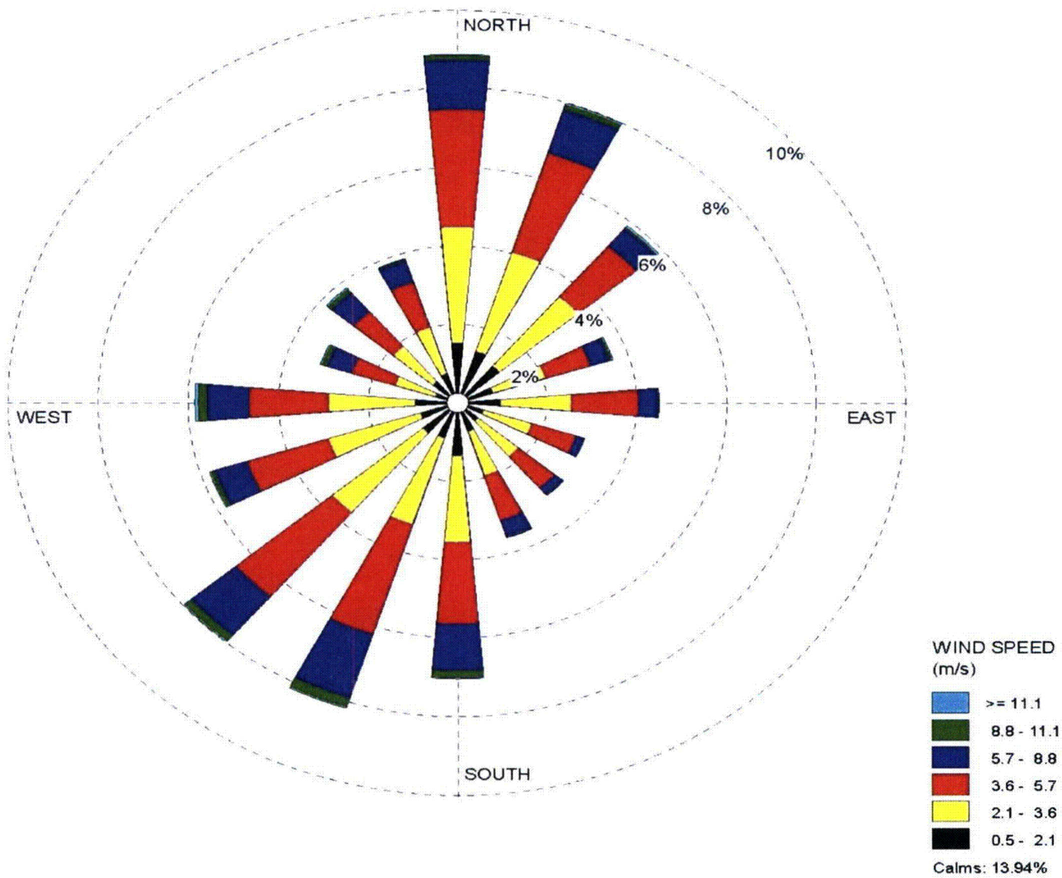


Figure 1-7. Wind Rose for Wilmington International Airport.

WIND ROSE PLOT:
Station #13748 - WILMINGTON/NEW HANOVER COUNTY, NC

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS	DATA PERIOD	TOTAL COUNT	DATE	PROJECT NO.
Source of Data: DS-3505.	**1990-2006** **Jan 1 - Dec 31** **00:00 - 23:00**	**143191 hrs.**	**7/7/2007**	
	CALM WINDS: **13.94%**			
	AVG. WIND SPEED: **3.57 m/s**			

WRPLOT View - Lakes Environmental Software

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APPENDIX A -

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE, OR SPECIAL NUCLEAR MATERIAL

U.S. Nuclear Regulatory Commission
Division of Fuel Cycle Safety
and Safeguards
Washington, DC 20555
April 1993

APPENDIX A

The instructions in this guide, in conjunction with Table 1, specify the radionuclides and radiation exposure rate limits which should be used in decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table 1 do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control is considered on a case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 1 prior to the application of the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces of premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

    a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

    b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table 1. A copy of the survey report shall be filed with the Division of Fuel Cycle Safety and Safeguards, U. S. Nuclear Regulatory Commission, Washington, DC 20555, and also the Administrator of the NRC Regional Office having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report shall:

   a. Identify the premises.

   b. Show that reasonable effort has been made to eliminate residual contamination.

   c. Describe the scope of the survey and general procedures followed.

   d. State the findings of the survey in units specified in the instruction.

   Following review of the report, the NRC will consider visiting the facilities to confirm the survey.

APPENDIX A

TABLE 1
ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDES[a]	AVERAGE[bcf]	MAXIMUM[bdf]	REMOVABLE[bef]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/ 100 cm^2	15,000 dpm α/ 100 cm^2	1,000 dpm α/ 100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1000 dpm/100 cm^2	3000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm βγ/ 100 cm^2	15,000 dpm βγ/ 100 cm^2	1,000 dpm βγ/ 100 cm^2

[a]Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

CHAPTER 2
REVISION LOG

Rev.	Effective Date	Affected Pages	Revision Description
0	04/30/2009	ALL	Initial Application Submittal.
1	03/31/2010	ALL	Incorporate RAI responses submitted to the NRC via MFN-09-802 dated 12/28/2009.
2	06/18/2010	8, 15	Added details regarding the transition from design/construction to operations and the concurrent construction and operations phases. Added the word "overseeing" to the designated responsibilities of the NCS function.

TABLE OF CONTENTS

TABLES

NONE

FIGURES

2. ORGANIZATION AND ADMINISTRATION

This chapter of the GE-Hitachi Global Laser Enrichment LLC (GLE) Commercial Facility License Application (LA) presents the organizations responsible for managing the design, construction, operation, and decommissioning of the GLE Commercial Facility. Key management and supervisory positions and functions are described, including personnel qualifications for each key position. This chapter also describes the management system and administrative procedures for effective implementation of Environmental, Health, and Safety (EHS) functions at the GLE Commercial Facility.

It is a GLE policy to maintain a safe work place for employees and assure operational compliance within the terms and conditions of the license and applicable regulations. The GLE Facility Manager has overall operational responsibility for safety and compliance to this GLE policy. In particular, GLE employs the principle of keeping radiation exposures to employees and the general public as low as reasonably achievable (ALARA).

2.1 ORGANIZATIONAL STRUCTURE

2.1.1 Corporate Functions, Responsibilities, and Authority

GLE supports the national energy security goal of maintaining a reliable and secure domestic source of enriched uranium. GLE uses the laser-based technology, which represents a cost-effective and efficient technology for the enrichment of uranium for domestic and foreign nuclear power plants.

GLE is a limited liability corporation formed to provide uranium enrichment services for commercial nuclear power plants. The GLE partnership is described in GLE LA Section 1.2, *Institutional Information*. GLE's immediate parent company, GE-Hitachi Nuclear Energy Americas LLC (GEH), is the parent company of U.S. Nuclear Regulatory Commission (NRC) licensees whom are licensed under 10 CFR 50, *Domestic Licensing of Production and Utilization Facilities (Ref. 2-1)*, 10 CFR 70, *Domestic Licensing of Special Nuclear Material (Ref. 2-2)*, and 10 CFR 72, *Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor Related Greater Than Class C Waste (Ref. 2-3)*, at facilities in Sunol, California; Wilmington, North Carolina; and Morris, Illinois. The GLE President and CEO receives direction from the GLE parent company GE-Hitachi Nuclear Energy Americas through the GEH Fuel Cycle Senior Vice President.

The GLE President and CEO provides overall direction and management with respect to design, construction, operation, and decommissioning activities. Figure 2-1, *GLE Organizational Structure During Design and Construction*, details the organization of GLE during design and construction. Figure 2-2, *GLE Organizational Structure during Operations*, details the organization of GLE during operations.

2.1.2 GLE Design and Construction Organizational Structure

As the owner and operator, GLE is responsible for the design, construction, operation, maintenance, modification, and testing of the GLE Commercial Facility. The GLE President and CEO is responsible for ensuring the facility complies with applicable regulatory requirements and establishing the basic policies of the Quality Assurance (QA) Program. These polices are described in the Quality Assurance Program Description (QAPD) document, are transmitted to all levels of management, and are implemented through approved written policies, plans, and/or procedures.

The lines of communication of key management positions during design and construction are shown in Figure 2-1. The GLE EHS and QA Organizations support the GLE Projects Manager; however, the functions are independent allowing for objective audit, review, and control activities.

The GLE Projects Manager is responsible for managing the design, construction, initial startup, and procurement activities. In addition to managing A/E and construction contracts, the GLE Projects Manager also manages a group of Project Managers and the Project Controls Manager. The Project Managers are responsible for implementing procurement, construction, engineering, project engineering, project controls, and startup.

The Engineering Manager is the design authority and is responsible for developing the conceptual design for the facility, which includes the development of design requirements, design bases, and design criteria for the enrichment process and supporting systems. An architect/engineering (A/E) firm has been contracted to further specify structures and systems, as well as to ensure the design meets applicable U.S. codes and standards. A contractor specializing in site evaluations has been contracted to perform the site evaluation. Nuclear consultants have been contracted to support the Integrated Safety Analysis (ISA) and development of the LA. During the construction phase, preparation of construction documents, in addition to construction itself, is completed utilizing qualified contractors. The GLE QA function reviews and approves contractor QA Programs. Approval of contractor QA Programs shall be obtained prior to commencing work activities.

The reporting lines and qualifications of the principal managers for design and construction of the facility are as follows:

The QA and Infrastructure Program Manager reports directly to the GLE President and CEO. The QA and Infrastructure Program Manager shall have, as a minimum, a bachelor's degree in an engineering or scientific field and four years of supervisory nuclear experience in the implementation of a QA Program. The QA and Infrastructure Program Manager shall have at least two years experience in a QA Organization at a nuclear facility.

The Operations Manager reports directly to the GLE President and CEO. The Operations Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years of related nuclear experience.

The Engineering Manager reports directly to the GLE President and CEO. The Engineering Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and a minimum of five years of related nuclear experience in implementing and supervising a nuclear engineering program.

The GLE Projects Manager reports directly to the GLE President and CEO. The GLE Projects Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field, five years of nuclear experience, and three years of supervisory or management experience.

The Security Manager reports directly to the GLE President and CEO. The Security Manager shall have, as a minimum, a bachelor's degree (or equivalent) in a related field and five years of related experience; or a high school diploma with eight years of related experience.

The GLE EHS Manager reports directly to the GLE President and CEO. The GLE EHS Manager shall 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. The manager of the GLE EHS function shall have experience in the understanding and management of Nuclear Criticality Safety (NCS), Environmental Protection, and Industrial Safety programs.

2.1.3 Operations Organizational Structure

The GLE organizational structure during operations is shown in Figure 2-2. GLE has direct responsibility for preoperational testing, initial startup, operation, and maintenance of the GLE Commercial Facility. The GLE Facility Manager reports to the GLE President and CEO and is responsible for the overall operation, administration, and regulatory compliance of the GLE Commercial Facility. In the discharge of these responsibilities, the GLE Facility Manager directs the activities of the following: QA, Operations, Engineering, Projects, Security and Emergency Preparedness, Infrastructure Programs, EHS, and the Facility Safety Review Committee (FSRC).

The responsibilities, authorities, and lines of communication of key management positions within the Operations Organization are discussed in Section 2.2, *Key Management Positions, Responsibilities, and Qualifications.*

During operations, the QA Manager reports to the GLE Facility Manager; however, the QA Manager has the authority and responsibility to directly contact the GLE President and CEO with any QA concerns during operations. Likewise, the GLE EHS Manager has the authority and responsibility to directly contact the GLE President and CEO with any EHS concerns during operations.

2.1.4 Transition From Design and Construction to Operations

GLE is responsible for the design, QA, construction, testing, initial startup, operation, and decommissioning of the GLE Commercial Facility. When the end of Phase 1 construction (initial construction of 1 MSWU facility) approaches, the focus of the organization will shift from design and construction to initial startup and operation. As Phase 1 facility construction nears completion, GLE will staff the Operations Organization to ensure a smooth transition from Phase 1 construction activities (managed by the Projects team) to operation activities (managed by the Operations team). During this transition, the GLE EHS Manager position reports directly to the GLE President and CEO (as shown in Figure 2-1) for EHS matters related to design and construction and reports directly to the GLE Facility Manager (as shown in Figure 2-2) for EHS matters related to operations. This position is intentionally duplicated to provide significant continued focus on the EHS goals during design and construction when the Operating Organization is not yet fully developed and implemented. Similarly, the QA Manager position is duplicated during the transition from design and construction to operations to ensure quality is adequately maintained throughout the transition phase. The Projects team will continue to manage the construction that occurs during Phase 2 construction (Construction and Component Installation to Ramp up to 6 MSWU). Similar transitions from the Projects team to the Operations team will occur during each ramp up period. Likewise, the EHS and Quality functions will have active roles in each ramp up period in order to provide continuous facility oversight.

As the construction of systems is completed, the systems undergo acceptance testing as required by approved written policies, plan, and/or procedures. Following successful completion of acceptance testing, systems are transferred from the Projects Organization to the Operations Organization by means of a detailed transition plan. The transition plan will describe individual roles and responsibilities, and provide task assignments to ensure that the facility remains in compliance during the transition. The transition plan will be available to the NRC upon request. The turnover includes the physical systems, corresponding design information, and records. Following turnover, the Operations Organization is responsible for system maintenance. The design basis for the facility is maintained during the transition from construction to operations through the CM Program described in GLE LA Chapter 11, *Management Measures*.

2.2 KEY MANAGEMENT POSITIONS, RESPONSIBILITIES, AND QUALIFICATIONS

This section describes the key functional positions responsible for managing the safe operation of the GLE Commercial Facility. The responsibilities, authorities, and lines of communication for each key management position are provided in this section. Management responsibilities, supervisory responsibilities, and NCS engineering staff responsibilities related to NCS are in accordance with American National Standards Institute (ANSI)/American Nuclear Society (ANS)-8.19-2005, *Administrative Practices for Nuclear Criticality Safety (Ref. 2-4).*

Responsibilities, authorities, and inter-relationships of the GLE organizational groups with responsibilities important to safety are specified in approved written position descriptions and procedures.

Individuals who do not meet the qualification requirements described in this section are not automatically eliminated from a position if other factors provide sufficient demonstration of their abilities to fulfill the duties of the position. These factors shall be evaluated on a case-by-case basis, and approved and documented by the GLE Facility Manager.

2.2.1 Global Laser Enrichment President and Chief Executive Officer

The GLE President and CEO is responsible for providing overall direction and management of GLE activities. The GLE President and CEO is also responsible for maintaining the basic policies of the QA Program, and ensuring those policies are transmitted to all levels of management and implemented appropriately through approved written procedures.

The GLE President and CEO shall have, as a minimum, a bachelor's degree (or equivalent) and five years of related experience. The GLE President and CEO receives direction from the GLE parent company GE-Hitachi Nuclear Energy Americas through the GEH Fuel Cycle Senior Vice President.

2.2.2 Global Laser Enrichment Facility Manager

The GLE Facility Manager reports to the GLE President and CEO and is the individual with the overall responsibility for safety and activities conducted at the GLE Commercial Facility. The activities of the GLE Facility Manager are performed in accordance with GLE's policies, plans, procedures, and work instructions. The GLE Facility Manager provides for safety, control of operations, and protection of the environment by delegating and assigning responsibility to qualified line management and area managers.

The GLE Facility Manager shall have, as a minimum, a bachelor's degree in an engineering or scientific field and four years of experience in nuclear facility operations. The GLE Facility Manager shall be knowledgeable of the safety program concepts as applied to the overall safety of the facility, and has the authority to enforce the shutdown of any process or facility. The GLE Facility Manager must approve restart of an operation that he/she directs to be shutdown.

2.2.3 Quality Assurance Organization

2.2.3.1 Quality Assurance Manager

The GLE QA Manager reports to the GLE Facility Manager and is responsible for establishing and maintaining the GLE QA Program and the Laboratory Services Program. Line management and their staff, who are responsible for performing quality-affecting work, are responsible for ensuring implementation of and compliance with the GLE QA Program. The QA Manager position is independent from other management positions at the facility to ensure the QA Manager has access to the GLE Facility Manager for matters affecting quality. In addition, the QA Manager has the authority and responsibility to contact the GLE President and CEO with any QA concerns. The QA Manager has the authority to stop work based on quality concerns. This authority to stop work and the process to resume stopped work is documented in approved policies, plans, and/or procedures.

The QA Manager shall have, as a minimum, a bachelor's degree in an engineering or scientific field and four years of supervisory nuclear experience in the implementation of a QA Program. The QA Manager shall have a minimum of two years experience in a QA Organization at a nuclear facility.

2.2.3.2 Laboratory Services Manager

The Laboratory Services Manager reports to the QA Manager and has the responsibility for the implementation of chemistry analysis and laboratory programs and procedures for the GLE Commercial Facility. The Laboratory Services Manager's responsibilities typically include, but are not limited to, chemical analysis of samples and maintaining the laboratories.

The Laboratory Services Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and three years of related nuclear experience associated with implementation of a chemistry program.

2.2.4 Operations Organization

2.2.4.1 Operations Manager

The Operations Manager reports to the GLE Facility Manager and has the responsibility of directing the day-to-day operation of the facility. This includes activities such as ensuring the correct and safe operation of uranium hexafluoride (UF_6) processes, proper handling of UF_6, and the identification and mitigation of any off-normal operating conditions.

The Operations Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years of related nuclear experience.

2.2.4.2 *Maintenance Manager*

The Maintenance Manager reports to the Operations Manager and has the responsibility of directing and scheduling maintenance activities to ensure proper operation of the facility. Other Maintenance Manager responsibilities typically include, but are not limited to, activities such as: corrective and preventive maintenance of facility equipment; preparation and implementation of maintenance procedures; and coordinating and maintaining testing programs for the facility, to include testing of systems, structures, and components (SSCs) to ensure the SSCs are functioning as specified in design documents.

The Maintenance Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years of related nuclear experience.

2.2.4.3 *Production Control Manager*

The Production Control Manager reports to the Operations Manager and is responsible for developing and maintaining production schedules for enrichment services.

The Production Control Manager shall have, as a minimum, a bachelor's degree (or equivalent) in a technical field and three years of experience in operations; or a high school diploma and five years of operations experience.

2.2.4.4 *Integrated Safety Analysis Manager*

The ISA Manager reports to the Operations Manager. ISA Manager responsibilities typically include, but are not limited to, maintaining the ISA program; identifying IROFS; identifying the management measures and QA elements to be applied to safety controls; and providing advice and counsel to area managers on matters of the ISA program.

The ISA Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years of related experience. The ISA Manager shall have experience in the understanding and management of the assigned programs.

2.2.4.5 *Configuration Management Manager*

The CM Manager reports to the Operations Manager and is responsible for establishing and maintaining a CM Program for uranium enrichment equipment and safety controls, including related record retention.

The CM Manager shall have, as a minimum, a bachelor's degree (or equivalent) and two years of related experience; or a high school diploma with eight years of related experience. The CM Manager shall have experience in the understanding and management of the assigned programs.

2.2.4.6 *Area Managers*

Area managers report to the Operations Manager. Area managers are the designated individuals responsible for ensuring 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 processed, handled, or stored. Designated area manager responsibilities typically include, but are not limited to, the following:

- Assure safe operation, maintenance, and control of activities;
- Assure safety of the environs as influenced by operations;
- Assure performance of ISA for the assigned facility area, as required;
- Assure application of management measures and QA elements to safety controls, as appropriate;
- Assure configuration control for Items Relied on for Safety (IROFS) in the assigned facility area, as required;
- Ensure use of approved written procedures which incorporate safety controls and limits; and
- Provide adequate operator training.

The area managers shall 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; or a high school diploma with five years of operations experience, two of which are in fuel cycle facility operations. Area managers shall be knowledgeable of the safety program procedures (including Industrial Safety, Radiation Protection [RP], Fire Safety, NCS, and Environmental Protection) and shall have experience in the application of the program controls and requirements, as related to their assigned area of responsibility. The GLE Facility Manager shall approve the assignment of individuals to the position of area manager. A listing of area managers, by area of responsibility, shall be maintained current at the facility.

2.2.4.7 *Shift Supervisors*

Shift supervisors report to the Operations Manager and are the interface between management and facility operators. Designated shift supervisor responsibilities typically include, but are not limited to, the following:

- Provide day-to-day work direction to operators and other assigned workers;
- Assure safe operation and control of activities;
- Assure adherence to approved written procedures and controls;
- Provide adequate operator oversight and guidance; and
- Identify and communicate off-normal conditions.

The shift supervisors shall have, as a minimum, a high school diploma and three years of experience in a technical field. Shift supervisors shall be knowledgeable of the applicable safety program procedures (including Industrial Safety, RP, Fire Safety, NCS, and Environmental Protection).

2.2.5 Engineering Organization

2.2.5.1 Engineering Manager

The Engineering Manager reports to the GLE Facility Manager and is the design authority. The Engineering Manager has the responsibility for providing engineering support for the GLE Commercial Facility. The responsibilities of the Engineering Manager include, but are not limited to, ensuring the safe operation of enrichment and support equipment; providing maintenance support for equipment and systems; and supporting the development of operating and maintenance procedures. The Engineering Manager is responsible for the development of design changes to the facility.

The Engineering Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and five years of related nuclear experience in implementing and supervising a nuclear engineering program.

2.2.6 GLE Projects Organization

2.2.6.1 GLE Projects Manager

The GLE Projects Manager reports to the GLE President and CEO and has the responsibility for the implementation of facility modifications, and provides engineering support, as needed, to support operations, maintenance, and performance testing of systems and equipment. The GLE Projects Manager is also responsible for managing remaining design and construction activities. The GLE Projects Manager manages a group of Project Managers and a Project Controls Manager.The GLE Projects Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field, five years of nuclear experience, and three years of supervisory or management experience.

2.2.7 Security and Emergency Preparedness Organization

2.2.7.1 Security and Emergency Preparedness Manager

The Security and Emergency Preparedness functions are administratively independent of Operations. The Security and Emergency Preparedness Manager reports to the GLE President and CEO and has designated responsibilities that typically include, but are not limited to, the following:

- Direct the activities of security personnel to ensure the physical protection of the GLE Commercial Facility and GLE Site;
- Protection of classified matter at the facility and obtaining security clearances for facility personnel and support personnel;
- Establish and maintain the Emergency Preparedness Program, to include training and program evaluations;

- Provide advice and counsel to area managers on matters of security and emergency preparedness; and
- Maintain agreements and preparedness with offsite emergency support groups.

The Security and Emergency Preparedness Manager shall have, as a minimum, a bachelor's degree (or equivalent) in a related field and five years of related experience; or a high school diploma with eight years of related experience.

2.2.8 Infrastructure Programs Organization

2.2.8.1 Infrastructure Programs Manager

The Infrastructure Programs Manager reports to the GLE Facility Manager and has the responsibility of providing business and administrative support to the GLE Commercial Facility. The Infrastructure Programs Manager's responsibilities typically include, but are not limited to, Document Control, Records Management, Training, and Administrative Functions.

The Infrastructure Program Manager shall have, as a minimum, a bachelor's degree (or equivalent) in a related field, and three years of related experience in implementing and supervising administrative responsibilities at a nuclear facility.

2.2.8.2 Document Control and Records Management Manager

The Document Control and Records Management Manager reports to the Infrastructure Programs Manager and has the responsibility for establishing and maintaining a Document Control System for adequately controlling documentation and a Records Management System to adequately control QA Records in accordance with the Quality Assurance Program Description.

The Document Control and Records Management Manager shall have, as a minimum, a bachelor's degree (or equivalent) and three years of related experience in implementing and supervising a document control or records management program.

2.2.8.3 Training Manager

The Training Manager reports to the Infrastructure Programs Manager and is responsible for establishing and maintaining the Training Program as well as maintaining training records for personnel at the facility.

The Training Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years of related experience.

2.2.9 Global Laser Enrichment Environmental, Health, and Safety Organization

The GLE EHS function is administratively independent of Operations but has the authority to enforce the shutdown of any process or facility in the event that controls for any aspect of safety are not assured.

2.2.9.1 *Global Laser Enrichment Environmental, Health, and Safety Manager*

The GLE EHS Manager reports to the GLE Facility Manager. In addition, the GLE EHS Manager has the authority and responsibility to contact the GLE President and CEO with any EHS concerns. The GLE EHS Manager has designated overall responsibility to establish and manage the NCS, Industrial Safety, Material Control and Accounting (MC&A), RP, Environmental Protection, and Fire Safety Programs to ensure compliance with applicable federal, state, and local regulations and laws. These programs are designed to ensure the health and safety of employees and the public, as well as the protection of the environment. The GLE EHS Manager must approve restart of any operation shutdown by the EHS function.

The GLE EHS Manager works with the other facility managers to ensure consistent interpretations of EHS requirements, performs independent reviews, and supports facility and operations change control reviews. This position is independent from other management positions at the facility to ensure objective EHS audit, review, and control activities. The EHS Manager has the authority to issue stop work orders and must be consulted prior to resumption of stopped work. 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 GLE EHS Manager shall 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. The manager of the GLE EHS function shall have experience in the understanding and management of NCS, Environmental Protection, and Industrial Safety programs.

2.2.9.2 *Nuclear Criticality Safety Function*

The NCS function is administratively independent of Operations and has the authority to shutdown potentially unsafe operations. The NCS Manager reports to the GLE EHS Manager and must approve restart of any operation shutdown by the NCS function. Designated responsibilities of the NCS Manager typically include, but are not limited to, overseeing the following:

- Establish the NCS program, to include design criteria, procedures, and training;
- Provide NCS support for operations including ISAs and configuration control;
- Assess normal and credible abnormal conditions;
- Determine NCS limits for controlled parameters;
- Perform methods development and validation to support NCS analyses;
- Perform neutronics calculations, develop criticality safety analyses (CSAs), and approve proposed changes in process conditions or equipment involving fissionable material;
- Specify NCS control requirements and functionality;
- Provide advice and counsel to area managers on NCS control measures, to include review and approval of operating procedures;
- Support emergency response planning and events; and

- Assess the effectiveness of the NCS program through audit programs.

The NCS Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field, four years of experience in assignments involving regulatory activities, and experience in the understanding, application, and direction of NCS programs.

A Senior Engineer, within the NCS function, shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field with three years of nuclear-related experience in criticality safety. A senior engineer shall have experience in the assigned safety function, and has the authority and responsibility to conduct activities assigned to the NCS function.

An Engineer, within the NCS function, shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and experience in the assigned safety function. An NCS Engineer shall have the authority and responsibility to conduct activities assigned to the NCS function with the exception of independent verification of NCS analyses.

2.2.9.3 Material Control and Accounting Manager

The MC&A Manager reports to the GLE EHS Manager and has the responsibility for proper implementation and control of the Fundamental Nuclear Material Control Plan (FNMCP). This position is separate from, and independent of, the Operations and Engineering Organizations to ensure a definite division between the MC&A function and the other organizations.

The MC&A Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and five years of experience in the management of a safeguards program for special nuclear material (SNM), to include responsibilities for material control and accountability. No credit for academic training may be taken toward fulfilling this experience requirement.

2.2.9.4 Industrial Safety Manager

The Industrial Safety Manager is administratively independent of Operations and has the authority to shutdown operations when potentially hazardous health and safety conditions are identified. The Industrial Safety Manager reports to the GLE EHS Manager and must approve restart of any operation shutdown by the Industrial Safety function. Designated responsibilities of the Industrial Safety Manager typically include, but are not limited to, the following:

- Identify industrial safety requirements from federal, state, and local regulations which govern GLE Commercial Facility operations;
- Ensure proper implementation of the GLE Industrial Safety Program;
- Develop practices regarding non-radiation chemical safety affecting nuclear activities;
- Provide advice and counsel to area managers on matters of industrial safety;
- Ensure proper implementation of the Laser Safety Program;
- Provide consultation and review of new, existing, or revised equipment, processes, and procedures regarding industrial safety; and

- Provide industrial safety support for ISAs and configuration control.

The Industrial Safety Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and two years of experience in related assignments; or a high school diploma and eight years of related experience.

2.2.9.5 Environmental Protection Function

The Environmental Protection Manager is administratively independent of Operations and has the authority to shutdown operations with potentially adverse environmental impacts. The Environmental Protection Manager reports to the GLE EHS Manager and must approve restart of any operation shutdown by the Environmental Protection function. Designated responsibilities of the Environmental Protection Manager typically include, but are not limited to, the following:

- Identify Environmental Protection requirements from federal, state, and local regulations which govern the facility operation;
- Establish systems and methods to measure and document adherence to regulatory Environmental Protection requirements and license conditions;
- Provide advice and counsel to area managers on matters of Environmental Protection;
- Evaluate and approve new, existing, or revised equipment, processes, and procedures involving Environmental Protection activities;
- Provide Environmental Protection support for ISAs and configuration control; and
- Assure proper federal and state permits, licenses, and registrations are obtained for non-radiation discharges from the GLE Commercial Facility.

The Environmental Protection Manager shall 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.

2.2.9.6 Radiation Protection Function

The RP function is administratively independent of Operations and has the authority to shutdown potentially unsafe operations. The RP Manager reports to the GLE EHS Manager and is responsible for overseeing the training program for training personnel in radiation protection policies, plans, and/or procedures. The RP Manager is responsible for establishing the initial training program, and as stated in GLE LA Section 4.5.5, reviews the contents of the training program every two years. The RP Manager must approve restart of any operation shutdown by the RP function. Designated responsibilities for the RP Manager typically include, but are not limited to, the following:

- Establish and maintain the RP Programs, procedures, and training;
- Evaluate radiation exposures of employees and visitors, and ensure the maintenance of related records;
- Conduct radiation and contamination monitoring and control programs;

- Evaluate the integrity and reliability of radiation detection instruments;
- Provide RP support for ISAs and configuration control;
- Provide advice and counsel to area managers on matters of RP;
- Support emergency response planning; and
- Assess the effectiveness of the RP Program through audit programs.

The RP Manager shall have, as a minimum, a bachelor's degree in an engineering or scientific field, three years of experience that includes assignments involving responsibility for RP, and experience in the understanding, application, and direction of RP Programs.

A senior engineer of the RP function shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and two years of nuclear industry experience in the assigned function. Alternate minimum experience qualification for a senior member of the RP function is a professional certification in health physics. A senior member shall have experience in the assigned safety function, and has authority and responsibility to conduct activities assigned to the RP function.

2.2.9.7 Fire Safety Function

The Fire Safety function is administratively independent of Operations and has the authority to shut down operations when imminent hazardous fire safety conditions are identified. The Fire Safety Manager reports directly to the GLE EHS Manager and must approve restart of any operation shutdown by the Fire Safety function. Designated responsibilities of the Fire Safety Manager typically include, but are not limited to, the following:

- Identify fire protection requirements from federal, state, and local regulations which govern GLE Commercial Facility operations;
- Ensure proper implementation of the GLE Fire Protection Program and ensure performance of fire protection systems is maintained;
- Manage a staff composed of trained personnel with experience in fire protection;
- Manage the GLE Commercial Facility Fire Brigade;
- Ensure inspection, testing, and maintenance of fire protection systems, features, and equipment is conducted;
- Develop practices regarding fire safety affecting nuclear activities;
- Provide advice and counsel to area managers on matters of fire safety;
- Provide consultation and review new, existing, or revised equipment, processes, and procedures regarding fire safety; and
- Provide fire safety support for ISA and configuration management activities.

The Fire Safety Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years of experience in fire protection related assignments.

The Fire Safety Manager staff shall include a licensed fire protection engineer with a minimum of seven years of fire protection related experience.

Additional available support staff shall include a mechanical engineer, electrical engineer, and structural engineer; all with a minimum of four years of fire protection related experience. Operational support staff performing inspection, observation, and training duties shall have a minimum of two years of fire protection experience. Support staff can be available either through direction employment or under contract.

2.2.10 Licensing Manager

The Licensing Manager reports operationally to the GLE Facility Manager and functionally to the Regulatory Affairs General Manager. The Licensing Manager has responsibility for coordinating facility activities to ensure compliance with applicable NRC requirements. The Licensing Manager is also responsible for ensuring abnormal events are reported to the NRC in accordance with NRC regulations.

The Licensing Manager shall have, as a minimum, a bachelor's degree (or equivalent) and five years of related experience in implementing and supervising nuclear activities in compliance with NRC regulations and facility license commitments.

2.2.11 Safety Committees

2.2.11.1 Facility Safety Review Committee

The FSRC provides the GLE Facility Manager with an independent overview of the safety of operations, and provides management with guidance relative to involvement in safety risks. The committee shall provide professional advice and counsel on Environmental Protection, NCS, RP, and Industrial Safety issues affecting nuclear activities.

A review of the ALARA program and projects shall be conducted annually. This ALARA review shall consider:

- Programs and projects undertaken by the RP function and the Radiation Safety Committee (RSC);
- Performance including, but not limited to, trends in airborne concentrations of radioactivity, personnel exposures, and environmental monitoring results; and
- Programs for improving the effectiveness of equipment used for effluent and exposure control.

The FSRC is responsible to the GLE Facility Manager. The committee's proceedings, findings and recommendations are reported in writing to the GLE Facility Manager, appropriate line management, and appropriate area manager(s) responsible for operations. Such reports shall be retained for a minimum of three years.

The committee shall consist of the Chairman and five members, at a minimum. The committee shall include competence in the applicable scientific and engineering disciplines and shall be staffed with members outside of the GLE Operations Organization. The committee shall hold a minimum of three meetings each calendar year with a maximum interval of 180 days between any two consecutive meetings.

2.2.11.2 Radiation Safety Committee

The objective of the RSC is to maintain occupational radiation exposures ALARA through improvements in operations. The committee meets monthly to maintain a continual awareness of the status of projects, performance measurement and trends, and the current radiological safety conditions of site activities. The maximum interval between meetings shall not exceed 60 days. A written report of each RSC meeting is forwarded to the appropriate line management, area managers, and the GLE EHS Manager. Records of the committee proceedings are maintained for a minimum of three years. The committee consists of managers or representatives from key functions with activities affecting radiological safety. GLE LA Chapter 4, *Radiation Protection*, provides further information regarding the RSC.

2.2.11.3 Chemical Review Committee

Before a new chemical is ordered, the requester must obtain approval from the Chemical Review Committee. The Chemical Review Committee is comprised of a representative of the EHS Organization, an area manager, and others as deemed appropriate by the EHS representative. The EHS representative leads the review and is a qualified chemical safety reviewer. The process for approval includes reviewing the health and safety risks of the chemical, as well as appropriate handling, storage, and disposal information. Every effort is made to limit the amount of hazardous chemicals used, including identifying feasible alternative chemicals or processes. GLE LA Chapter 6, *Chemical Process Safety*, provides further information on the Chemical Review Committee.

2.3 MANAGEMENT MEASURES

Management measures for the conduct and maintenance of GLE's EHS Programs are contained in approved written policies, plans, and/or procedures as described in GLE LA Chapter 11. Such practices are part of a Document Control Program, and appropriately span the organizational structure and major facility activities to control inter-relationships and specify program objectives, responsibilities, and requirements. Personnel are appropriately trained to the requirements of these management controls, and compliance is monitored through internal and independent audits and assessments. Management measures for IROFS are defined in the individual IROFS Boundary Control Documents.

2.3.1 Configuration Management

CM is provided for IROFS throughout facility design, construction, testing, and operation. CM provides oversight and control of design information, safety information, and records of modifications (both temporary and permanent) that could impact the ability of IROFS to perform their safety functions when needed. The Operations Manager has responsibility for CM. Selected documentation is controlled under the CM Program in accordance with appropriate QA procedures associated with design control, document control, and records management. Design changes to IROFS undergo formal review, including interdisciplinary reviews as appropriate, in accordance with approved written policies, plans, and/or procedures. See GLE LA Section 11.1, *Configuration Management*, for additional details on CM.

2.3.2 Maintenance

The GLE Maintenance Program shall be implemented for the operations phase of the GLE Commercial Facility. Preventive maintenance activities, surveillance, and performance trending provide reasonable and continuing assurance that IROFS will be available and reliable to perform their safety functions when needed. Maintenance activities include: corrective and preventive maintenance, surveillance/monitoring, and functional testing. These maintenance activities are discussed in further detail in GLE LA Section 11.2, *Maintenance*.

2.3.3 Training and Qualifications

Personnel training is conducted, as necessary, to provide reasonable assurance that individuals are qualified and continue to understand and recognize the importance of safety while performing assigned activities. Training is provided for each individual working at the GLE Commercial Facility, commensurate with assigned duties. Training and qualification requirements are met prior to personnel fully assuming the duties of safety-significant positions, and before assigned tasks are independently performed. The system established for training and retraining is described in GLE LA Section 11.3, *Training and Qualifications*.

2.3.3.1 *Nuclear Safety Training*

GLE training policy requires that employees complete formal nuclear safety training prior to unescorted access to Radiological Controlled Areas (RCAs). Formal training relative to nuclear safety includes, but is not limited to, the following topics:

- Radiation and radioactive materials,
- Risks involved in receiving low-level radiation exposure in accordance with 10 CFR 19.12, *Instruction to Workers (Ref. 2-5),*
- Basic criteria and practices for RP,
- Industrial safety,
- Maintaining radiation exposures ALARA,
- Maintaining radioactivity in effluents ALARA, and
- Emergency response; and
- Applicable NCS objectives contained in ANSI/ANS-8.19-2005 and ANSI/ANS-8.20-1991, Nuclear Criticality Safety Training (Ref. 2-6).

2.3.3.2 *Operator Training*

Operator training is performance-based and incorporates the structured elements of analysis, design, development, implementation, and evaluation. Job-specific training includes applicable procedures, safety provisions, and requirements. Emphasis is placed on safety requirements where human actions are important to safety. Operator training and qualification requirements are met prior to safety-related tasks being independently performed or before startup following significant changes to safety controls.

2.3.4 Procedures

GLE Commercial Facility activities are conducted through the use of approved written policies, plans, and/or procedures (herein referred to as procedures). Applicable procedure and training requirements are satisfied before use of any procedure. Approved written procedures are used to control activities to ensure the activities are carried out in a safe manner.

Procedures are categorized as either operating procedures or management control procedures. Operating procedures provide specific direction for task-based work. Management control procedures describe administrative and general facility practices approved and issued by cognizant management at a level appropriate to the scope of the practice. These procedures direct and control activities across the various process functions and assign functional responsibilities and requirements for these activities.

Additional details on the use of procedures, including the preparation of procedures in accordance with the Document Control Program are provided in GLE LA Section 11.4, *Procedures*.

2.3.5 Audits and Assessments

The GLE QA Program requires periodic audits and assessments to confirm activities affecting quality comply with the QA Program and that the QA Program is being implemented effectively. Additional details on audit and assessments are provided in GLE LA Section 11.5, *Audits and Assessments.*

2.3.5.1 Facility Safety Review Committee

The FSRC provides technical and administrative reviews of facility operations that could affect facility and worker safety. The FSRC shall review audit findings and performance, including external inspections, for adequacy and timeliness of corrective actions and for trends or overall weaknesses as indicated by audit findings.

2.3.5.2 Quality Assurance Organization

The QA Organization conducts periodic audits of activities associated with the GLE Commercial Facility to verify the facility's compliance with established procedures.

2.3.5.3 Audited Organization

Audited organizations shall assure that deficiencies identified are corrected in a timely manner. Audited organizations shall transmit a response to each audit report within the time period specified in the audit report. For each identified deficiency, the response shall identify the corrective action taken or to be taken. For each identified deficiency, the responses shall also address whether or not the deficiency is considered to be indicative of other problems (for example, a specific audit finding may indicate a generic problem) and the corrective action taken or to be taken for any such identified problems. Copies of audit reports and responses are maintained in accordance with the Records Management Program.

2.3.6 Incident Investigations

Incident investigations are performed to assure that the upset condition(s) is understood, and appropriate corrective actions are identified and implemented to prevent recurrence. GLE Management measures include documenting process-upset conditions in Unusual Incident Reports (UIRs). UIRs are documented and the associated corrective actions are tracked to completion. The objectives of the incident investigation and reporting procedure(s) are to: establish the validity of the data related to the incident; develop and implement corrective action plans, as appropriate; document an event which was or could become a danger to persons or property; and ensure that proper levels of GLE management and public agencies are notified. Additional details on Incident Investigations are provided in GLE LA Section 11.6, *Incident Investigations.*

2.3.7 Records Management

Approved written procedures that control the process for submittal, receipt, processing, retention, maintenance, and storage of facility documents or records are established. Details on the Records Management Program are provided in GLE LA Section 11.7, *Records Management.*

2.4 EMPLOYEE CONCERNS

GLE is committed to providing a safe and productive work environment that encourages employees to raise issues or concerns related to the design, construction, or operation of the GLE Commercial Facility. Employees who feel that safety or quality is being compromised have the right and responsibility to initiate the "stop work" process in accordance with the applicable project or facility procedures to ensure the work environment is placed in a safe condition. Employees also have access to various resources to ensure their safety or quality concerns are addressed, including:

- Line management or other facility management (for example, ESH Manager, GLE Facility Manager, QA Manager),
- The facility safety personnel (that is, any of the safety engineers or managers);
- NRC's requirements under 10 CFR 19, Notices, Instructions, and Reports to Workers: Inspection and Investigations (Ref. 2-7).

In addition to the above, GLE has established an employee concerns program to provide an avenue for employees to obtain an independent evaluation of concerns.

GLE Management is committed to investigating and resolving employee concerns in an effective manner and providing timely resolutions to issues. The employee concerns program provides methods for establishing a work environment in which employees feel free to raise concerns to their management or the NRC without fear of reprisal.

2.5 WRITTEN AGREEMENTS WITH OFFSITE EMERGENCY RESOURCES

The plans for responding to emergencies at the GLE Commercial Facility are presented in detail in the Radiological Contingency and Emergency Plan (RC&EP). The RC&EP includes a description of the facility Emergency Response Organization and interfaces with offsite emergency response organizations. The RC&EP includes references to agreements with applicable offsite emergency response organizations.

2.6 REFERENCES

2-1. 10 CFR 50, *Domestic Licensing of Production and Utilization Facilities*, U.S. Nuclear Regulatory Commission, 2008.

2-2. 10 CFR 70, *Domestic Licensing of Special Nuclear Material*, U.S. Nuclear Regulatory Commission, 2008.

2-3. 10 CFR 72, *Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor Related Greater Than Class C Waste*, U.S. Nuclear Regulatory Commission, 2008.

2-4. ANSI/ANS-8.19-2005, *Administrative Practices for Nuclear Criticality Safety*, American Nuclear Society, January 2005.

2-5. 10 CFR 19.12, *Instruction to Workers*, U.S. Nuclear Regulatory Commission, 2008.

2-6. ANSI/ANS-8.20-1991, *Nuclear Criticality Safety Training*, American Nuclear Society, January 1991.

2-7. 10 CFR 19, *Notices, Instructions, and Reports to Workers: Inspections and Investigations*, U.S. Nuclear Regulatory Commission, 2008.

Figure 2-1. GLE Organizational Structure During Design and Construction.

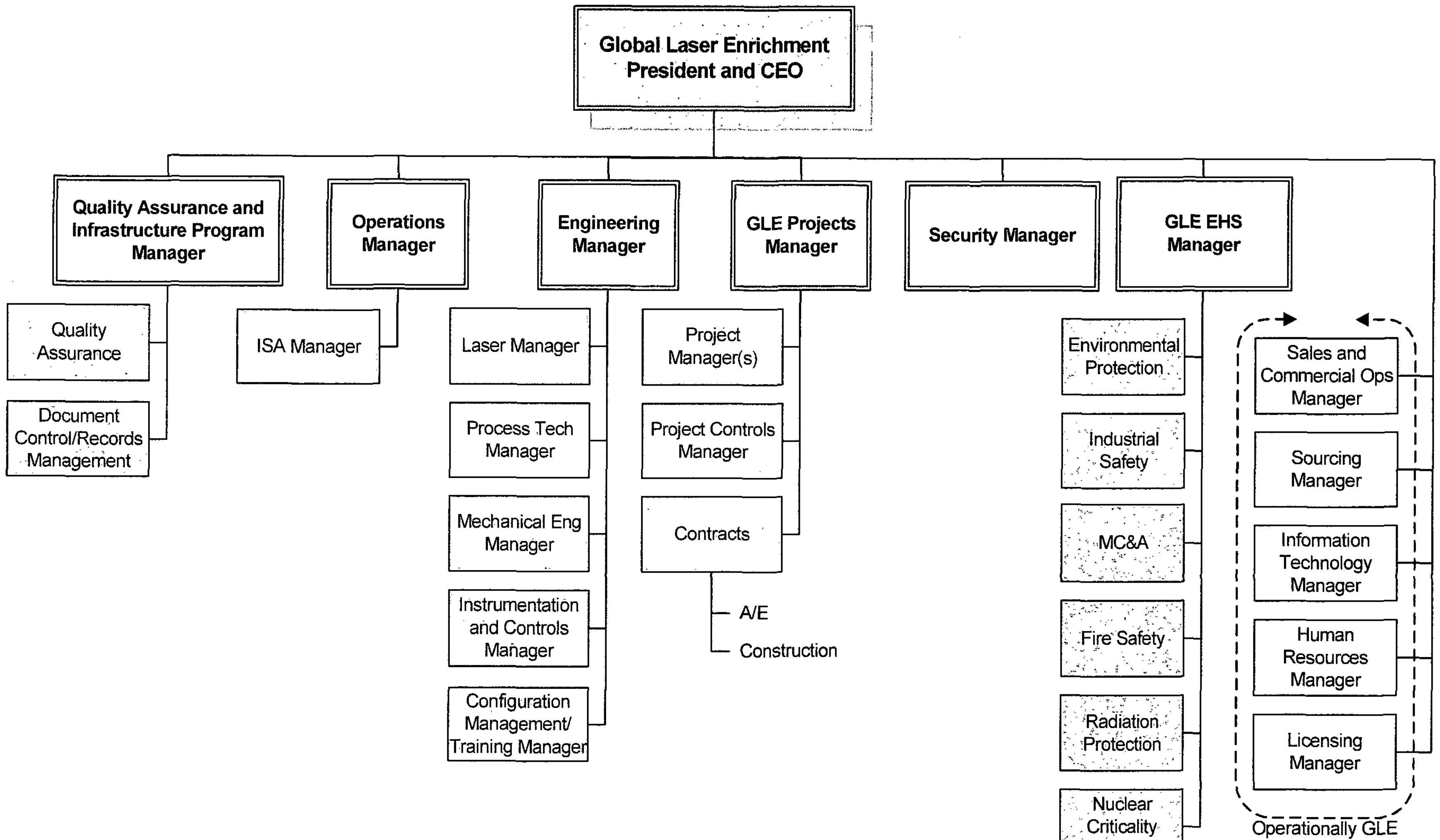
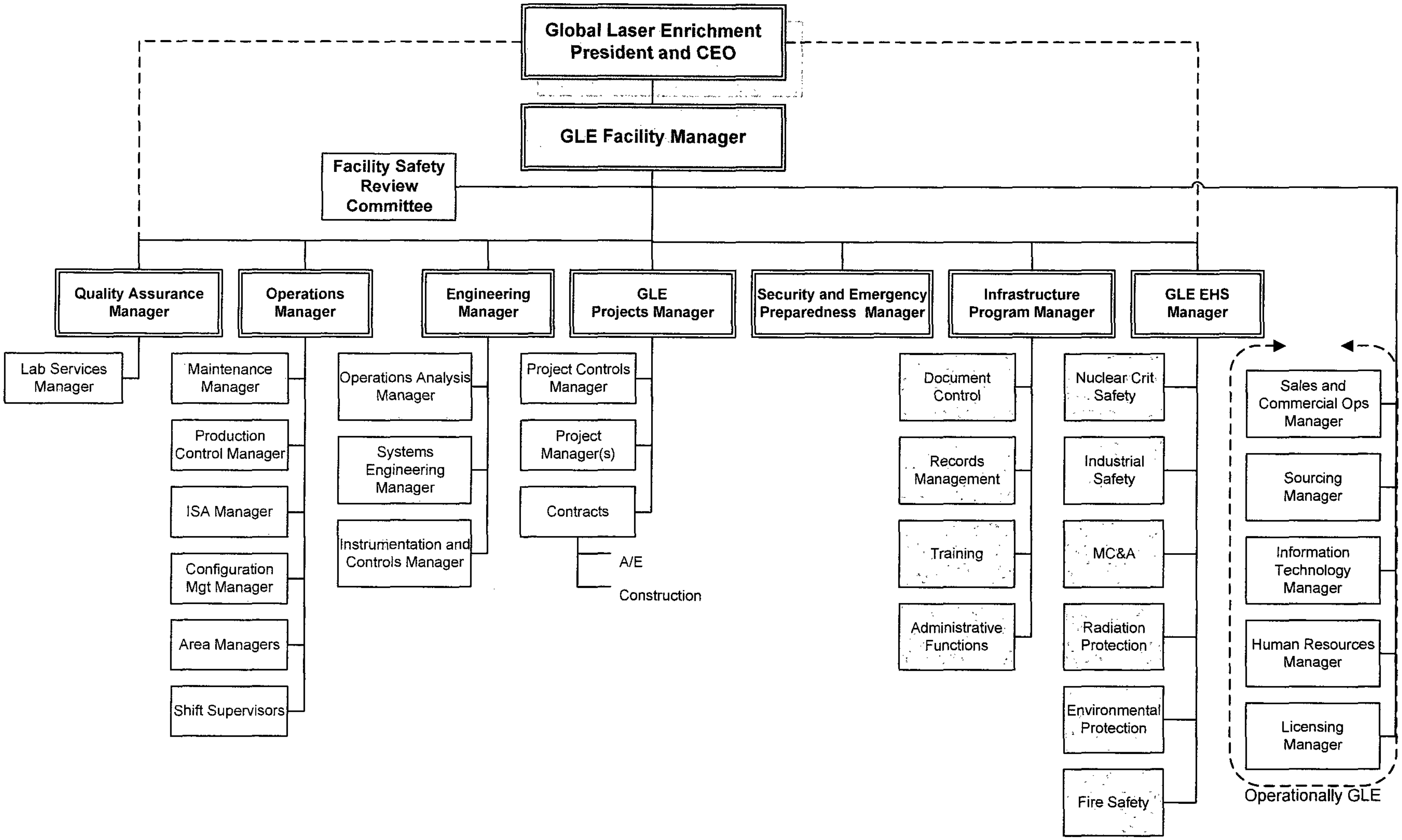


Figure 2-2. GLE Organizational Structure During Operations.



CHAPTER 3
REVISION LOG

Rev.	Effective Date	Affected Pages	Revision Description
0	04/30/2009	ALL	Initial Application Submittal.
1	03/31/2010	8, 9, 16, 23, 25-32	Incorporate RAIs responses submitted to the NRC via MFN-09-578 dated 09/04/2009 and MFN-09-802 dated 12/28/2009.
2	06/18/2010	22, 29	Deleted text related to probabilistic risk assessments in QRAs (only done in initial ISA summary, future revisions use both quantitative and qualitative assessments). Added NAVFAC DM 7 to Table 3-1.

TABLE OF CONTENTS

TABLES

FIGURES

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3. INTEGRATED SAFETY ANALYSIS (ISA) AND ISA SUMMARY

This chapter presents the GE-Hitachi Global Laser Enrichment LLC (GLE) Integrated Safety Analysis (ISA) commitments and outlines the GLE ISA methodology. The approach used for performing the ISA is based on NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility (Ref. 3-1)*, Chapter 3, Appendix A, Example Procedure for Accident Sequence Evaluation. This approach employs a semi-quantitative risk index method for categorizing accident sequences in terms of their likelihood of occurrence and their consequences of concern. The risk index method identifies which accident sequences have consequences that could potentially exceed the performance requirements of 10 CFR 70.61, *Performance Requirements (Ref. 3-2)*; and therefore require a designation of Items Relied on for Safety (IROFS) and supporting management measures. Descriptions of these general types of higher consequence accident sequences are reported in the ISA Summary.

The ISA is a systematic analysis to identify facility and external hazards, credible initiating events, potential accident sequences, the likelihood and consequences of each accident sequence, and the IROFS implemented to prevent or mitigate each credible accident. The ISA Team reviewed the hazard identified for the credible worst-case consequences. Credible high or intermediate consequence accident scenarios were assigned accident sequence identifiers and accident sequence descriptions, and a risk index determination was made. The risk index method is regarded as a screening method, not as a definitive method, of proving the adequacy or inadequacy of the IROFS for any particular accident.

The primary scope of the ISA included fires, hazardous material releases, radioactive material releases, credible nuclear criticality accident sequences, and explosions that could result in injuries to workers and/or the public, or significant environmental impacts during routine and non-routine (startup, shutdown, emergency shutdown, etc.) operations.

The accident summary resulting from the ISA identifies which engineered or administrative IROFS must fail to allow the occurrence of consequences that exceed the levels identified in 10 CFR 70.61.

The ISA was used to develop an ISA Summary that has been separated into two documents: (1) an unclassified ISA Summary to be submitted as Security–Related, Export Controlled, and Proprietary Information; and (2) a classified ISA Summary that is submitted separately as Classified, Export Controlled, and Proprietary Information.

3.1 SAFETY PROGRAM AND INTEGRATED SAFETY ANALYSIS COMMITMENTS

3.1.1 Process Safety Information

GLE has compiled and maintains up-to-date documentation of process safety information. Process safety information is used in updating the ISA and in identifying and understanding the hazards associated with the processes. The compilation of written process safety information includes information pertaining to:

- The hazards of materials used or produced in the process, which includes information on chemical and physical properties included on material safety data sheets (MSDSs) meeting the requirements of 29 CFR 1910.1200(g), *Toxic and Hazardous Substances, (Ref. 3-3).*

- Technology of the process which includes block flow diagrams or simplified process flow diagrams, a brief outline of the process, safe upper and lower limits for controlled parameters (for example, temperature, pressure, flow, and concentration), and evaluation of the health and safety consequences of process deviations.

- Equipment used in the process, including general information on topics such as the materials of construction, piping and instrumentation diagrams (P&IDs), ventilation, design codes and standards employed, material and energy balances, IROFS (for example, interlocks, detection, or suppression systems), electrical classification, and relief system design and design basis.

Process safety information is maintained up-to-date by the Configuration Management (CM) Program described in GLE license application (LA) Section 11.1, *Configuration Management*. Changes to the ISA are conducted in accordance with approved written procedures. This includes implementation of a facility change mechanism that meets the requirements of 10 CFR 70.72, *Facility Changes and Change Process (Ref. 3-4)*. The development and implementation of procedures is described in GLE LA Section 11.4, *Procedures.*

GLE uses personnel with the appropriate experience and expertise in engineering and process operations 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 GLE LA Section 2.2, *Key Management Positions, Responsibilities, and Qualifications.*

3.1.2 Integrated Safety Analysis

GLE has conducted an ISA for each process, such that it identifies the following:

- Nuclear criticality hazards,

- Radiological hazards,

- Chemical hazards that could increase radiological risk,

- Facility hazards that could increase radiological risk,
- Credible accident sequences,
- Consequences and likelihood of each accident sequence, and
- IROFS including the assumptions and conditions under which they support compliance with the performance requirements of 10 CFR 70.61.

A summary of the results of the ISA, including the information specified in 10 CFR 70.65(b), *Additional Contents of Application (Ref. 3-5)*, is provided in the ISA Summary.

GLE has implemented programs to maintain the ISA and supporting documentation so that it is accurate and up-to-date. Changes to the ISA Summary are submitted to the U.S. Nuclear Regulatory Commission (NRC) in accordance with 10 CFR 70.72(d)(1) and (3). The ISA update process accounts for changes made to the facility or its processes. This update also verifies that initiating event frequencies and IROFS reliability values assumed in the ISA remain valid. Required ISA changes, as a result of the update process, are included in a revision to the ISA. Evaluation of facility changes, or a change in the process safety information, which may alter the parameters of an accident sequence, is performed using the ISA method(s) described in the ISA Summary. For any revisions to the ISA, personnel having qualifications similar to those of ISA Team members who conducted the original ISA are used. Personnel used to update and maintain the ISA and ISA Summary are trained in the ISA method(s) and are suitably qualified.

Proposed changes to the facility or its operations are evaluated using the ISA method(s). New or additional IROFS and appropriate management measures are designated as required. The adequacy of existing IROFS and associated management measures are promptly evaluated to determine if they are impacted by changes to the facility and/or its processes. If a proposed change results in a new type of accident sequence or increases the consequences or likelihood of a previously analyzed accident sequence within the context of 10 CFR 70.61, the adequacy of existing IROFS and associated management measures are promptly evaluated and the necessary changes are made, if required. Unacceptable performance deficiencies associated with IROFS are addressed through updates to the ISA.

3.1.3 Management Measures

Management measures are utilized to maintain the IROFS so that they are available and reliable to perform their safety functions when needed. Management measures ensure compliance with the performance requirements assumed in the ISA documentation. The measures are applied to particular structures, systems, components (SSCs), equipment, and activities of personnel; and may be graded commensurate with the reduction of the risk attributable to that IROFS. Management Measures are described in GLE LA Chapter 11, *Management Measures.*

3.1.4 Design Codes and Standards

GLE commits to follow the industry practice to adhere to all "shall" statements in standards applied. Suggestions and recommendations in applied standards (so called "should" statements) are not considered by GLE as binding commitments unless it is specifically stated that GLE's intent is to treat the "should" statements as binding commitments (that is, treat as if they are "shall" statements). GLE may make such commitments as part of the description of the safety program basis. If a definitive commitment to a "should" statement is necessary to provide adequate protection, GLE may provide explanation of this as an issue in response to requests for additional information (RAI) on specific licensing actions. Suggestions and recommendations in applied standards may or may not be used by GLE, at its discretion if not otherwise identified as binding commitments. Shown in Table 3.1, *Code of Record*, is an inclusive listing of Codes and Standards that are planned to be used in the safe design of the facility.

3.2 INTEGRATED SAFETY ANALYSIS SUMMARY AND DOCUMENTATION

3.2.1 Site Description

The ISA Summary provides a description of the GLE Site and the surrounding Owner Controlled Area (herein referred to as the Wilmington Site). A summary description of the GLE Site and the Wilmington Site is contained in GLE LA Chapter 1, *General Information*.

3.2.2 Facility Description

The ISA Summary provides a description of the GLE Commercial Facility. A summary description of the GLE Commercial Facility is provided in GLE LA Chapter 1.

3.2.3 Process, Hazards, and Accident Sequences

The ISA Summary provides a description of the GLE Commercial Facility processes and associated SSCs, the process hazards, and a general description of the accident sequences evaluated in the ISA. A summary of the enrichment process is provided in GLE LA Chapter 1.

3.2.4 Compliance with the Performance Requirements of 10 CFR 70.61

The ISA Summary provides information that demonstrates GLE's compliance with the performance requirements of 10 CFR 70.61.

3.2.4.1 Accident Sequence Evaluation and IROFS Designation

The ISA Summary provides information that demonstrates compliance with the performance criteria of 10 CFR 70.61. The ISA Summary provides sufficient information to demonstrate that credible high consequence events are controlled to the extent needed to reduce the likelihood of occurrence to "Highly Unlikely" and credible intermediate consequence events are controlled to the extent needed to reduce the likelihood of occurrence to "Unlikely."

3.2.4.2 Management Measures

The ISA Summary provides a description of the management measures to be applied to IROFS for each accident sequence for which the consequences could exceed the performance requirements of 10 CFR 70.61.

3.2.4.3 Criticality Monitoring

The GLE Commercial Facility has a Criticality Accident Alarm System (CAAS) as required by 10 CFR 70.24, *Criticality Accident Requirements (Ref. 3-6)*. CAAS coverage shall be provided in each process area where special nuclear material (SNM) is handled, used, or stored, with the exception of those areas exempted as described in Section 1.2.5.7 of this license application. Areas where special nuclear material (SNM) is handled, used, or stored in amounts at or above the 10 CFR 70.24 mass limits have CAAS coverage. The CAAS is designed, installed, and maintained in accordance with ANSI/ANS 8.3-1997, *Criticality Accident Alarm System (Ref. 3-7)*, as modified by Regulatory Guide 3.71, *Nuclear Criticality Safety Standards Fuels and Material Facilities (Ref. 3-8)*. The CAAS is described in GLE LA Chapter 5, *Nuclear Criticality Safety*.

3.2.4.4 New Facilities or New Processes at Existing Facilities

Baseline design criteria (BDC) that must be used for new facilities is specified in 10 CFR 70.64, *Requirements for New Facilities or New Processes at Existing Facilities (Ref. 3-9)*. The ISA accident sequences for the credible high and intermediate consequence events for the GLE Commercial Facility have defined the design basis events. The IROFS for these events and safety parameter limits ensure that the associated BDC are satisfied. IROFS safety parameter limits are available in the ISA documentation. The BDC in 10 CFR 70.64 have been used as bases for the design of the GLE Commercial Facility as described below.

3.2.4.4.1 Quality Standards and Records

SSCs that are determined by the ISA to be IROFS are designed, fabricated, erected, and tested in accordance with the applicable quality assurance (QA) criteria described in GLE LA Section 11.8, *Other Quality Assurance Elements*. Appropriate records of the design, fabrication, erection, procurement, and testing of SSCs that are IROFS are maintained throughout the life of the facility. Management Measures applicable to IROFS are discussed in GLE LA Chapter 11 and in the ISA Summary.

3.2.4.4.2 Natural Phenomena Hazards

SSCs that are determined to be IROFS are designed to withstand the effects of, and be compatible with, the environmental conditions associated with operation, maintenance, shutdown, testing, and accidents for which the IROFS are required to function.

3.2.4.4.3 Fire Protection

SSCs that are IROFS are designed and located so that they can continue to perform their safety functions effectively under credible fire and explosion exposure conditions. Non-combustible and heat resistant materials are used wherever practical throughout the facility, particularly in locations vital to the control of hazardous materials and to the maintenance of safety control functions. Fire detection, alarm, and suppression systems are designed and provided with sufficient capacity and capability to minimize the adverse effects of fires and explosion on IROFS. The design includes provisions to protect against adverse effects that may result from either the operation or the failure of the fire suppression system.

3.2.4.4.4 Environmental and Dynamic Effects

SSCs that are IROFS are protected against dynamic effects, including effects of missiles and discharging fluids, that may result from natural phenomena; accidents at nearby industrial, military, or transportation facilities; equipment failure; and other similar events and conditions both inside and outside the facility.

3.2.4.4.5 Chemical Protection

The design provides adequate protection against chemical risks produced from licensed material, facility conditions that affect the safety of licensed material, and hazardous chemicals produced from licensed material.

3.2.4.4.6 *Emergency Capability*

SSCs that are required to support the GLE Radiological Contingency and Emergency Plan (RC&EP) are designed for emergencies. The design provides accessibility to the equipment of onsite and available offsite emergency facilities and services such as hospitals, fire and police departments, ambulance service, and other emergency agencies.

3.2.4.4.7 *Utility Services*

Onsite utility service systems required to support IROFS are provided. Each utility service system required to support IROFS are designed to perform their function under normal and abnormal conditions. Utility systems are described in the ISA Summary.

3.2.4.4.8 *Inspection, Testing, and Maintenance*

SSCs that are determined to be IROFS are designed to permit inspection, maintenance, and testing.

3.2.4.4.9 *Criticality Control*

The design of process and storage systems shall include demonstrable margins of safety for the nuclear criticality parameters that are commensurate with the uncertainties in the process and storage conditions, in the data and methods used in calculations, and in the nature of the immediate environment under accident conditions. Process and storage systems are designed and maintained with sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. The Nuclear Criticality Safety (NCS) Program and NCS methodologies and technical practices are described in GLE LA Chapter 5.

3.2.4.4.10 *Instrumentation and Controls*

Instrumentation and control systems are provided to monitor variables and operating systems that are significant to safety over anticipated ranges for normal operation, abnormal operation, accident conditions, and safe shutdown. These systems ensure adequate safety of process and utility service operations in connection with their safety function.

The variables and systems that require surveillance and control include process systems having safety significance, the overall confinement system, confinement barriers and their associated systems, and other systems that affect the overall safety of the facility. Controls shall be provided to maintain these variables and systems within the prescribed operating ranges under normal conditions. Instrumentation and control systems are designed to fail into a safe state or to assume a state demonstrated to be acceptable on some other basis if conditions such as disconnection, loss of energy or motive power, or adverse environments are experienced.

3.2.4.4.11 Defense-in-Depth Practices

The facility and system designs are based on defense-in-depth practices. The design incorporates a preference for engineered controls over administrative controls to increase overall system reliability. For criticality safety, the engineered controls preference is for use of passive engineered controls over active engineered controls. The design also incorporates features that enhance safety by reducing challenges to IROFS. Facility and system IROFS are identified in the ISA Summary.

The enrichment process systems and support systems are described in the ISA Summary. In addition to identifying the IROFS associated with each system, the ISA Summary identifies the additional design and safety features (considerations) that provide defense-in-depth.

3.2.5 Integrated Safety Analysis Methodology

GLE utilized methodologies identified in NUREG-1520, Chapter 3, Appendix A, to identify hazards and evaluate accident scenarios. This approach employs a semi-quantitative risk index method for categorizing accident sequences in terms of their consequences of concern and their likelihood of occurrence. The risk index method framework identifies which accident sequences have consequences that could exceed the performance requirements of 10 CFR 70.61 and; therefore, require designation of IROFS and supporting management measures. Descriptions of these general types of higher-consequence accident sequences are reported in the ISA Summary. The ISA is a systematic analysis to identify facility and external hazards, potential accidents, accident descriptions, the likelihood and consequences of the accidents, and the IROFS.

The ISA uses a hazard analysis method, the What-If/Checklist Method, to identify the hazards relevant to each node or the facility in general. The ISA Team reviewed the hazards identified for the "credible worst-case" consequences. The credible high or intermediate severity consequence accident scenarios were assigned accident description identifiers, accident descriptions, frequency or probability, and then a risk index determination was performed. The risk index was used to evaluate unmitigated risk as unacceptable or acceptable.

For each accident scenario having an unacceptable unmitigated risk index, IROFS were defined and the mitigated likelihood determined for each accident scenario. Using the unmitigated initiating event frequency and the failure probability of each IROFS, the mitigated likelihood and mitigated risk was determined. The risk index method is regarded as a screening method, not as a definitive method, of proving the adequacy or inadequacy of the IROFS for any particular accident. The credible accidents that potentially exceed the levels identified in 10 CFR 70.61 are evaluated using a Quantitative Risk Analysis (QRA) approach. The determination of the mitigated likelihood for an accident scenario is documented in a QRA report.

The intent of the QRA reports is to evaluate unacceptable risk identified during a formal What-If analysis. The ISA provides sufficient background and operational information to understand and examine accident scenarios that result in undesired outcomes for each initiating event. Each QRA report provides details concerning an accident scenario's quantification, including the method used; initiating event frequency determination; enabling or conditional event probabilities; the IROFS credited to prevent or mitigate the initiating event(s) being analyzed; the failure probabilities for the credited IROFS; and the overall likelihood estimates. Initiating event frequencies of occurrence presented in the QRAs were conservatively selected with the maximum event frequency bounded by a frequency of once per year. The QRA reports are controlled documents and maintained up-to-date by the CM Program described in GLE LA Chapter 11.

Figure 3-1, *Integrated Safety Analysis Process Flow Diagram,* describes the ISA process steps. The following sub-sections correspond to each block in the flow diagram.

3.2.5.1 Define Nodes to be Evaluated

The first step of the ISA is for the ISA Team to systematically break down the process system, subsystem, facility area, or operation being studied into well-defined nodes. The ISA nodes establish the 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 in order to allow interactions to be studied.

Operations were treated in this manner so that the entire facility was evaluated in a logical process flow approach. This approach is also used to evaluate the hazards associated with each process or operation, and to identify any new hazards resulting from modifications made to an existing process or operation. The GLE Commercial Facility defined nodes are listed in Table 3-2, *Integrated Safety Analysis Nodes*. Information used to define the nodes and to perform the process hazard analysis (PHA) includes, but are not limited to, the following:

- System descriptions,
- Process flow diagrams,
- Plot plans,
- Topographic maps,
- Equipment arrangement drawings with general equipment layout and elevations,
- Design temperatures and pressures for major process equipment and interconnected piping,
- Materials of construction for major process equipment and interconnected piping,
- MSDSs for any chemicals involved in the process (including any intermediate chemical reaction products) and other pertinent data for the chemicals or process chemistry (such as, chemical reactivity hazards),
- Utility system drawings, and
- Criticality safety analyses (CSAs) / radiological safety assessments (RSAs).

3.2.5.2 Hazard Identification

What-If analysis and Checklist methods were used for identifying the hazards for the GLE process. Event Tree Analysis was employed to assist in determining credible or non-credible events and in identifying IROFS. These methods are consistent with the guidance provided in NUREG-1520 and NUREG-1513, *Integrated Safety Analysis Document (Ref. 3-10).* The hazard identification process documents materials that are:

- Radioactive,
- Fissile,
- Flammable,
- Explosive,
- Toxic, and
- Reactive.

The hazards identification process results in identification of radiological or chemical characteristics that have the potential for causing harm to workers, the public, or to the environment. The hazards of concern for the GLE Commercial Facility are related to either a release of uranium hexafluoride (UF_6) (loss of confinement) or a criticality. In general, the loss of confinement would initially result in moisture in the air reacting with the UF_6, forming uranyl fluoride (UO_2F_2) and hydrogen fluoride (HF) as by-products. The HF, which would be in a gaseous form, could be transported through the facility and ultimately beyond the site boundary. HF is a toxic chemical with the potential to cause harm to the workers or the public. For licensed material or hazardous chemicals produced from licensed materials, chemicals of concern are those that, in the event of release, have the potential to exceed concentrations defined in 10 CFR 70, *Domestic Licensing of Special Nuclear Material (Ref. 3-11).* Criteria for evaluating potential releases and characterizing their consequence as either "High" or "Intermediate" for members of the public and facility workers are presented in Table 3-3, *Consequence Severity Categories Based on 10 CFR 70.61*, and Table 3-4, *AEGL Thresholds from the EPA for Uranium Hexafluoride, Soluble Uranium, and Hydrogen Fluoride.*

An HF release would cause a visible cloud and a pungent odor. The odor threshold for HF is less than 1 part per million (ppm) and the irritating effects of HF are intolerable at concentrations well below those that could cause permanent injury or which produce escape-impairing symptoms. Employees are trained in proper actions to take in response to a release and it can be confidently predicted that workers will take immediate self-protective action to escape a release area upon detecting any significant HF odor. Sufficient time is available for the worker to reliably detect and evacuate the area of concern. Public exposures were estimated to last for duration of 30 minutes. This is consistent with self-protective criteria for UF_6/HF plumes listed in NUREG-1140, *A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees (Ref. 3-12).* The AEGL-1, -2, and -3 values were used as the threshold concentration levels for establishing a low, intermediate, or high severity consequence as shown in Table 3-3. AEGL values for other time periods may be utilized if more appropriate for the accident scenarios in question.

10 CFR 70.61(b)(3) states, *An intake of 30 mg or greater of uranium in soluble form by any individual located outside the controlled area identified pursuant to Paragraph (f) of this section.* The UF_6 concentration in air is not directly equivalent to soluble uranium intake. GLE uses an accepted intake value of 75 mg or greater, corresponding to the threshold for permanent renal damage consistent with a high consequence event to a worker as defined in 10 CFR 70.61(b)(4).

Dermal exposures to HF have been evaluated in the ISA Summary. Although HF is not used directly in the enrichment process, limited quantities of dilute HF (< 4%) are generated in the Laboratory and Decontamination and Maintenance Areas. The criteria for assessing the consequence severity for HF dermal exposures are provided in Table 3-3.

The "What-If/Checklist Analysis method was used for identifying process hazards for the UF_6 process systems at GLE Commercial Facility. This PHA technique combines the What-if Analysis with Checklist Analysis, which is used to identify and document items identified in the hazard analysis meetings. The hybrid method lends a more systematic nature to the "Brainstorming" character of the What-If method. For identified single-failure events (that is, those accidents that result from the failure of a single control), the What-If method is the recommended approach. Previously performed "What-If" analyses developed for similar or identical processes at the Wilmington Site were used as a checklist to ensure completeness of the GLE Commercial Facility "What-If" analyses. The primary sources were "What-If" analyses developed for onsite facilities. Implementation of the What-If/Checklist method was accomplished using the GLE Commercial Facility design and performing a What-If for each system.

The results of the ISA Team meetings are summarized in the ISA What-If/Checklist tables, which forms the basis of the hazards portion of the Hazard and Risk Determination Analysis. The What-If/Checklist tables are contained in the ISA documentation. The format for this table, which has spaces for describing the node under consideration and the date of the workshop, is provided in Table 3-5, *What-If/Checklist Example*. The What-If Checklist is divided into ten columns, which are as follows:

1. Item – This is a unique number assigned to each What-If.
2. What-If – This column provides a description of the What-If question to be analyzed.
3. Scenarios Initiator – This column provides a description of the initiating event required to cause the accident.
4. Consequence – This column provides a description of the design basis event (for example, the potential and worst case consequences from fire, potential criticality event, etc.)
5. Category – This column provides the risk category affecting workers, the public, and the environment.
6. Severity – This column identifies the estimated severity category as unmitigated hazard.
7. Likelihood – This column identifies the frequency category of the event as unmitigated hazard.

8. Risk – This column identifies whether the unmitigated risk is acceptable or unacceptable based on the estimated severity, likelihood, and the results of the risk index.

9. IROFS – This column identifies the IROFS which identifies the engineered and/or administrative protection designed to prevent the hazard from occurring.

10. References – This column provides reference to documents used by the ISA Team that provided support to the determinations made during the hazard review.

This approach was used for the process system hazard identification. The results of the unmitigated What-If/Checklists are used directly as input to the risk matrix and risk index development. In addition, the hazard identification identifies potentially hazardous process conditions. Most hazards were assessed individually for the potential impact on the discrete components of the process systems. However, hazards were assessed on a facility-wide basis for credible hazards from fires (such as, external to the process system) and external events (such as, seismic, severe weather, etc.).

As stated earlier, the hazards of concern are related to either a release of UF_6 or a postulated criticality event as a potential source of damaging energy and would result in the release of prompt radiation and airborne fission products. The radiation and airborne fission products could result in direct radiation exposure and chemical/radiological inhalation exposure to workers and the public. Each SSC that may possibly contain enriched uranium is designed with criticality safety as an objective.

For the design of new facilities, like the GLE Commercial Facility, or significant additions or changes in existing facilities, the proposed design is reviewed by the NCS function to identify potential criticality hazards. The NCS function evaluates each fissile material process to identify the normal and credible abnormal conditions, and establishes the controls required to meet the double contingency design criteria. Use of the double contingency design criteria assures that nuclear processes remain subcritical under normal and credible abnormal conditions. The NCS evaluations that provide the criticality safety basis are documented in CSAs, which describe the facility criticality hazards and the identification of criticality accident scenarios. The CSAs are an integrated part of the ISA, which document the criticality hazards and credible criticality accident scenarios. The ISA input information is included in the ISA documentation.

For the purpose of evaluating the impacts of fire hazards, the ISA Team considered the following:

- Postulated the development of a fire occurring in in-situ combustible material from an unidentified ignition source (such as, electrical shorting, or other source);
- Postulated the development of a fire occurring in transient combustible material from an unidentified ignition source (such as, electrical shorting, or other source); and
- Evaluated the uranic content in the space and its configuration (for example, UF_6 solid/gas in cylinders, UF_6 gas in piping, UF_6 and/or byproducts bound on chemical traps, UO_2F_2 particulate on solid waste or in solution). The appropriate configuration was considered relative to the likelihood of the target releasing its uranic content as a result of a fire in the area.

In order to assess the potential severity of a given fire and the resulting failures to important systems, a Fire Hazards Analysis (FHA) was consulted; however, since the design supporting the license submittal for this facility is not yet at the detailed design stage, detailed in-situ combustible loading and in-situ combustible configuration information is estimated. Therefore, in order to place reasonable and conservative bounds on the fire scenarios analyzed, the ISA Team estimated in-situ combustible loadings based on the FHA information of the in-situ combustible loading for the GLE Commercial Facility. This information indicates that in-situ combustible loads are expected to be very low.

External events were considered at the site and facility level. The external event ISA considered both natural phenomena and man-made hazards. During the external event ISA Team meeting, each area of the GLE Commercial Facility was discussed as to whether or not it could be adversely affected by the specific external event under consideration. If so, specific consequences were then discussed. If the consequences were known or identified to be a low consequence, then a specific design basis with a likelihood of "Highly Unlikely" would be selected. Each external event was assessed for both the unmitigated case and then for the mitigated case. The mitigated cases could be a specific design basis for that external event, IROFS, or a combination of both.

Natural phenomena hazards (NPH) considered for evaluation included:

- Earthquakes,
- Hurricanes (including topical storms),
- Tornados (including tornado missiles and extreme straight wind),
- Volcanoes,
- Flooding,
- Tsunamis,
- Snow and ice, and
- Local precipitation.

External man-made hazards considered for evaluation included:

- Transportation hazards onsite/offsite,
- Onsite facility hazards,
- Aircraft crashes,
- Wildland fires (range fires),
- Pipelines,
- Roadways and highways,
- Nearby industrial facilities,
- Nearby military installations,
- Railways,

- Waterways,
- Underground utilities (onsite use of natural gas and electrical services),
- Internal flooding from onsite above ground liquid storage tanks, and
- Land use impacts.

3.2.5.3 Identify Accident Scenarios

The goal is to identify credible accident scenarios or sequences by analyzing single initiating events. Using approved methods, the ISA Team identified potential accident scenarios associated with a process or operation, including possible worse-case consequences, causes (events that can initiate the accident), and safeguards or controls that are available to prevent the cause of the event or mitigate the consequences. Safeguards are design features or administrative programs that provide defense-in-depth, but are not credited as IROFS. Consequences of interest include nuclear criticality accidents, radiological material releases, radiation exposures, chemical/toxic exposures from licensed material or hazardous chemicals produced from licensed material, and fires and explosions. Hazards are defined to be materials, equipment, or energy sources with the potential to cause injury or illness to humans.

An important product of an ISA consists of a description of accident scenarios identified and recorded during the analysis process. An accident scenario involves an initiating event, any factors that allow the accident to propagate (enablers), and any factors that reduce the risk (likelihood or consequence) of the accident (controls). The accident scenario is a scenario of specific real events.

When analyzing accident scenarios, the ISA Team considered process deviations, human errors, internal facility events, and credible external events, including natural phenomena. Natural phenomenon events, such as hurricanes, tornadoes/high winds, seismic events, and external events (such as aircraft crashes) are addressed separately in Chapter 2 of the ISA Summary. FCSS ISG-08, *Natural Phenomena Hazards (Ref. 3-13)*, was used as guidance when evaluating natural phenomena hazards as initiating events. The team evaluated common mode failures and systems interactions where preventive actions and/or control measures are required to prevent and/or mitigate accident scenarios. The team-listed scenarios considered not credible. In addition to normal conditions, the team considered abnormal conditions including startup, shutdown, maintenance, and process upsets.

For each accident scenario, enabling conditions, and conditional events that affect the outcome of the accident scenario (for example, conditions that affect the likelihood of the scenario or could mitigate the consequences to either workers or the public) were identified where appropriate.

An enabling condition does not directly cause the scenario but must be present for the initiating event to proceed to the consequences described. Enabling conditions are expressed as probabilities and can reflect such things as the mode of operation (for example, percent of operational online availability).

Conditional events that affect the probability of the undesired outcome were also identified. These include probabilistic consideration of individual or administrative actions that would not be considered IROFS but would affect the overall likelihood of the accident. For example, if a scenario involves personal injury hazards, at least one worker must be present in the affected area at the time of the event for the injury to occur. Thus, the presence of workers in the affected area is a conditional modifier for a consequence involving personal injury. Another example of a conditional event is the probability that a worker can successfully evacuate from an area given that a hazard is present.

In considering accident scenarios at the GLE Commercial Facility, it is necessary to determine which scenarios are considered not credible and which are credible. When conducting the PHA, the ISA Team considered each accident scenario as credible, unless the scenario could be determined to be not credible. See Section 3.2.5.5, *Determine Unmitigated Likelihood,* for the criteria GLE used to determine if an accident scenario is credible.

3.2.5.4 Determine Consequence Severity

Table 3-3 presents the radiological and chemical consequences severity limits of 10 CFR 70.61 for each of the three accident consequences categories. Table 3-4 provides information on the chemical dose limits specific to the GLE Commercial Facility.

For each credible accident scenario identified, the ISA Team assigned a severity ranking for the consequences using the consequence severity rankings provided in Table 3-3. Assigning a severity ranking allowed each accident scenario to be categorized in terms of the performance requirements outlined in 10 CFR 70.61(b), (c), and (d). The Severity Ranking System is outlined below:

- A severity ranking of 3 corresponds to high consequences,
- A severity ranking of 2 corresponds to intermediate consequences, and
- A severity ranking of 1 corresponds to low consequences.

When estimating the possible "worst-case" consequences of an accident scenario, the ISA Team members used experience, guidance from NUREG/CR-6410, *Nuclear Fuel Cycle Facility Accident Analysis Handbook (Ref. 3-13)*, and best judgment.

10 CFR 70.61 specifies two categories for a credible accident description consequence: "Credible High Consequence" and "Intermediate Consequence." Implicitly there is a third category for accidents that produce consequence less than "Intermediate." These are referred to as "Low Consequence" accident descriptions. The primary purpose of PHA is to identify the uncontrolled and unmitigated accident descriptions. These accident descriptions are then categorized into one of the three consequence categories (high, intermediate, low) based on their forecast radiological, chemical, and/or environmental impacts. For evaluating the magnitude of the accident consequence, calculations were performed using the methodology described in the ISA documentation. The consequence of concern is the chemo-toxic exposure to HF and UO_2F_2. The dose consequence for each of the accident descriptions were evaluated and compared to the criteria for "High" and "Intermediate" consequences.

The inventory or uranic material for each accident considered was dependent on the specific accident description. For potential criticality accidents, the consequence was conservatively assumed to the high for the worker, the public, and the environment. Scenarios that resulted in a severity rank of 2 or 3 are: criticality, large UF_6/HF release (such as a multiple cylinder failure or cascade failure), and a heated cylinder release. A solid or gas release of a cold trap, low-temperature takeoff station (LTTS), or single cylinder that is not heated does not exceed intermediate consequence requirements. For a severity level of 1, there is "No Safety Consequence of Concern." There is no further action and the What-If checklist is updated.

3.2.5.5 *Determine Unmitigated Likelihood*

The likelihood of an accident scenario occurring was determined for the unmitigated case (unmitigated likelihood). Unmitigated likelihood is the likelihood or frequency that the initiating event or cause of the accident sequence occurs. This likelihood/frequency estimate assumes that none of the available safeguards or IROFS are available to perform their intended safety function. Table 3-6, *Unmitigated Likelihood Categories,* shows the likelihood of occurrence limits of 10 CFR 70.61 for each of the three likelihood categories. The team assigned a likelihood level for each accident scenario using the defined categories in Table 3-7, *Event Likelihood Categories*, and Table 3-8, *Determination of Likelihood Category.* When assigning a likelihood category, the team made use of process knowledge, accident scenario information, operating history, and manufacturers/product information to determine which category of likelihood was appropriate. For accident scenarios where multiple initiating events have been identified, the team estimated the likelihood for the most credible initiating event. This helped ensure that the accident scenario was screened using the most conservative estimate of risk.

The definitions of likelihood terms are presented in the following sections.

3.2.5.5.1 *Highly Unlikely*

The guideline for acceptance of the definition of "Highly Unlikely" has been derived as the highest acceptable frequency that is consistent with a goal of having no inadvertent nuclear criticality accidents and no accidents of similar consequences in the industry. To within an order of magnitude, this is taken to mean a frequency limit of less than one such accident in the industry every 100 years. This has been translated into a guideline limiting the frequency of individual accidents to 10^{-5} per-event per-year. As the goal is to have no such accidents, accident frequencies should be reduced substantially below this guideline when feasible.

3.2.5.5.2 *Unlikely*

Intermediate consequence events include significant radiation exposures to workers (those exceeding 0.25 Sieverts or 25 rem). No increase in the rate of such significant exposures is the NRC's goal. This has been translated into a guideline of 4.0 x 10^{-5} per-event per-year. This guideline may be more generally considered as a range between 10^{-4} and 10^{-5} per-event per-year since exact frequencies at such levels cannot accurately be determined.

3.2.5.5.3 Not Credible

The definition of "Not Credible" is also taken from NUREG-1520. If an event is "Not Credible," IROFS are not required to prevent or mitigate the event. The fact that an event is "Not Credible" must not depend on any facility feature that could credibly fail to function. One cannot claim that a process does not need IROFS because it is "Not Credible" due to characteristics provided by IROFS. The implication of "Credible" in 10 CFR 70.61 is that events that are "Not Credible" may be neglected. Any one of the following independent acceptable sets of qualities could define an event as "Not Credible:"

- An external event for which the frequency of occurrence can conservatively be estimated as less than once in a million years.
- A process deviation that consists of a description of many unlikely human actions or errors for which there is no reason or motive. In determining that there is no reason for such actions, a wide range of possible motives, short of intent to cause harm, must be considered. Necessarily, no such description of events can ever have actually happened in any fuel cycle facility.
- Process deviations for which there is a convincing argument, given physical laws that they are not possible, or are unquestionably extremely unlikely.

3.2.5.5.4 Credible

A "Credible" accident is any event that does not meet the definition of "Not Credible" as defined above.

3.2.5.6 Determine Unmitigated Risk

Credible accident scenarios identified for the facility, which have the capability of producing conditions that fail to meet the performance requirements of 10 CFR 70.61(b), (c) or (d), are included in the scope of the ISA Summary. For each credible accident scenario, the ISA Team used the severity category ranking and unmitigated likelihood level to assign an unmitigated risk level. (The unmitigated risk is determined from the product of the severity category and the unmitigated-likelihood category.) The ISA Team used the risk matrix in Table 3-9, *Unmitigated Risk Assignment Matrix*, to determine the unmitigated risk. The unmitigated risk associated with each accident scenario indicates the relative importance of the associated controls. Accident scenarios of which the consequences and likelihoods yield an unacceptable risk index require further evaluation to determine IROFS and mitigated risk, as described in Section 3.2.5.8, *Develop IROFS and Frequency Determination.*

If the unmitigated risk is less than or equal to 4, the unmitigated risk is acceptable and no further action is required. The What-If table is updated to reflect this conclusion of no further action and the Qualitative Risk Analysis is performed.

3.2.5.7 *Perform Quantitative Risk Analysis*

The QRA identifies the GLE Commercial Facility nodes to which it applies, describes the node operations and operational areas, presents the QRA layout including the PHA reference nodes, accident description, initiating events evaluated, potential preventive and mitigative features, and describes management measures. An event tree analysis is provided and the overall likelihood of the accident is given.

3.2.5.8 *Develop IROFS and Frequency Determination*

For each accident scenario having an unacceptable unmitigated risk index, IROFS must be defined and the mitigated likelihood determined for each accident scenario. Using the unmitigated initiating event frequency and the failure probability of each IROFS, the mitigated likelihood is determined.

The QRAs present an accident evaluation including a detailed discussion concerning the selection of initiating events, IROFS, and the quantification of the accident sequences through the use of event trees. Determination of the mitigated likelihood for an accident scenario is documented in a QRA Report. The intent of the QRA reports is to provide sufficient background and operational information to understand and examine accident scenarios that result in undesired outcomes for each initiating event. Each QRA report provides details concerning an accident scenario's quantification, including method used, initiating-event frequency determination, the IROFS credited to prevent or mitigate the initiating event(s) being analyzed, the failure probabilities for the credited IROFS, and the overall likelihood estimates. The QRA reports are controlled documents and are maintained up-to-date by the CM Program described in GLE LA Section 11.1. The quantification results from each QRA are summarized in this ISA Summary.

The mitigated likelihood of the accident scenario occurring with the preventive or mitigating IROFS in-place must meet the requirements in 10 CFR 70.61, which requires that unacceptable consequences be limited. This is accomplished using index values, which are defined as the logarithm of the frequency (or probability) associated with the initiating event and subsequent IROFS failures for the accident scenario. The values of the index numbers for an accident scenario, depending on the number of events involved, are added to obtain a total likelihood index, "T." The likelihood index is therefore the logarithm of the overall likelihood (that is, $\log_{10}(L_T)$). Accident scenarios are then assigned to one of the three likelihood categories of the risk matrix, depending on the value of the likelihood index in accordance with Table 3-7.

The reliability and availability of an IROFS to perform is a function of the management measures applied to each IROFS. The management measures provide the overall management oversight and assurance that the GLE safety program is maintained and functions properly. These management measures are described in GLE LA Chapter 11. ISA Summary, Appendix C, provides a consolidated list of IROFS.

For IROFS, a human factors engineering review of the human-system interfaces shall be conducted using the applicable guidance in NUREG-0700, *Human-System Interface Design Review Guidelines (Ref. 3-16)*; and NUREG-0711, *Human Factors Engineering Program Review Model (Ref. 3-17)*. The results of this review will be documented in the IROFS boundary packages, to be prepared later in the design.

In this document, safety controls and IROFS are synonymous. Safeguards are design features or administrative programs that provide defense-in-depth, but are not IROFS and are not credited with preventing or mitigating accident scenarios. 10 CFR 70.64 states that the design process must be founded on defense-in-depth principles, and incorporate, to the extent practicable, preference for engineered controls over administrative controls, and reduction of challenges to the IROFS that are frequently or continuously challenged. Safety controls used at the facility can be characterized as either administrative or engineered. Administrative controls are generally not considered to be as reliable as engineered controls since human errors usually occur more frequently than equipment failures. Engineered controls may be categorized as being "Passive" or "Active." Passive controls include pipes or vessels that provide containment. Active controls include equipment such as pumps or valves that perform a specific function related to safety. In general, passive controls are considered to be less prone to failure than active controls.

IROFS are those engineered or administrative controls, or control systems, which comprise the SSCs that form the preventive and/or mitigating barriers identified by the ISA. The IROFS selected for each accident scenario may be a control that helps reduce the likelihood that the initiating event occurs, detects or mitigates the consequences, or helps reduce the amount of hazardous material released. IROFS are the barriers that prevent and/or mitigate the unacceptable consequences identified by the performance requirements of 10 CFR 70.61(b), (c) and (d). When selecting IROFS, the IROFS must be independent of the initiating event (for example, occurrence of the initiating event does not cause failure of the IROFS) and other credited IROFS (for example, failure of one IROFS does not cause failure of another IROFS).

GLE commits to identify IROFS as a part of the ISA process and include the identification of the IROFS in the ISA Summary prepared and maintained for the GLE Commercial Facility. The IROFS are defined in such a way as to delineate their boundaries, to describe the characteristics of the preventive/mitigating function, and to identify the assumptions and conditions under which the item is relied on.

3.2.5.9 Update What-If/Checklist, Risk Index, and ISA Summary

The QRA document results in the development of IROFS and the overall accident sequence frequency determination based on the event tree evaluation of the potential accident. This information was then used to update the what-if/checklist table, including the unmitigated likelihood and the unmitigated risk.

Based on the updated what-if/checklist and the QRA, the Accident Sequence Summary and Risk Index (Table 3-10) is completed. For accident sequences that are of low consequence, or that have a risk index of 4 or less, the risk is acceptable and Table 3-10 requires no entries (that is, “N/A”) for the initiating event frequency, IROFS and their failure probabilities, or likelihood index.

The ISA process is an iterative process. The ISA Summary provides an overview of the ISA based upon the existing design level of detail. The ISA Summary that supports the License Application is based on the level of design necessary to establish the safety basis for the GLE Commercial Facility and support the licensing effort.

The final step of the ISA process (see Figure 3-1) is to update supporting ISA documentation and then develop the ISA Summary. As the design of the GLE Commercial Facility progresses, the ISA and supporting documents will be revised, or new supporting documents developed.

3.2.5.10 ISA Integration

The ISA is intended to give assurance that the potential failures, hazards, accident descriptions, scenarios, and IROFS have been investigated in an integrated fashion, so as to adequately consider common mode and common cause situations. Included in this integrated review is the identification of IROFS function that may simultaneously be beneficial and harmful with respect to different hazards, and interactions that might not have been considered in the previously completed sub-analyses. This review is intended to ensure that the designation of one IROFS does not negate the preventive or mitigative function of another IROFS. The ISA Team performed an integrated review during the process hazard review and an overall integration review after the Nodes were completed. Some items that warrant special consideration during the integration process evaluation are:

- Common mode failures and common cause situations.
- Support system failures such as loss of electrical power or city water. Such failures can have a simultaneous effect on multiple systems.
- Divergent impacts of IROFS. Assurance must be provided that the negative impacts of an IROFS, if any, do not outweigh the positive impacts; that is, to ensure that the application of an IROFS for one safety function does not degrade the defense-in-depth of an unrelated safety function.
- Other safety and mitigating factors that do not achieve the status of IROFS that could impact system performance.
- Identification of scenarios, events, or event descriptions with multiple impacts, that is, impacts on chemical, fire, criticality, and/or radiation safety. For example, a flood might cause both a loss of confinement and moderation impacts.
- Potential interactions between processes, systems, areas, and buildings; any interdependence of systems or potential transfer of energy or materials.
- Major hazards or events that tend to be common cause situations leading to interactions between processes, systems, buildings, etc.

3.2.6 Integrated Safety Analysis Team

The ISA was performed, and is maintained, by a team with expertise in engineering, safety analysis, and enrichment process operations. The team included personnel with experience and knowledge specific to each process or system being evaluated. The team was comprised of individuals who have experience, individually or collectively, in the following:

- Nuclear criticality safety,
- Radiological safety,
- Fire safety,
- Chemical process safety,
- Operations and maintenance, and
- ISA methods.

The ISA team leader is trained and knowledgeable in the ISA method(s) chosen for the hazard and accidents evaluations. A qualified NCS engineer is included on each ISA team. Collectively, the team had an understanding of the process operations and hazards under evaluation. The ISA Manager is responsible for the overall direction of the ISA. Additional information on the ISA Team is provided in ISA Summary Chapter 1, *General ISA Information.*

3.2.7 Descriptive List of IROFS

The ISA Summary provides a list of IROFS in the identified high and intermediate accident sequences.

3.2.8 Sole Items Relied On For Safety

Sole IROFS are not used for the GLE Commercial Facility. Instead, a minimum of two independent IROFS are typically selected.

3.3 REFERENCES

3-1. NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility*, U.S. Nuclear Regulatory Commission, March 2002.

3-2. 10 CFR 70.61, *Performance Requirements*, U.S. Nuclear Regulatory Commission, 2008.

3-3. 29 CFR 1910.1200, *Toxic and Hazardous Substances*, Occupational Safety and Health Administration, 2008.

3-4. 10 CFR 70.72, *Facility Changes and Change Process*, U.S. Nuclear Regulatory Commission, 2008.

3-5. 10 CFR 70.65, *Additional Content of Application*, U.S. Nuclear Regulatory Commission, 2008.

3-6. 10 CFR 70.24, *Criticality Accident Requirements*, U.S. Nuclear Regulatory Commission, 2008.

3-7. ANSI/ANS 8.3-1997 (R2003), *Criticality Accident Alarm System*, American Nuclear Society, January 1997.

3-8. Regulatory Guide 3.71, *Nuclear Criticality Safety Standards for Fuels and Material Facilities*, U.S. Nuclear Regulatory Commission, Revision 1, October 2005.

3-9. 10 CFR 70.64, *Requirements for New Facilities or New Processes at Existing Facilities*, U.S. Nuclear Regulatory Commission, 2008.

3-10. NUREG-1513, *Integrated Safety Analysis Guidance Document*, U.S. Nuclear Regulatory Commission, May 2001.

3-11. 10 CFR 70, *Domestic Licensing of Special Nuclear Material,* U.S. Nuclear Regulatory Commission, 2008.

3-12. NUREG-1140, *A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees*, U.S. Nuclear Regulatory Commission, January 1988.

3-13. FCSS ISG-08, *Natural Phenomena Hazards,* U.S. Nuclear Regulatory Commission, Revision 0, October 2005.

3-14. NUREG/CR-6410, *Nuclear Fuel Cycle Facility Accident Analysis Handbook*, U.S. Nuclear Regulatory Commission, March 1998.

3-15. 10 CFR 20, *Standards for Protection Against Radiation,* U.S. Nuclear Regulatory Commission, 2008.

3-16. NUREG-0700, *Human-System Interface Design Review Guidelines,* U.S. Nuclear Regulatory Commission, Revision 2, May 2002.

3-17. NUREG-0711, *Human Factors Engineering Program Review Model,* U.S. Nuclear Regulatory Commission, Revision 2, February 2004.

Table 3-1. GLE Commercial Facility Design Codes and Standards.[1]

Code Group / Reference	Code Number	Year or Edition	Title
ACGIH	2090	2001	Industrial Ventilation: A Manual of Recommended Practice
ACI	117	2006	Specifications for Tolerances for Concrete Construction
ACI	318	2008	Building Code Requirements for Structural Concrete
ACI	349	2007	Code Requirements for Nuclear Safety Related Concrete Structures
AISC	325-05 13th Edition	2006	Manual of Steel Construction
AISC	341	2005	Seismic Provision for Structural Steel Buildings
AISC	360	2005	Specification for Structural Steel Building
AISC	M-011	1989	Manual of Steel Construction Allowable Stress, Ninth Edition
AISC	N-690 (S327)	2006	Nuclear Facilities, Steel Safety-Related Structures for Design and Fabrication
ANSI	N14.1	2001	Nuclear Materials - Uranium Hexafluoride – Packaging for Transport
ANSI/AIHA	Z9.5	2003	Laboratory Ventilation
ANSI/ANS	2.26	2004	Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design
ANSI/ANS	8.1	2007	Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactor
ANSI/ANS	8.3	1997	Criticality Accident Alarm System as modified by Regulatory Guide 3.71, Nuclear Criticality Safety Standards Fuels and Material Facilities
ANSI/ASME	AG-1	2009	Code on Nuclear Air and Gas Treatment, Section FC-5160.
ANSI/ASME	B16.5	1996	Pipe Flanges and Flanged Fittings
ANSI/ASME	B30.2	2005	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trough Hoist)
ANSI/ASME	B31.3	2008	Process Piping (excludes Vacuum Piping Systems)
ANSI/ASME	B31.9	2008	Building Services Piping
ANSI/ASME	NOG-1	2004	Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)

[1] In citing industry consensus codes and standards the applicant has not delineated specific commitments in the standards that will be adopted. These industry consensus codes and standards may not be adopted in their entirety, but form the initial baseline of applicable codes and standards that are evaluated during the design of the GLE CF. Actual codes and standards are established in design documents and the design criteria manual. These documents provide the level of compliance or non-compliance necessary to understand the design criteria used for the design and construction of the GLE Facilities.

Code Group / Reference	Code Number	Year or Edition	Title
ANSI/ASSE	Z117.1	2009	Safety Requirements for Confined Spaces
ANSI/IEEE	C2	2007	National Electric Safety Code
ANSI/IEEE	C37.04	2006	Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI/IEEE	C37.06	2000	Switchgear – AC High-voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities
ANSI/IEEE	C37.11	2003	AC High-Voltage Circuit Breaker Control Requirements
ANSI/IEEE	C37.20.2	2005	Metal-Clad Switchgear
ANSI/IEEE	C37.90	2005	Standard for Relays and Relay Systems Associated with Electric Power Apparatus
ANSI/IEEE	C37.100	2001	Definitions for Power Switchgear
ANSI/IEEE	C57.12.80	2002	Standard Terminology for Power and Distribution Transformers
ANSI/IEEE	C57.12.90	2006	Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
ANSI/IEEE	C57.12.91	2001	Standard Test Code for Dry-Type Distribution and Power Transformers
ANSI/ISA	67.04.01	2000	Setpoints for Nuclear Safety-Related Instrumentation
ASCE	7-05	2006	Minimum Design Loads for Buildings and Other Structures
ASHRAE	62.1	2007	Ventilation for Acceptable Indoor Air Quality
ASHRAE	90.1	2007	Energy Standard for Buildings Except Low-Rise Residential Buildings
ASME	N510	2007	Testing of Nuclear Air Treatment Systems
ASME	NQA-1	1994	Quality Assurance Requirements for Nuclear Facility Applications, w/Addenda Part I: Basic Requirements and Supplementary Requirements for Nuclear Facilities, Part II: Quality Assurance Requirements for Nuclear Facility Application, Part III: Nonmandatory Appendices
ASME	Section VIII	2007	Boiler and Pressure Vessel Code
ASTM	C761-04	2004	Standard Test Methods for Chemical, Mass Spectrometric, Spectrochemical, Nuclear, and Radiochemical Analysis of Uranium Hexafluoride
ASTM	C787-06	2006	Standard Specification for Uranium Hexafluoride for Enrichment
ASTM	C996-04	2004	Standard Specifications for Uranium Hexafluoride Enriched to Less than 5% ^{235}U

Code Group / Reference	Code Number	Year or Edition	Title
ASTM	D6646-03	2003	Standard Test Method for Determination of the Accelerated Hydrogen Sulfide Breakthrough Capacity of Granular and Pelletized Activated Carbon
ASTM	E84	2008	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM	E814	2008	Standard Test Method for Fire Tests of Penetration Firestop Systems
CGA	G-5	2005	Hydrogen
CGA	H-5	2008	Installation Standards for Bulk Hydrogen Supply Systems
CGA	P-1	2008	Safe Handling of Compressed Gas in Cylinders
CGA	SB-2	2007	Safety Bulletin, Oxygen-Deficient Atmospheres, 4th Edition
IAEA	TS-R-1	2009	Regulations for the Safe Transport of Radioactive Material
ICC	NCBC	2009	2006 ICC International Plumbing Code, IPC w/2009 NC Amendments
ICC	NCBC	2009	2006 ICC International Mechanical Code, IMC w/2009 NC Amendments
ICC	NCBC	2009	North Carolina State Building Codes, Version 1.0, 2009 2006 ICC International Building Code w/2009 NC Amendments
ICC	NCFC	2009	North Carolina Fire Code, IFC - 2006 w/2009 NC Amendments
IEEE	80	2000	Guide for Safety in AC Substation Grounding
IEEE	81	1983	Guide for Measuring Earth Resistivity, Ground Impendence and Earth Surface Potential of a Ground System
IEEE	142	2007	Grounding of Industrial and Commercial Power Stations
IEEE	383	2003	IEEE Standard for Qualifying Electric Cables and Field Splices for Nuclear Generating Systems
IEEE	519	1992	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE	1100	2005	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
IEEE	1202	2006	IEEE Standard for Flame Testing of Cables For Use in Cable Tray in Industrial and Commercial Occupancies
NAVFAC	DM 7	1983	*Naval Facilities Engineering Command Design Manual,* Naval Facilities Engineering Command
NEMA	SG 4	2005	Alternating - Current High-Voltage Circuit Breaker
NFPA	1	2009	Fire Code

Code Group / Reference	Code Number	Year or Edition	Title
NFPA	10	2002	Standard for Portable Fire Extinguishers
NFPA	13	2007	Installation of Sprinkler Systems
NFPA	14	2007	Standard for the Installation of Standpipes and Hose Systems
NFPA	20	2007	Standard for the Installation of Stationary Fire Pumps for Fire Protection
NFPA	22	2008	Standard for Water Tanks for Private Fire Protection
NFPA	24	2007	Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA	25	2008	Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
NFPA	30	2008	Flammable and Combustible Liquids Code
NFPA	45	2004	Standard on Fire Protection for Laboratories Using Chemicals
NFPA	51	2007	Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes
NFPA	51B	2009	Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA	54	2009	National Fuel Gas Code
NFPA	55	2005	Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks, with ERRATA 1 2006
NFPA	58	2008	Liquefied Petroleum Gas Code
NFPA	69	2008	Standard on Explosion Prevention Systems
NFPA	70	2008	National Electrical Code®
NFPA	72	2007	National Fire Alarm Code®
NFPA	75	2009	Protection of Information Technology Equipment
NFPA	80	2007	Standard for Fire Doors and Other Opening Protectives
NFPA	80A	2007	Recommended Practice for Protection of Buildings from Exterior Fire Exposures
NFPA	90A	2009	Standard for the Installation of Air-Conditioning and Ventilating Systems
NFPA	90B	2009	Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
NFPA	91	2004	Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids

Code Group / Reference	Code Number	Year or Edition	Title
NFPA	92A	2006	Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences
NFPA	92B	2005	Standard for Smoke Management Systems in Malls, Atria, and Large Spaces
NFPA	101®	2009	Life Safety Code®
NFPA	105	2007	Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives
NFPA	110	2005	Standard for Emergency and Standby Power Systems
NFPA	111	2005	Standard on Stored Electrical Energy Emergency and Standby Power Systems
NFPA	220	2009	Standard on Types of Building Construction
NFPA	221	2009	Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls
NFPA	241	2009	Standard for Safeguarding Construction, Alteration, and Demolition Operations
NFPA	497	2008	Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
NFPA	600	2005	Standard on Industrial Fire Brigades
NFPA	704	2007	Standard System for the Identification of the Hazards of Materials for Emergency Response
NFPA	780	2008	Standard for the Installation of Lightning Protection Systems
NFPA	801	2008	Standard for Fire Protection for Facilities Handling Radioactive Materials
NFPA	1620	2003	Recommended Practice for Pre-Incident Planning
NFPA	2001	2008	Standard on Clean Agent Fire Extinguishing Systems
NRC		2007	Environmental Assessment for Renewal of Special Nuclear Material License No. SNM-1097 General Electric Company Nuclear Energy Product Facility
NRC	Inspection Manual 0609	2005	Appendix F, Fire Protection Significance Determination Process
NRC	FCSS-ISG-08	Rev. 0	Natural Phenomena Hazards, Interim Staff Guidance Document for Fuel Cycle Facilities
NRC Reg Guide	3.12	1973	General Design Guide for Ventilations Systems of Plutonium and Fuel Fabrication Plants
NRC Reg Guide	3.71	2005, Rev. 1	Nuclear Criticality Safety Standards Fuels and Material Facilities

Code Group / Reference	Code Number	Year or Edition	Title
NRC Reg Guide	8.24	1979, Rev. 1	Health Physics Surveys During Enriched Uranium-235 Processing and Fuel Fabrication
NUREG	0700	2002, Rev. 2	Human-System Interface Design Review Guidelines
NUREG	1278	1983	Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications
NUREG	1391	1991	Chemical Toxicity of Uranium Hexafluoride Compared to Acute Effects of Radiation
NUREG	1513	2001	Integrated Safety Analysis Guidance Document
NUREG/CR	6410	1998	Nuclear Fuel Facility Cycle Accident Analysis Handbook
NUREG/CR	6928	2007	Industry-Average Performance for Components and Initiating Events at U.S. Commercial Nuclear Power Plants
PCI	MNL-120 6th Edition	2004	Precast Concrete Institute Design Handbook: Precast and Pre-Stressed Concrete
SMACNA	006	2005	HVAC Duct Construction Standards - Metal and Flexible
SMACNA	1922	2004	Rectangular Industrial Duct Construction Standards
SMACNA	1520	1999	Rounded Industrial Duct Construction Standards
SMACNA	1143	2003	HVAC Air Duct Leakage Test Manual, First Edition
SMACNA	1780 3rd Edition	2002	HVAC Systems Testing, Adjusting, and Balancing
SMACNA	1958 4th Edition	2006	HVAC Systems Duct Design
UL	555	2010	Standard for Safety Fire Dampers
UL	555S	2010	Standard for Safety Smoke Dampers
UL	586	2009	Standard for Safety High-Efficiency, Particulate, Air Filter Units
UL	900	2007	Standard for Safety Air Filter Units

Table 3-2. Integrated Safety Analysis Nodes.

Node Number / Designation	Node Description/Name
4100-00	Cylinder Storage and Handling
4200-00	Feed/Vaporization
4300-00	Product Withdrawal
4400-00	Tails Withdrawal
4500-00	*Intentionally Left Blank*
4600-00	Cascade / Gas Handling
4700-00	Blending
4800-00	Sampling
4900-00	Radioactive Waste (Liquid/Solid)
5000-00	HVAC/MCES
5100-00	Utilities
5200-00	Decontamination/Maintenance
5300-00	*Intentionally Left Blank*
5400-00	Laboratory Operations
5500-00	Laser System
5600-00	External Events
5700-00	Balance of Plant

Table 3-3. Consequence Severity Categories Based on 10 CFR 70.61.

<table>
<tr><th rowspan="2">Severity Ranking</th><th colspan="3">Consequence Description</th></tr>
<tr><th>Workers</th><th>Offsite Public</th><th>Environment</th></tr>
<tr><td rowspan="5">3</td><td>Radiological dose greater than 1 Sv (100 rem)</td><td>Radiological dose greater than 0.25 Sv (25 rem)</td><td rowspan="5">N/A</td></tr>
<tr><td>75 mg soluble uranium intake</td><td>30 mg soluble uranium intake</td></tr>
<tr><td>Chemical exposure greater than AEGL-3 (10 minute exposure)</td><td>Chemical exposure greater than AEGL-2 (30 minute exposure)</td></tr>
<tr><td>A criticality accident occurs</td><td>A criticality accident occurs</td></tr>
<tr><td>Dermal exposure from an HF solution that endangers the life of the worker</td><td>Dermal exposure to HF solution resulting in irreversible or other serious long-lasting effects</td></tr>
<tr><td rowspan="4">2</td><td>Radiological dose greater than 0.25 Sv (25 rem) but less than or equal to 1 Sv (100 rem)</td><td>Radiological dose greater than 0.05 Sv (5 rem) but less than or equal to 0.25 Sv (25 rem)</td><td rowspan="4">Radioactive release greater than 5,000 times 10 CFR 20, Appendix B, Table 2</td></tr>
<tr><td>Chemical exposure greater than AEGL-2 but less than or equal to AEGL-3 (10 minute exposure)</td><td>Chemical exposure greater than AEGL-1 but less than or equal to AEGL-2 (30 minute exposure)</td></tr>
<tr><td>Dermal exposure to HF solution resulting in irreversible or other serious long-lasting health effects</td><td>Dermal exposure from HF solution resulting in mild transient health effects</td></tr>
<tr><td>Direct eye contact with any HF solution (leads to irreversible or other serious long-lasting health effects)</td><td></td></tr>
<tr><td>1</td><td>Accidents with radiological and/or chemical exposures to workers less than those above</td><td>Accidents with radiological and/or chemical exposures to the public less than those above</td><td>Radioactive releases to the environment producing effects less than those specified above</td></tr>
<tr><td colspan="4">Sv = Sieverts
AEGL = Acute Exposure Guideline Level
The MSDS for chemicals used in the GLE process were reviewed for hazards to the workers. HF solution was determined to present a potential serious or long-lasting health hazard and is therefore included in above table. No other chemicals were identified as presenting potential serious or long-lasting health hazards as used in the GLE process.</td></tr>
</table>

Table 3-4. AEGL Thresholds from the EPA for Uranium Hexafluoride, Soluble Uranium, and Hydrogen Fluoride.

Uranium hexafluoride [mg/m^3]					
	10 min	30 min	60 min	4 hr	8 hr
AEGL 1	3.6	3.6	3.6	NR	NR
AEGL 2	28	19	9.6	2.4	1.2
AEGL 3	216	72	36	9	4.5
Soluble Uranium [mg/m^3]					
	10 min	30 min	60 min	4 hr	8 hr
AEGL 1	2.4	2.4	2.4	NR	NR
AEGL 2	19	13	6.5	1.6	0.8
AEGL 3	145	48	24	6	3.0

Soluble Uranium = UF_6 x Uranium fraction [0.67]

Hydrogen fluoride [mg/m^3]					
	10 min	30 min	60 min	4 hr	8 hr
AEGL 1	0.8	0.8	0.8	0.8	0.8
AEGL 2	78	28	20	10	10
AEGL 3	139	51	37	18	18

Table 3-5. What-If/Checklist Example.

GLE Commercial Facility		Site: Wilmington, North Carolina	Unit: TR-XXXX.XX	System:
Method: What-If/Checklist		Design Intent		
No: XX		Description:		

Item	What-If..?	Scenarios Initiators	Consequences	Cat	S	UL	UR	Safeguards	References

Table 3-6. Unmitigated Likelihood Categories.

Likelihood Category	Qualitative Description
1	Consequence Category 3 accidents must be "Highly Unlikely"
2	Consequence Category 2 accidents must be "Unlikely"
3	"Not Unlikely"

Table 3-7. Event Likelihood Categories.

	Likelihood Category	Frequency or Probability of Occurrence*
Not Unlikely (Credible)	**3**	More than or equal to 10^{-4} per-event per-year
Unlikely (Credible)	**2**	Between 10^{-4} and 10^{-5} per-event per-year
Highly Unlikely	**1**	Less than or equal to 10^{-5} per-event per-year

Note: Based on approximate order-of-magnitude ranges.

Table 3-8. Determination of Likelihood Category.

Likelihood Category	Likelihood Index T* (= sum of index numbers)
1	$T \le -5$
2	$-5 < T \le -4$
3	$-4 < T$

*The likelihood category is determined by calculating the likelihood index, T, then using this table. The term T is calculated as the sum of the indices for the events in the accident sequence.

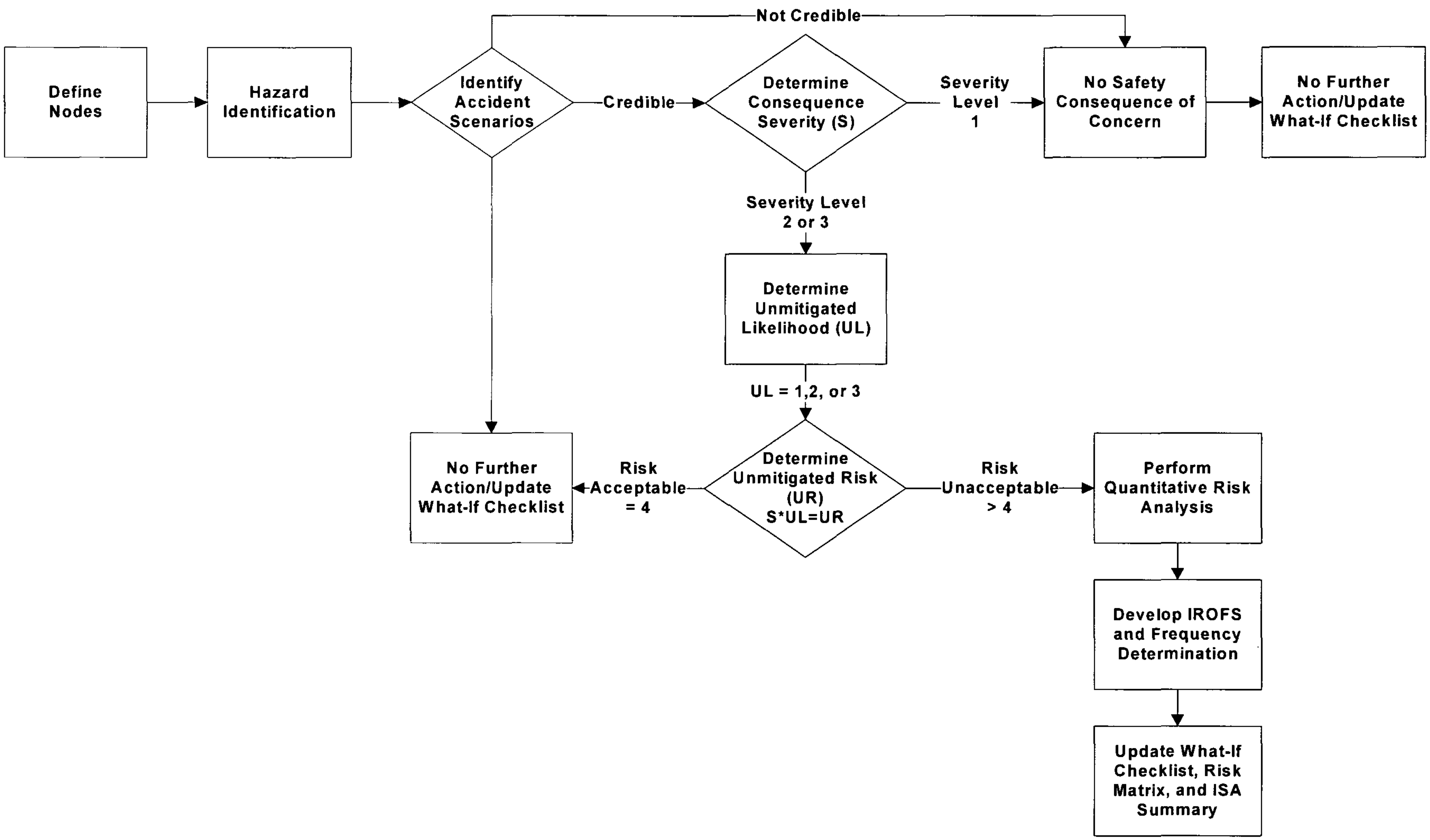
Table 3-9. Unmitigated Risk Assignment Matrix.

Severity of Consequences	Likelihood of Occurrence		
	Likelihood Category 1 Highly Unlikely (1)	**Likelihood Category 2 Unlikely (2)**	**Likelihood Category 3 Not Unlikely (3)**
Consequence Category 3 – High (3)	Acceptable Risk 3	Unacceptable Risk 6	Unacceptable Risk 9
Consequence Category 2 – Intermediate (2)	Acceptable Risk 2	Acceptable Risk 4	Unacceptable Risk 6
Consequence Category 1 – Low (1)	Acceptable Risk 1	Acceptable Risk 2	Acceptable Risk 3

Table 3-10. Accident Sequence Summary and Risk Index Evaluation.

Accident Identifier	Initiating Event	Initiating Event	Safety Parameter 1 or IROFS 1	Failure Probability Index 1	Preventive Safety Parameter 2 or IROFS 2	Failure Probability Index 2	Preventive Safety Parameter 3 or IROFS 3	Failure Probability Index 3	Likelihood Index T Uncontrolled / Controlled (c+e+g+i)	Likelihood Category	Consequence Evaluation Reference	Consequence Category	Risk Index (I=iXk)	Comments and Recommendations
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)

Figure 3-1. Integrated Safety Analysis Process Flow Diagram.



CHAPTER 5
REVISION LOG

Rev.	Effective Date	Affected Pages	Revision Description
0	04/30/2009	ALL	Initial Application Submittal.
1	03/31/2010	7, 11-14, 18-20, 24, 27, 28, 31	Incorporate RAI responses submitted to the NRC via MFN-09-577 dated 09/04/2009 and MFN-09-801 dated 12/28/2009.
2	06/25/2010	19, 25, 26	Section 5.4.1.3.2 revised to include nonparametric method for determination of bias uncertainty, Section 5.4.4.5 revised to remove reference to MRA

TABLE OF CONTENTS

TABLES

NONE

FIGURES

NONE

5. NUCLEAR CRITICALITY SAFETY

5.1 MANAGEMENT OF THE NUCLEAR CRITICALITY SAFETY PROGRAM

5.1.1 Nuclear Criticality Safety Design Philosophy

In accordance with baseline design criterion (9) contained in 10 CFR 70.64(a), *Requirements for New Facilities or New Processes at Existing Facilities (Ref. 5-1)*, the design of fissile material processes must "provide for criticality control including adherence to the double contingency principle." The double contingency principle, as identified in American National Standard Institute (ANSI)/American Nuclear Society (ANS) 8.1-1998, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors (Ref. 5-2)*, is the fundamental technical basis for design and operation of fissile material processes within the GE-Hitachi Global Laser Enrichment LLC (GLE) Commercial Facility. As such, 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. As used in the double contingency principle, the term "concurrent" means: if the effect of the first process change persists until a second change occurs, an inadvertent nuclear criticality could result. It does not mean the two initiating events must occur simultaneously. The possibility of an inadvertent nuclear criticality can be markedly reduced if failures of nuclear criticality safety (NCS) controls are rapidly detected and processes rendered safe.

The established NCS design criteria and NCS reviews are applicable to: (1) new and existing processes, facilities, or equipment which process, store, transfer, or otherwise handle fissile materials; and (2) any change in existing processes, facilities, or equipment which may have an impact on the established basis for NCS. For fissile material operations, double contingency protection may be provided by either control of at least two independent parameters, or control of a single parameter using a system of multiple independent controls. The defense of one or more system parameters provided by at least two independent controls is documented in the GLE Criticality Safety Analyses (CSAs).

In accordance with the requirements contained in 10 CFR 70.61(d), *Performance Requirements (Ref. 5-3)*, "the risk of nuclear criticality accidents must be limited by assuring that under normal and credible abnormal conditions all nuclear processes are subcritical." The NCS Program evaluates each fissile material process to identify the normal and credible abnormal conditions, and establish the controls required to meet the double contingency design criteria. Use of the double contingency design criteria assures that all nuclear processes remain subcritical under credible conditions. As required in 10 CFR 70.62, *Safety Program and Integrated Safety Analysis (Ref. 5-4)*, the Integrated Safety Analysis (ISA) documents the credible accident sequences that could lead to an inadvertent nuclear criticality, and identifies the likelihood of occurrence for each potential accident sequence. For these credible accident sequences, the engineered and administrative NCS controls required to prevent an inadvertent nuclear criticality and meet the overall likelihood requirements specified in GLE LA Chapter 3, *Integrated Safety Analysis,* are designated as Items Relied on for Safety (IROFS). For each IROFS identified, appropriate management measures are applied to assure the control is available and reliable to perform its function when needed. The ISA methodology is described in GLE LA Chapter 3, and the ISA Summary.

5.1.2 Nuclear Criticality Safety Program Objectives

The NCS Program establishes and maintains NCS safety limits and operating limits for controlled parameters in nuclear processes. Qualified NCS personnel evaluate operations involving fissile material to determine the basis for safety of operation based on the assessment of both normal and credible abnormal conditions. Functional requirements for criticality safety controls are specified commensurate with the NCS design criteria, and management measures are applied to ensure the availability and reliability of the controls. The GLE NCS Program management commits to the following objectives:

- Develop, implement, and maintain an NCS Program that meets the regulatory requirements of 10 CFR 70, *Domestic Licensing of Special Nuclear Material (Ref. 5-5)*;
- Provide sufficient IROFS and defense-in-depth, and demonstrate an adequate margin of safety to prevent an inadvertent nuclear criticality in operations in which fissile material is present;
- Protect against the occurrence of accident sequences identified in the ISA Summary, which could result in an inadvertent nuclear criticality;
- Comply with NCS performance requirements in 10 CFR 70.61;
- Establish and maintain NCS controlled parameters and procedures;
- Establish and maintain NCS subcritical limits and operating limits for identified IROFS;
- Conduct NCS evaluations, herein referred to as CSAs, to assure under normal and credible abnormal conditions, fissile material processes remain subcritical and maintain an adequate margin of safety;
- Establish and maintain NCS postings, training, and emergency procedure training;
- Establish and maintain NCS IROFS, based on current NCS determinations;
- Adhere to NCS baseline design criteria requirements in 10 CFR 70.64(a), for new facilities and new processes at existing facilities requiring a license amendment under 10 CFR 70.72, *Facility Changes and Change Process (Ref. 5-6)*;
- Comply with NCS ISA Summary requirements in 10 CFR 70.65(b), *Additional Content of Applications (Ref. 5-7)*;
- Comply with NCS ISA Summary configuration management (CM) requirements in 10 CFR 70.72.

5.1.3 Evaluation of Nuclear Criticality Safety

As part of the design of new facilities, or significant additions or changes in existing facilities, the proposed design is reviewed and approved by the NCS function. Prior to operation of a new or modified facility/process, an evaluation is performed to demonstrate that the entire process will remain subcritical under both normal and credible abnormal conditions. When NCS considerations are impacted by a change, the NCS function recommends changes to the process parameter necessary to maintain safe operation of the facility, and specifies appropriate controls and management measures required for safety. The approval by the NCS function is required prior to operation of a new or modified facility/process. This NCS approval is documented in accordance with established practices and conforms to the CM Program described in GLE LA Section 11.1, *Configuration Management*.

GLE personnel initiate proposed changes to the facility (such as, design changes, changes to processes, operating and maintenance procedures, IROFS, and management measures) through use of a change request. Change requests are processed in accordance with approved written procedures. Change requests, which establish or involve a change in existing criticality safety parameters, require a Senior NCS Engineer to disposition the proposed change with respect to impacts to the safety basis and the need for a CSA. If a new analysis or a revision to an existing analysis is required, the change is not placed into operation until the CSA is complete and preoperational requirements specified by the NCS function are fulfilled. This assures that the documented safety basis is applicable to the current configuration of the facility.

The purpose of the CSA is to demonstrate compliance with 10 CFR 70.64(a)(9), the double contingency principle, through control of one or more parameters important to criticality safety. The parameters to be controlled and the controls on specified parameters are determined and evaluated in the CSA. The controls specified in the CSA may be passive engineered, active engineered, or administrative. Additional requirements for management measures such as postings, periodic inspections, and maintenance requirements are also specified in the CSA to assure the NCS controls are available and reliable. Application of the double contingency principle assures that the process will remain subcritical under normal and credible abnormal conditions.

5.2 ORGANIZATION AND ADMINISTRATION

5.2.1 General Organization and Administrative Methods

The GLE organizational structure and administrative practices have been established consistent with the guidance in ANSI/ANS 8.1-1998 and ANSI/ANS 8.19-2005, *Administrative Practice for Nuclear Criticality Safety (Ref. 5-8)*. Organizational positions, experience, and qualification requirements of personnel and functional responsibilities are described in GLE LA Chapter 2, *Organization and Administration*, which includes an outline of the organizational relationships. The GLE Operations Organization shall be provided adequate resources to ensure an effective NCS Program is implemented.

5.2.2 Nuclear Criticality Safety Organization

The NCS function is administratively independent of the Operations Organization and has the authority to shutdown potentially unsafe operations. The NCS function consists of an NCS Manager responsible for implementation of the NCS Program, and at least one Senior NCS Engineer to allow independent reviews of NCS evaluations. Specific details of the responsibilities and qualification requirements for the NCS Manager, Senior NCS Engineer, and NCS Engineer are described in GLE LA Chapter 2.

NCS personnel are trained in the interpretation of data pertinent to NCS and are familiar with the operation of the GLE Commercial Facility prior to being qualified as a member of the NCS function. Training and qualification of NCS personnel is described in Section 5.3.1, *Training and Qualification of the Nuclear Criticality Staff.*

5.2.3 Operating Procedures

Fissile material operations are performed in accordance with approved written operating procedures. If personnel encounter a condition not covered by the operating procedure, the individual is required to safely stop the operation and report the defective condition to the NCS function, either directly or through Operations management. The operation may not be restarted until the NCS function has evaluated the situation and the necessary procedure instructions are provided. Operations personnel are trained in this procedural compliance policy.

Procedures that govern the handling of enriched uranium are reviewed and approved by the NCS function. The Operations Organization is responsible for developing and maintaining operating procedures that incorporate limits and controls established by the NCS function. GLE management assures operators and other affected personnel review and understand these procedures through postings, training programs, and/or other written, electronic, or verbal notifications.

Documentation associated with the review and approval of operating procedures, and operator training or orientation is maintained within the CM Program and further described in GLE LA Chapter 11, *Management Measures.*

5.2.4 Postings and Labeling

NCS requirements defined by the NCS function are made available at workstations in the form of approved written or electronic operating procedures, and/or clear visible postings. Postings may include the placement of signs and/or marking on walls, floors, or process equipment to summarize key NCS requirements and limits, to designate approved work and storage areas, or to provide instructions or specific precautions to personnel. Information that may be displayed on postings include: limits on material types and forms, allowable quantities by weight or number, required spacing between units, critical control steps in the operation, and control limits (when applicable) on quantities such as moderation, density, or enrichment. Storage postings are located in conspicuous places and include, as appropriate: material type, container identification, number of items allowed, and mass, volume, moderation, and/or spacing limits. In addition, when administrative controls or specific actions/decisions by operators are involved, postings include pertinent requirements identified within the CSA.

Where practical, fissile material containers are labeled such that the material type, ^{235}U enrichment, and gross and/or net weight can be clearly identified or determined. Exceptions to this labeling process include the following:

- Large process vessels in which the content is continuously changing;
- Shipping containers which are labeled as required for shipment;
- Uranium hexafluoride (UF_6) cylinders containing heels in which the net weight is known but the exact fissile content is not quantified;
- Containers of one liter volume or less, or where labeling is not practical;
- In limited circumstances, where the exact enrichment of the material contained is not known (for example, equipment cleanout material or sludge removed from sumps); and
- Waste boxes/drums and contaminated items in which the exact fissile content is very small and not quantified.

Where labeling does not indicate the exact material type, enrichment, and gross and/or net weight, other methods are used to identify the presence of fissile material such as postings, procedures, and training.

5.3 NUCLEAR CRITICALITY SAFETY MANAGEMENT MEASURES

5.3.1 Training and Qualifications of the Nuclear Criticality Safety Staff

Training and qualification of NCS staff is conducted consistent with the guidance in ANSI/ANS 8.26-2007, *Criticality Safety Engineer Training and Qualification Program (Ref. 5-9).* As such, GLE has established a formalized NCS Engineer Training and Qualification Program that is periodically reviewed and maintained by the qualified NCS engineers. This program includes on-the-job training (OJT), demonstration of proficiency, periodic required technical classes or seminars, and participation in offsite professional development activities.

The NCS Engineer Training and Qualification Program content emphasizes on-the-job experience to fully understand the processes, procedures, and personnel required to assure that NCS controls on identified NCS parameters are properly implemented and maintained.

5.3.2 Auditing, Assessing, and Upgrading the Nuclear Criticality Safety Program

NCS audits and assessments are performed consistent with the guidance in ANSI/ANS 8.19-2005. Details of the GLE NCS Audit and Assessment Program are described in GLE LA Section 11.5, *Audits and Assessments.*

NCS audits are conducted by approved NCS personnel and documented in accordance with approved written procedures. Findings, recommendations, and observations are reviewed with the GLE Environmental, Health, and Safety (EHS) Manager to determine if other safety impacts exist. NCS audit findings are transmitted to applicable line managers and area managers for appropriate action and are tracked to completion.

NCS professionals, independent of GLE NCS personnel, conduct periodic NCS Program reviews. The program review provides a means to independently assess the effectiveness of GLE NCS Program components. The audit team is composed of individuals recommended by the NCS Manager, and the team's audit qualifications are approved by the GLE Facility Manager or GLE EHS Manager. Audit results are reported in writing to the NCS Manager, who disseminates the report to line management. Results in the form of corrective action requests are tracked to completion.

5.3.3 Integrated Safety Analysis Summary Revisions and the Nuclear Criticality Safety Program

In accordance with ANSI/ANS 8.19-2005, the CSA is a collection of information that "provides sufficient detail, clarity, and lack of ambiguity to allow independent judgment of the results." The CSA documents the safety basis for the defined fissile process, establishes the subcritical limits on associated controlled parameters, and establishes controls on said parameters to satisfy the double contingency principle.

Documented CSAs are controlled elements of the ISA methodology described in GLE LA Chapter 3 and the ISA Summary. The CSA establishes the NCS bases for a particular system under normal and credible abnormal conditions. CSAs are prepared or updated for new or significantly modified fissile units, processes, or facilities within the GLE Commercial Facility in accordance with the established CM Program described in GLE LA Chapter 11. When a facility change requires a CSA to be re-evaluated or modified, the modifications are carefully evaluated for effects on the ISA Process Hazards Analysis (PHA) and ISA Summary. Likewise, when changes are made to the PHA or ISA Summary, the changes are evaluated for effects on the documented CSAs. Documentation of the ISA Team review and approval of changes made to the PHA or ISA Summary is maintained in accordance with the CM Program.

5.3.4 Modifications to Operating and Maintenance Procedures

Operating and maintenance procedures are maintained consistent with the guidance in ANSI/ANS 8.19-2005. The Operations Organization is responsible for developing and maintaining operating procedures that incorporate limits and controls established by the NCS function. GLE management assures that appropriate GLE personnel and contractors review and understand these procedures through processes such as postings, training programs, and/or other written, electronic, or verbal notifications.

Procedures that govern the operation and maintenance of equipment involved in fissile material processes are reviewed and approved by the NCS function. Based on the review, the NCS function verifies that the required limits and controls have been incorporated into the procedure. In addition, the NCS function assures no single, inadvertent departure from a procedure could cause an inadvertent nuclear criticality and recommends modifications to the procedures to reduce the likelihood of occurrence of an inadvertent nuclear criticality. Documentation of the procedure review and approval process is maintained as described in GLE LA Sections 11.1 and 11.4.

5.3.5 Nuclear Criticality Accident Alarm System

The Criticality Accident Alarm System (CAAS) is designed and maintained to ensure compliance with requirements in 10 CFR 70.24, *Criticality Accident Requirements (Ref. 5-10)*, and ANSI/ANS 8.3-1997, *Criticality Accident Alarm System (Ref. 5-11)* as modified by Regulatory Guide 3.71, *Nuclear Criticality Safety Standards for Fuels and Material Facilities (Ref. 5-12)*. An evaluation that demonstrates compliance with the CAAS requirements of 10 CFR 70.24 is documented and maintained under CM. The location and spacing of the detectors are selected taking into account shielding by massive equipment or materials. Spacing between detectors is reduced where high-density building materials such as brick, concrete, or grout-filled cinder block shield a potential accident area from the detector. Low-density materials of construction, such as wooden stud construction walls, plaster, or metal corrugated panels, doors, non-load walls, and steel office partitions, are accounted for with conservative modeling approximations in determining detector placement.

The CAAS initiates immediate evacuation of the facility to ensure radiation exposure to workers is minimized. Employees are trained to recognize the evacuation signal and to evacuate promptly to a designated safe location. This system and proper response protocol is described in the GLE Radiological Contingency and Emergency Plan (RC&EP). Emergency response planning, procedures, and training to address an inadvertent criticality are consistent with the guidance in ANSI/ANS 8.23-1997, *Nuclear Criticality Accident Emergency Planning and Response (Ref. 5-13).*

GLE commits to having a CAAS that:

- Has components that are located or protected to minimize damage in case of fire, explosion, corrosive atmosphere, or other credible extreme conditions;
- Is designed to minimize the potential failure, including false alarms, due to human error and has major system components labeled;
- Is designed to remain operational in the event of seismic shock equivalent to the requirements of the International Building Code;
- Is uniform throughout the facility for the type of radiation detected, mode of detection, alarm signal, and system dependability;
- Provides coverage in each area that needs CAAS coverage by a minimum of two detectors; and
- Is clearly audible in areas that must be evacuated, or provides alternate visual notification methods documented to be effective in notifying personnel of a necessary evacuation.

The CAAS is maintained through routine response checks and scheduled functional tests conducted in accordance with approved written procedures. In the event of loss of normal power, emergency power is automatically supplied to the CAAS. In the event that CAAS coverage is lost and not restored to an area, affected operations are promptly rendered safe. The exact amount of time necessary to shut down the operation, or place it in a safe state, is dependent on the exact process and operating conditions present during the time the CAAS is not functional. While the CAAS is not functional, compensatory measures such as limiting access to the area and halting special nuclear material (SNM) movement are employed.

5.3.5.1 CAAS Exemption Basis

10 CFR 70.24 requires that licensees authorized to possess SNM in a quantity exceeding 700 g of contained ^{235}U shall maintain, in each area in which such licensed SNM is handled, used, or stored, a monitoring system capable of detecting a criticality that produces an absorbed dose in soft tissue of 20 rads of combined neutron and gamma radiation at an unshielded distance of two meters from the reacting material within one minute.

10 CFR 70.17, *Specific Exemptions (Ref. 5-14),* allows the U.S. Nuclear Regulatory Commission (NRC), upon application of any interested person or upon its own initiative, to grant such exemptions from the requirements of the regulations in this part 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. The requested exemption is authorized by law because there is no statutory provision prohibiting the grant of the exemption. The requested exemption will not endanger life or property or the common defense and security and is otherwise in the public interest for the reasons discussed below. Exemption from CAAS coverage is requested for each of the following locations based on the discussion presented.

5.3.5.1.1 UF_6 Cylinder Storage Pads

The Tails and In-Process Pads are used for storage of source material only (not SNM) and therefore would not require CAAS coverage according to the regulations. Although a potential exists for storing UF_6 cylinders containing SNM on these pads (a wrong cylinder event), the 30B and 48GLE model cylinders are sufficiently different due to size, in the case of the 30B, and in color, in the case of the 48GLE, that such upsets will be immediately identifiable and correctable. Controls exist prior to material being stored on the cylinder pads to prevent such a mishap. 30B model cylinders are stored on the product pad and contain 5 wt% ^{235}U, or less, enriched material. 48GLE model cylinders are stored under CAAS coverage in the Cylinder Shipping and Receiving Area. Transport, handling, and storage of the 30B model cylinder, only involves solid UF_6 and is doubly contingent based on the robust nature of the container, routine certification of the cylinders, and on post-handling inspections that verify the integrity of the cylinder.

- UF_6 cylinder vessel is engineered to be "leak-tight" containers that prevent moderating materials from entering the cylinder. The packaging shall consist of bare metal cylinders (no protective overpacks required), which are designed, fabricated, inspected and marked in accordance with ANSI N14.1, *Nuclear Materials – Uranium Hexafluoride – Packaging for Transport (Ref. 5-15),* standard in effect at the time of manufacture.
- Cylinder integrity is verified through routine operational and periodic inspections and testing pursuant to ANSI N14.1 standard in effect at the time of action.
- To prevent cylinder breach (loss of cylinder integrity), only approved overhead crane rigging, forklift, or transport carrier is used for handling UF_6 cylinders in accordance with approved procedures and authorized trained personnel.
- The robust design of the 30B model cylinders are established as defense-in-depth criticality safety controls to ensure the health and safety of the public and workers and are maintained by the GLE Quality Program to applicable ANSI standards.

Evaluation of historical data associated with 30B model cylinder handling also concludes that the cylinders have not been damaged as frequently as 48-inch cylinders of any make (due in part because fewer 30B model cylinders are handled, 30B model cylinders are stacked only one-high, 30B model cylinders have a shorter storage period, and 30B model cylinders are smaller and lighter than 48-inch cylinders). Further, most 48-inch cylinder failures have been small and healed with uranium tetrafluoride (UF_4), hydrated uranyl fluoride (UO_2F_2- x H_2O), and corrosion product "patches" that significantly slowed further intrusion from water (liquid or vapor) *(Ref. 5-16).*

Due to the high turn-around rate of 30B model cylinders in use, failure to identify corrosion type cylinder wall failures is judged highly unlikely. Evaluation of puncture events to these cylinders have concluded that under maximum rainfall rates for the region, the time to accumulate enough water in a 30B model cylinder to support criticality ranges from 2 to 8 days for very conservatively postulated 12- to 6-inch diameter holes that are difficult to miss during post-handling inspections. Further, these evaluations were conservatively based on an enrichment of 8 wt% ^{235}U and not the approved 5 wt% ^{235}U, or less, approved for 30B model cylinders stored on the Product Pad.

Administrative controls require damage to be remediated within eight hours of identification of the post-handling inspection. Lastly, the Product Pad is not a continuously occupied area. Personnel enter the area only to move 30B cylinders to and from the pad and to inspect cylinders and the cylinder yards to satisfy the requirements for various programs (Material Control and Accounting [MC&A], Quality Assurance [QA], and Fire Protection [FP]).

5.3.5.1.2 Trailer Storage Area

UF_6 cylinders temporarily stored in this area are packaged according to U.S. Department of Transportation (DOT) requirements in over-packs (for SNM containing 30B cylinders) and, as such, have undergone substantial evaluation to evaluate the accidental criticality hazard and assure that the packaging system provides conservative protection against accidental criticality to preclude the need for CAAS in transit.

5.3.5.1.3 UF_6 Cylinder Staging Area

UF_6 cylinders handled in this area are in the process of being packaged in an over-pack (for SNM containing 30B cylinders). The cylinders are either in the DOT packaged state or continuously monitored until the packaging is complete or the cylinder is removed to the Cylinder Shipping and Receiving Area (a CAAS covered area). Any mishaps that occur are immediately identified by the DOT packaging inspection process and corrective actions taken to remediate any hazard identified. Packaging activities are not performed in this area during rain (this requirement is driven by the need to perform radiological surveys on "dry" surfaces of the cylinders, shipping packages, and truck) where moderation control failure can occur during a cylinder mishap. Once packaged according to DOT requirements in an approved over-pack, the staging area is a location for temporary storage until the trailer is moved to Over Road Truck Trailer Storage Area for shipment.

In addition to the above features for safe storage of the cylinders to preclude accidental criticality, the increased vehicular and pedestrian traffic in support of CAAS maintenance and calibration requirements in these areas would cause a subsequent increased likelihood for impact events involving cylinders. CAAS detection clusters are required to be mounted high over the storage areas and the calibration and maintenance activity causes additional vehicular traffic in the area and introduces new drop hazards (bucket truck or man-lift collapse) that do not otherwise exist. This equipment and traffic increases the likelihood for fire and impact events on the UF6 Cylinder Pads and this places workers at a higher risk for injury and exposure relative to the mitigative value provided by the activation of the CAAS.

5.3.6 Corrective Action Program

A regulatory compliance tracking system is used to track planned corrective or preventive actions in regard to procedural, operational, regulatory, or safety-related deficiencies. NCS Program management assures that unacceptable performance deficiencies, which could result in an inadvertent nuclear criticality, are addressed using the Corrective Action Program. The Corrective Action Program is described in GLE LA Section 11.6, *Incident Investigations*.

5.3.7 Nuclear Criticality Safety Records Retention

Records of CSAs are maintained in sufficient detail and form to permit independent review and audit of the calculation method and results. Such records are retained during the conduct of activities and in accordance with approved written procedures following cessation of such activities. Records of employee nuclear safety training and NCS related documents under configuration control are maintained as described in GLE LA Section 11.7, *Records Management*.

5.4 NUCLEAR CRITICALITY SAFETY METHODOLOGIES AND TECHNICAL PRACTICES

5.4.1 Nuclear Criticality Safety Analysis Methods

5.4.1.1 K_{eff} Limits

Validated analytical methods may be used to evaluate individual process operations or potential system interaction. When analytical methods are used, the effective neutron multiplication factor (k_{eff}) of the system, plus three times the standard deviation of the analytical method, must be less than or equal to the established upper subcritical limit (USL) for both normal and credible process upset (accident) conditions; that is:

$$k_{eff} + 3\sigma \leq USL$$

Normal operating conditions assume the optimum credible conditions (that is, most reactive) expected to be encountered when the criticality control systems function properly. Credible process upsets assume optimum credible conditions anticipated for each off-normal or credible accident condition, and must be demonstrated critically safe in accordance with Section 5.1.1, *Nuclear Criticality Safety Design Philosophy*. The NCS function derives safety limits and operating limits by using these criteria to ensure processes remain subcritical under both normal and credible abnormal conditions. Safety and operating limits are established with sufficient margin of safety taking into consideration variability and uncertainty in process parameters under control to protect against a limit being accidentally exceeded. The sensitivity of key controlled parameters are evaluated with respect to the effect on k_{eff} for each system to assure adequate criticality safety controls are defined for the analyzed system. These studies are performed to correlate the change in k_{eff} that occurs as a result of a change to a controlled parameter.

5.4.1.2 Analytical Methods

Methodologies currently employed by the NCS function include hand calculations utilizing published experimental data (such as, ARH-600, Criticality Handbook [*Ref. 5-17]*), and Monte Carlo codes (specifically, Geometry Enhanced Merit [GEMER]) that utilize stochastic methods to approximate a solution to the three-dimensional neutron transport equation. Additional Monte Carlo code packages (such as, SCALE, MCNP) or S_n Discrete Ordinates codes (such as, ANISN, DORT, TORT, or the DANTSYS code package) may be used after validation has been performed as described in Section 5.4.1.3, *Validation Techniques*, and Section 5.4.1.4, *Validation Reports*.

The primary analytical method used for GLE criticality calculations is the GEMER Monte Carlo Program. GEMER is a multi-group Monte Carlo Program that approximates a solution to the neutron transport equation in three-dimensional space. The GEMER Criticality Program is based on 190-energy group structure to represent the neutron energy spectrum. In addition, GEMER treats resolved resonances explicitly by tracking the neutron energy and solving the single-level Breit-Wigner Equation at each collision in the resolved resonance range in regions containing materials whose resolved resonances are explicitly represented. The cross-section treatment in GEMER is especially important for heterogeneous systems since the multi-group treatment does not accurately account for resonance self-shielding.

5.4.1.3 *Validation Techniques*

The validity of the calculational method (computer code and nuclear cross-section data) used for the evaluation of NCS must be demonstrated and documented in validation reports according to approved written procedures. The validation of the computer code must determine its calculational bias, bias uncertainty, and the minimum margin of subcriticality (MMS) using well-characterized and adequately documented critical experiments. The following definitions apply to the documented validation report(s):

Bias – The systematic difference between calculated results and experimentally measured values of k_{eff} for a fissile system.

Bias Uncertainty – The integrated uncertainty in experimental data, calculational methods, and models estimated by a valid statistical analysis of calculated k_{eff} values for critical experiments.

Minimum Margin of Subcriticality (MMS) – An allowance for any unknown (or difficult to identify or quantify) errors or uncertainties in the method of calculating k_{eff}, that may exist beyond those which have been accounted for explicitly in calculating bias and bias uncertainty.

GLE validation methodologies are consistent with the guidance in ANSI/ANS 8.1-1998 and ANSI/ANS 8.24-2007, *Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations (Ref. 5-18)*. In accordance with the requirements of these national consensus standards, the GLE criteria to establish subcriticality requires the calculated k_{eff} to be less than or equal to an established USL, as presented in the validation report, for a system or process to be considered subcritical. The validation of the calculational method and cross-sections considers a diverse set of parameters that include, but are not limited to:

- Fuel enrichment, composition, and form of associated uranium materials,
- Homogeneity or heterogeneity of the system,
- Presence of neutron absorbing materials,
- Characterization of the neutron energy spectra,
- Types of neutron moderating materials,
- Types of neutron reflecting materials,
- Degree of neutron moderation in the system (such as, H/fissile atom ratio), and
- Geometry configuration of the system (such as, shape, size, spacing, reflector).

Within the validation, various areas of applicability are established based on parameters having a significant effect on the calculation of k_{eff}, bias, and bias uncertainty. The areas of applicability are established by grouping experiments with common parameters of importance to determine bias and bias uncertainty. Parameters with a significant effect on the calculation include: (1) neutron energy spectrum; (2) neutron absorbing materials; and (3) heterogeneity (for low-enriched uranium [LEU] systems). Based on these known parameters of importance, a typical grouping of areas of applicability for a validation may be as follows:

- Homogeneous LEU systems (thermal spectrum),
- Heterogeneous LEU systems (thermal spectrum),
- Common absorber systems (such as, boron, cadmium, gadolinium).

In performing CSA, the appropriate area of applicability shall be applied based on a comparison of parameters being evaluated to parameters covered by the area of applicability. For GLE Commercial Facility Operations, the most common area of applicability is homogeneous LEU systems based on the fact that materials evaluated are typically: (1) homogeneous (uranium hexafluoride and uranyl fluoride); (2) low-enriched ($\leq$ 10 wt% ^{235}U); and (3) slightly to optimally moderated (thermal spectrum). When applying the validation outside an area of applicability, justification must be provided in the CSA. The selection of critical experiments, for each identified area of applicability of the NCS computer code validation, incorporates the following considerations:

- Experimental data for validation is assessed for completeness, accuracy, and applicability to operations prior to selection and use as a critical benchmark.
- Selection of experiments must encompass appropriate parameters spanning the range of normal and credible abnormal conditions that are anticipated to be evaluated using the calculational method.
- To minimize systematic error, benchmark data selected for validation are drawn from multiple, independent series, and sources of critical experiments. The range of parameters characterized by selected critical experiments is used to define the area of applicability for the code.
- The calculational method used to analyze the set of critical benchmarks incorporates the same analytic techniques used to analyze systems or processes to which the validation is applied.
- Data outliers in results obtained for the critical experiments selected for the validation may only be rejected based upon inconsistency of the data with known physical behavior.

The calculational bias, bias uncertainty, and USL over each defined area of applicability are determined by statistical methods as described in the following sections.

5.4.1.3.1 Calculational Bias

The bias is determined either as a constant, if no trends exist, or as a smooth and well-behaved function of a selected characteristic parameter (for example, hydrogen-to-fissile ratio) by regression analysis. Regression analysis may be used when trends exist with parameters statistically significant over the area of applicability.

Bias is determined from the calculated benchmark k_{eff} data, which are weighted using the overall uncertainty of each calculated data point. The overall uncertainty accounts for calculation uncertainty and benchmark uncertainty. Bias is applied over its negative range and assigned a value of zero over its positive range.

5.4.1.3.2 Bias Uncertainty

The bias uncertainty may be estimated using one of the following statistical methods. The details of each statistical method are documented in the validation report.

Single-Sided Lower Confidence Band (SSLCB): Estimates bias uncertainty to ensure, at a 95% level of confidence, a future calculation of k_{eff} for a critical system or process is actually above the lower confidence limit. The SSLCB may be used when there is a clear trend in the calculated critical benchmark results.

Single-Sided Lower Tolerance Band (SSLTB): Estimates the bias uncertainty to ensure, at a 95% level of confidence, at least 95% of future calculations of k_{eff} for critical systems or processes are actually above the lower tolerance limit. The SSLTB may be used when there is a clear trend in the calculated critical benchmark results.

Single-Sided Lower Tolerance Limit (SSLTL): Estimates the bias uncertainty to ensure, at a 95% level of confidence, at least 95% of future calculations of k_{eff} for critical systems or processes are actually above the lower tolerance limit. The SSLTL is used when there are no trends apparent in the calculated critical benchmark results.

Non-Parametric Method: Estimates the bias uncertainty to ensure, at a 95% level of confidence, that future calculations of k_{eff} for critical systems or processes are actually above the lower tolerance limit. This statistical technique is based on a rank order analysis of the data. When the sample size is insufficient to obtain a 95% confidence level using the statistical method, additional non-parametric margin is applied to assure the desired degree of confidence is achieved. The non-parametric technique is applied in cases where the calculated critical benchmark results (non-trending data) or the residuals of bias regression (trending data) fail the normality test.

5.4.1.3.3 Data Normality

Where no trends to a characteristic parameter exist (SSLTL), the normality of calculated k_{eff} values for the set of critical experiments must be verified prior to estimation of bias and bias uncertainty. Where trends to a characteristic parameter do exist (SSLCB and SSLTB), normality of the regression analysis residuals must be verified prior to estimation of the bias and bias uncertainty.

5.4.1.3.4 *Upper Subcritical Limit (USL)*

The USL is established based on calculated bias, bias uncertainty, and MMS for the area of applicability as follows:

$$USL = 1 + bias - bias\ uncertainty - MMS$$

At GLE, a minimum *MMS* = 0.03 is used to establish acceptance criteria for criticality calculations, which compared to the uncertainty in calculated k_{eff} values, is large.

The following acceptance criteria, considering worst-case credible accident conditions, must be satisfied, when using k_{eff} calculations by Monte Carlo methods, to establish subcritical limits for the GLE Commercial Facility:

$$k_{eff} + 3\sigma \leq USL$$

where σ is the standard deviation of the k_{eff} value obtained from the calculational method.

5.4.1.4 *Validation Reports*

Validation reports are documented, reviewed, and approved for each analytical method used to derive NCS limits. Validation reports are created, revised, reviewed, and approved by the NCS function and are controlled under the CM Program. The following requirements apply to Validation reports documented by the NCS function:

- Describe the NCS analytical method to which the validation applies.
- Clearly describe the theory of the validation methodology in sufficient detail to allow understanding of the methodology and independent duplication of results.
- Describe the mathematical and statistical operations used in the validation methodology to determine bias and bias uncertainty, including statistical testing performed to verify the acceptability of results.
- Provide a description or summary of the benchmark experiments or critical experiments selected for the validation, which indicate experiment characteristics important to the area of applicability and a reference to reliable experimental data.
- Identify the bias, uncertainty in the bias, uncertainty in calculated data, uncertainty in the benchmark experiments, and margin of subcriticality. If the derived bias is positive, it must be assigned a value of zero.
- Summarize the range in (or values of) NCS parameters describing the area of applicability. The area of applicability should be consistent with the values of parameters used in selected benchmark experiments. Any extrapolation beyond the area of applicability should be supported by an established mathematical methodology or sound engineering judgment. The mathematical method used to determine the acceptable extrapolation limit for a regression model is the leverage statistic. The leverage statistic is a measure of the distance between the extrapolation point for a predication and the

mean of trending parameter values in the critical benchmark data set. For a predication by extrapolation to be considered reliable with the predefined confidence level, its leverage value should not exceed the largest leverage value in the benchmark data set.

- Provide a description of the analytical method verification process and assurance that only verified software and hardware are used in the validation process.

5.4.1.5 Computer Software and Hardware Configuration Control

The software and hardware used within the criticality safety calculational system is configured and controlled in accordance with CM approved written procedures. Software changes are conducted in accordance with CM Program described in GLE LA Section 11.1.

Software, designated for use in NCS, are compiled into working code versions with executable files traceable by length, time, date, and version. Working code versions of compiled software are validated against critical experiments using an established methodology with differences in experiment and analytical methods being used to calculate bias and uncertainty values to be applied to the calculational results.

Each individual workstation is verified to produce results equivalent to the development workstation prior to use of the software for criticality safety calculation demonstrations on the production workstation. The verification results are documented for each individual workstation. Modifications to software and nuclear data affecting the calculational logic require re-validation of the software. Modifications to hardware or software that do not affect calculational logic are followed by code operability verification; in which case, selected calculations are performed to verify equivalent results from previous verifications. Deviations noted in code verification that may alter the bias or uncertainty requires re-qualification of the code prior to release for production use.

5.4.2 Control Practices

CSAs identify specific independent controls necessary to provide safe double contingent protection of a process. As discussed in Section 5.1.1, controls identified in the CSA are selected to assure no single credible event or failure can result in a criticality accident. As such, it is demonstrated that the process will remain subcritical under both normal and credible abnormal conditions. Prior to use in any enriched uranium process, NCS controls are verified against CSA criteria. The ISA methodology described in GLE LA Chapter 3 implements performance based management of process requirements and specifications important to NCS.

5.4.2.1 Verification and Maintenance of Controls

Reliable methods and instruments are used when NCS parameters are controlled by measurement. To assure continued reliability, required periodic verification and maintenance of controls are performed as described in GLE LA Section 11.2, *Maintenance*. The purpose of the verification program is to ensure the controls selected and installed fulfill the requirements identified in the CSA.

Processes are examined in the "as-built" condition to validate safety design and to verify the installation conforms to control specifications identified in the CSA. NCS personnel observe or monitor the performance of initial functional tests, and conduct preoperational audits to verify the controls function as intended, and the installed configuration agrees with the control specifications identified in the CSA. Operations personnel are responsible for subsequent verification of controls through the use of periodic functional testing or verification. When necessary, control calibration and routine maintenance are normally provided by the Instrument and Calibration and/or Maintenance functions. The purpose of the Maintenance Program is to ensure that the effectiveness of NCS controls designated for a specific process are maintained at the original level of intent and functionality. This requires a combination of routine maintenance, functional testing, and verification of design specifications on a periodic basis.

Verification and maintenance activities are performed per established practices documented through the use of forms and/or computer tracking systems. NCS personnel randomly review control verifications and maintenance activities to assure controls remain effective. Details of the Maintenance Program are described in GLE LA Section 11.2.

5.4.2.2 Consideration of Material Composition (Heterogeneity)

The CSA for each process determines the effects of material composition (for example, type, chemical form, physical form) within the process being analyzed, and identifies the basis for selection of compositions used in subsequent system modeling activities. In considering material composition, it is especially important to distinguish between homogeneous and heterogeneous system conditions. Heterogeneous effects are particularly relevant for LEU processes where all other parameters being equal; heterogeneous systems are typically more reactive than homogeneous systems. Systems involving uranium hexafluoride and uranyl fluoride are typically homogeneous; however, solid forms of uranium oxides may be heterogeneous. Evaluation of systems where the particle size varies must take into consideration effects of heterogeneity, as appropriate, for the process being analyzed.

5.4.3 Means of Control

The relative effectiveness and reliability of controls are considered during the CSA process. Passive engineered controls are preferred over other system controls and are utilized when practical and appropriate. Active engineered controls are the next preferred method of control. Administrative controls are the least preferred; however, augmented administrative controls are preferred over simple administrative controls. A criticality safety control must be capable of preventing a criticality accident independent of operation or failure of any other criticality control for a given credible initiating event.

5.4.3.1 Passive Engineered Controls

A device using only fixed physical design features to maintain safe process conditions without any required human action. Assurance is maintained through specific periodic inspections or verification measurement(s), as appropriate.

5.4.3.2 Active Engineered Controls

A physical device using active instrumentation, electrical components, or moving parts to maintain safe process conditions without any required human action. Assurance is maintained through specific periodic functional testing, as appropriate. Active engineered controls are designed to be fail-safe (that is, failure of the control results in a safe condition).

5.4.3.3 *Administrative Controls*

Either an augmented administrative control or a simple administrative control as defined herein:

Augmented Administrative Control – A procedurally required or prevented human action, combined with a physical device, which alerts an operator when action is needed to maintain safe process conditions or otherwise adds substantial assurance of the required human performance.

Simple Administrative Control – A procedural human action prohibited or required to maintain safe process conditions.

Use of administrative controls is limited to situations where passive and active engineered controls are not practical. Administrative controls may be proactive (requiring action prior to proceeding) or reactive (proceeding unless action occurs). Proactive administrative controls are preferred. Assurance is maintained through periodic verification, audit, and training.

5.4.4 Control of Parameters

NCS is achieved by controlling one or more parameter(s) of a system within established subcritical limits. The CM Program may require NCS staff review of proposed new or modified processes, equipment, or facilities to ascertain impact on controlled parameters associated with the particular system. Assumptions relating to processes, equipment, or facility operations, including material composition, function, operation, and credible upset conditions, are justified and documented in the CSA and independently reviewed.

Identified below are specific controlled parameters, which include mass, geometry, enrichment, reflection, moderation, concentration, interaction, neutron absorption, and process characteristics that may be considered during the NCS review process.

5.4.4.1 *Mass*

Mass control may be used for NCS control alone or in combination with other control methods. Mass control may be utilized to limit the quantity of uranium within specific process operations or vessels and within storage, transportation, or disposal containers. Mass may be controlled by direct measurement (for example, use of certified scales) through the use of fixed geometric dimensions and the assumption of a conservative fissile material density, or by using analytical or non-destructive methods.

Establishment of mass limits involves consideration of enrichment, potential moderation, reflection, geometry, spacing, and material composition. The CSA considers normal operations and credible process upsets in determining actual mass limits for the system and for defining additional controls. When only administrative controls are used for mass-controlled systems, double batching is considered to ensure adequate safety margin.

Where mass is the only parameter being controlled, and double batching is considered credible, the mass of any single accumulation shall not exceed either: (1) a safe batch, which is defined to be 45 percent of the minimum critical mass; or (2) 50 percent of the safe mass limit derived using validated analytical methods and an approved MMS.

Where mass is one of two parameters being controlled, or where engineered controls prevent over batching, the mass of any single accumulations shall not exceed either: (1) 75 percent of the minimum critical mass; or (2) the safe mass limit derived using validated analytical methods and an approved MMS.

When experimental data from published handbooks are used for mass limits, the following assumptions are applicable to the minimum critical mass: (1) spherical geometry; (2) full water reflection; (3) optimal moderation content; and (4) maximum credible enrichment. In addition, the chemical and physical form specified in the handbook must be at consistent with, or more restrictive than, that which may be present in the actual system to which the limit will be applied.

5.4.4.2 Geometry

Geometry may be used for NCS control alone or in combination with other control methods. Favorable geometry is based on limiting dimensions of defined geometrical shapes to established subcritical limits. Structure and/or neutron absorbers that are not removable constitute a form of geometry control. At the GLE Commercial Facility, favorable geometry is developed conservatively assuming full water or concrete equivalent reflection, optimal hydrogenous moderation, worst credible heterogeneity, and maximum credible enrichment. Examples of parameters used for engineered geometry controls include cylinder diameters, annulus inner and outer radii, slab thickness, and/or fixed volumes.

Subcritical limits for geometry controls may be derived using either validated analytical methods and an approved MMS or experimental data. Where experimental data are used, 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.

Geometry control systems are analyzed and evaluated allowing for fabrication tolerances and dimensional changes that may likely occur through corrosion, wear, or mechanical distortion. Before beginning operations, dimensions and nuclear properties applicable to the geometry control are verified using appropriate instrumentation. The CM Program is used to maintain these dimensions and nuclear properties within acceptable limits. Provisions are also made for periodic inspection, if credible conditions exist in which changes in the dimensions or nuclear properties of the equipment could occur, resulting in the inability to meet established NCS limits.

5.4.4.3 Enrichment

Enrichment control may be utilized to limit the weight percent ^{235}U within a process, vessel, or container, thus providing a method for NCS control. Enrichment controls may be used to segregate materials of different enrichment or to prevent material from being enriched above an NCS limit. Where enrichment is controlled, active engineered or administrative controls are required to measure or verify the enrichment, or to prevent the introduction of uranium at unacceptable enrichment levels within a defined subsystem. In cases where enrichment control is not utilized, the maximum credible enrichment for the particular process or subsystem is utilized in the CSA.

5.4.4.4 Reflection

Most systems are designed and operated with the assumption of 12-inch water or optimum reflection surrounding the system. In such cases, controls limiting reflection are not required since optimum reflection has been demonstrated safe. However, subject to approved controls limiting reflection, certain system designs may be analyzed, approved, and operated in situations where the analyzed reflection is less than optimum. In the CSA, the neutron reflection properties of the credible process environment are also considered. For example, reflectors more effective than water (such as, concrete) and adjacent structural materials are considered when appropriate.

5.4.4.5 Moderation

Moderation control may be used for NCS control alone or in combination with other control methods. Moderation controls are used to limit the amount of moderation present within fissile material. Where moderation is used as an NCS controlled parameter, moderation controls are implemented consistent with the guidance in ANSI/ANS 8.22-1997, *Nuclear Criticality Safety Based on Limiting and Controlling Moderators (Ref. 5-19)*. When moderation control is used, the area is posted as a Moderation Controlled Area (MCA) and specific moderation controls are delineated. Operations in MCAs must be demonstrated safe under normal and abnormal conditions such that the double contingency principle is satisfied.

In evaluating systems where the primary controlled parameter is moderation, the following requirements apply:

- Identify credible sources of moderation intrusion and either preclude or control the ingress of moderation in accordance with the double contingency principle;
- Design physical structures, barriers, and/or equipment involved in the system to limit or control the ingress of moderation;
- Use qualified instrumentation where moderation control requires the moderation content or other system parameters to be measured or monitored;
- Use redundant independent sampling methods where moderation control relies on sample analysis; and
- Control combustible materials, document fire-fighting methods in approved written procedures, and provide for approved sprinkler systems, manual means, or non-hydrogenous chemicals for fire fighting as specified by the process analysis.

When the worst credible accident is considered, the process moderation limit must be set *at least* a factor of two below the safety moderation limit such that the accident does not exceed the safety moderation limit without failure of multiple controls. The minimum protection is never less than two independent controls on moderation for each credible accident sequence, which must fail before a criticality accident is possible. Additional defense in depth protection may also be specified in process evaluations. The basis for selection of moderation controls shall be documented in CSAs and evaluated in accordance with the ISA Process described in GLE LA Chapter 3. The introduction and use of moderating materials (such as, cleaning agents, oils, or lubricants) within designated MCAs are subject to controls/limits that are approved by the NCS function.

5.4.4.6 Concentration (or Density)

Concentration control may be used for NCS control alone or in combination with other control methods. Concentration controls are established to ensure the concentration level is maintained within defined limits for the system. Each process relying on concentration control has engineered controls in place to detect and/or mitigate the effects of high concentration within the system; otherwise, the most reactive credible concentration (density) is assumed.

Concentration control is typically used in processes containing solution with low uranium concentrations such as a liquid effluent system. In evaluating systems containing concentration-controlled solution, the following requirements apply:

- Preclude a high concentration of uranium in a process unless the process is demonstrated safe at any credible concentration (for example, a favorable geometry tank);
- Equip the tank/vessel with backflow prevention controls (for example, air break, siphon breaks, overflow lines) where appropriate and inspect periodically for buildup; and
- Take precautions where precipitating agents are added to ensure agents are not inadvertently introduced.

When concentration is the only parameter controlled to prevent criticality, concentration may be controlled by two independent combinations of measurement and physical control, with each physical control capable of preventing the concentration limit from being exceeded in an unsafe location. The preferred method of attaining independence is to ensure that at least one of the two combinations is an active engineered control.

5.4.4.7 Interaction (or Unit Spacing)

Interaction/spacing control may be used for NCS control alone or in combination with other control methods. Interaction controls are based on either neutronic isolation or spacing of interacting units to control neutron leakage. Physical separation between process operations, vessels, or containers may be provided by either engineered or augmented administrative controls depending on the application. Where engineered spacing controls are required the structural integrity of the engineered feature must be sufficient for normal and credible abnormal conditions.

Units may be considered effectively non-interacting (isolated) if they are: (1) separated by 12-inches of full density water equivalent; (2) separated by the larger of 12-foot air distance or the greatest distance across an orthographic projection of the largest fissile accumulation on a plane perpendicular to the line joining their centers; or (3) shown to be non-interacting based on comparison of the calculated effective multiplication factor for the unit and that of the entire system.

5.4.4.8 Neutron Absorbers

Neutron absorbing materials may be utilized to provide a method for NCS control for a process, vessel, or container. Stable compounds such as boron carbide fixed in a matrix (such as, aluminum or polyester resin, elemental cadmium clad in appropriate material, elemental boron alloyed stainless steel, or other solid neutron absorbing materials) with an established dimensional relationship to the fissionable material are recommended. The use of neutron absorbers in this manner is defined as part of a passive engineered control. When evaluating the absorber effectiveness for an application, the neutron spectrum is considered in the CSA.

Where neutron absorbers are used as an NCS controlled parameter, fixed neutron absorbers controls are implemented consistent with the guidance in ANSI/ANS 8.21-1995, *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors (Ref. 5-20).*

Only fixed absorbers may be used as NCS controls on neutron absorption. Soluble neutron absorbers (for example, boric acid) and removable neutron absorbers (for example, Raschig Rings) are not used as NCS controls.

5.4.4.9 Process Characteristics

Within certain fissile material operations, credit may be taken for physical, chemical, and nuclear properties of the process and/or materials as NCS controls. Use of process characteristics is based upon the following requirements:

- Identify the bounding conditions and operational limits in the CSA and communicate, through training and procedures, to appropriate Operations personnel.
- Base bounding conditions for such process and/or material characteristics on established physical, chemical, or nuclear reactions, known scientific principles, and/or facility-specific experimental data supported by operational history.
- The devices and/or procedures, which maintain the limiting conditions, must have the reliability, independence, and other characteristics required of a criticality safety control.

5.4.5 Criticality Safety Analyses

The scope and content of any particular CSA reflects the needs and characteristics of the system being analyzed and typically includes the applicable information requirements listed below.

<u>Scope</u> – Defines the stated purpose of the analysis.

<u>General Discussion</u> – Presents an overview of the process affected by the proposed change. This section includes, as appropriate: process description, flow diagrams, normal operating conditions, system interfaces, and other important to design considerations.

Criticality Safety Controls/Bounding Assumptions – Defines the controlled parameter(s) and summarizes the criticality safety controls on each identified parameter that are imposed as a result of the evaluation. This section also clearly presents a summary of the bounding assumptions used in the analysis. Bounding assumptions include: worst credible contents (for example, material composition, density, enrichment, and moderation), boundary conditions, inter-unit water, and a statement on assumed structure. In addition, this section may include a statement summarizing interface considerations with other units, subareas, and/or areas.

Model Description – Presents a narrative description of the actual model used in the analysis. An identification of both normal and credible upset (accident) conditions and model file naming convention is provided. Key input listings and corresponding geometry plot(s) for both normal and credible upset cases are also provided.

Calculational Results – Identifies how the calculations were performed, what tools or reference documents were used, and when appropriate, presents a tabular listing of the calculational result and associated uncertainty (for example, $K_{eff} + 3\sigma$) results as a function of the key parameter(s) (for example, wt. fraction H_2O). When applicable, the assigned bias of the calculation is also clearly stated and incorporated into both normal and/or accident limit comparisons.

Safety During Upset Conditions – Presents a concise summary of the upset conditions considered credible for the defined unit or process system. This section includes a discussion as to how established NCS limits and controls address each credible process upset (accident) condition to maintain subcriticality.

Specifications and Requirements for Safety – When applicable, presents both design specifications and criticality safety requirements for correct implementation of established controls. These requirements are incorporated into operating procedures, training, maintenance, and QA as appropriate to implement the specifications and requirements.

Compliance – Concludes the analysis with pertinent summary statements and includes a statement regarding license compliance.

Verification – A qualified Senior NCS Engineer, who was not involved in the analysis, verifies each CSA in accordance with GLE LA Section 5.4.5.1, *Technical Reviews*.

Appendices – Where necessary, include a summary of information ancillary to calculations such as parametric sensitivity studies, references, key inputs, model geometry plots, equipment sketches, useful data, etc., for each defined system.

5.4.5.1 Technical Reviews

Independent technical reviews of proposed criticality safety control limits specified in the CSA are performed. A Senior NCS Engineer is required to perform the independent technical review. The independent technical review consists of a verification that the neutronics geometry model and configuration used adequately represent the system being analyzed. In addition, the reviewer verifies that the proposed material characterizations such as density, concentration, etc., adequately represent the system. The reviewer also verifies that the proposed criticality safety controls are adequate. The independent technical review of the specific calculations and computer models is performed using one of the following methods:

- Verify the calculations with an alternate computational method;

- Verify methods with an independent analytic approach based on fundamental laws of nuclear physics;

- Verify the calculations by performing a comparison to results from a similar design or to similar previously performed calculations; or

- Verify the calculations by performing specific checks of the computer codes used, and by performing evaluations of code input and output.

Based on one of these prescribed methods, the independent technical review provides a reasonable measure of assurance that the chosen analysis methodology and results are correct.

5.5 REPORTING REQUIREMENTS

A program for evaluating the criticality significance of NCS events is established for making the required notification to the NRC Operations Center. Qualified individuals make the determination of the significance of NCS events. The determination of loss or degradation of double contingency protection is made against the documented CSA, the License, and 10 CFR 70, Appendix A. GLE commits to the following NCS reporting requirements:

- The reporting criteria of 10 CFR 70, Appendix A and the report content requirements of 10 CFR 70.50, *Reporting Requirements (Ref. 5-21)*, are incorporated into approved written procedures.
- If it cannot be ascertained within one hour of the discovery of an event, whether the criteria of 10 CFR 70, Appendix A, Paragraph (a) applies, the event should be treated as a one-hour reportable event.
- If it cannot be ascertained within 24 hours of discovery of an event, whether the criteria of 10 CFR 70, Appendix A, Paragraph (b) applies, the event should be treated as a 24-hour reportable event.
- The required report is issued when the IROFS credited is lost, irrespective of whether the safety limits of the associated parameters are actually exceeded.

5.6 REFERENCES

5-1. 10 CFR 70.64, *Requirements for New Facilities or New Processes at Existing Facilities*, U.S. Nuclear Regulatory Commission, 2008.

5-2. ANSI/ANS 8.1-1998, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*, American Nuclear Society, January 1998.

5-3. 10 CFR 70.61, *Performance Requirements,* U.S. Nuclear Regulatory Commission, 2008.

5-4. 10 CFR 70.62, *Safety Program and Integrated Safety Analysis,* U.S. Nuclear Regulatory Commission, 2008.

5-5. 10 CFR 70, *Domestic Licensing of Special Nuclear Material*, U.S. Nuclear Regulatory Commission, 2008.

5-6. 10 CFR 70.72, *Facility Changes and Change Process*, U.S. Nuclear Regulatory Commission, 2008.

5-7. 10 CFR 70.65, *Additional Content of Applications,* U.S. Nuclear Regulatory Commission, 2008.

5-8. ANSI/ANS 8.19-2005, *Administrative Practice for Nuclear Criticality Safety*, American Nuclear Society, January 2005.

5-9. ANSI/ANS 8.26-2007, *Criticality Safety Engineer Training and Qualification Program*, American Nuclear Society, June 2007.

5-10. 10 CFR 70.24, *Criticality Accident Requirements*, U.S. Nuclear Regulatory Commission, 2008.

5-11. ANSI/ANS 8.3-1997 (R2003), *Criticality Accident Alarm System*, American Nuclear Society, January 1997.

5-12. Regulatory Guide 3.71, *Nuclear Criticality Safety Standards for Fuels and Material Facilities*, U.S. Nuclear Regulatory Commission, Revision 1, October 2005.

5-13. ANSI/ANS 8.23-1997, *Nuclear Criticality Accident Emergency Planning and Response*, American Nuclear Society, January 1997.

5-14. 10 CFR 70.17, *Specific Exemptions*, U.S. Nuclear Regulatory Commission, 2008.

5-15. ANSI N14.1-2001, *Nuclear Materials – Uranium Hexafluoride – Packaging for Transport,* American National Standards Institute, January 2001.

5-16. POEF-2086, ORNL/TM-11988, *Investigation of Breached Depleted UF_6 Cylinders*, Barber, E.J., et. al., September 1991.

5-17. ARH-600, *Criticality Handbook*, R. D. Carter, G. R. Kiel, and K. R. Ridgway, Atlantic Richfield Hanford Co. Report, 1968.

5-18. ANSI/ANS 8.24-2007, *Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations*, American Nuclear Society, 2007.

5-19. ANSI/ANS 8.22-1997 (R2006), *Nuclear Criticality Safety Based on Limiting and Controlling Moderators*, American Nuclear Society, January 1997.

5-20. ANSI/ANS 8.21-1995 (R2001), *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors*, American Nuclear Society, January 1995.

5-21. 10 CFR 70.50, *Reporting Requirements*, U.S. Nuclear Regulatory Commission, 2008.

CHAPTER 7
REVISION LOG

Rev.	Effective Date	Affected Pages	Revision Description
0	04/30/2009	ALL	Initial Application Submittal.
1	03/31/2010	ALL	Incorporate RAI responses submitted to the NRC via MFN-09-801 dated 12/28/2009 and MFN-10-036 dated 02/01/2010.
2	06/30/2010	ALL	Revised International Building Code Occupancy Classifications and added Solid Waste Storage Buildings discussion.

TABLE OF CONTENTS

TABLES

NONE

FIGURES

NONE

7. FIRE SAFETY

This chapter describes the features that enable an effective Fire Protection Program at the GE-Hitachi Global Laser Enrichment LLC (GLE) Commercial Facility located in Wilmington, North Carolina. The GLE Commercial Facility is located on the Wilmington Site, which also contains the Global Nuclear Fuel-Americas, LLC (GNF-A) Fuel Manufacturing Operations (FMO) facility, as well as other GE-owned facilities. See GLE LA Chapter 1, *General Information*, for a description of the GLE Site and the Wilmington Site. The cylinder storage and handling areas, Operations Building, and the Solid Waste Storage Buildings (SWSBs) may retain sufficient quantities of licensed materials or hazardous materials produced from licensed materials to challenge the performance requirements of 10 CFR 70.61.

The fire protection strategy for the GLE Commercial Facility minimizes the risk from potential fires and explosions to protect the health and safety of the workers, the public, and the environment. The Fire Protection Program is developed and implemented in accordance with the following:

- 10 CFR 30.33, *General Requirements for Issuance of Specific Licenses (Ref. 7-1);*
- 10 CFR 40.32, *General Requirements for Issuance of Specific Licenses (Ref. 7-2*);
- 10 CFR 70.22, *Contents of Applications (Ref. 7-3);*
- 10 CFR 70.61, *Performance Requirements (Ref. 7-4);*
- 10 CFR 70.62, *Safety Program and Integrated Safety Analysis (Ref. 7-5);*
- 10 CFR 70.64, *Requirements for New Facilities or New Processes at Existing Facilities (Ref. 7-6);*
- 10 CFR 70.65, *Additional Content of Applications (Ref. 7-7);*

7.1 FIRE SAFETY MANAGEMENT MEASURES

The GLE Fire Protection Program is based on National Fire Protection Association (NFPA) 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials (Ref. 7-8),* which contains fire safety management measures intended to reduce the risk of fires and explosions at facilities that handle radioactive materials. These management measures are applicable to locations where radioactive materials are stored, handled, or used in quantities, and under conditions, requiring government oversight and/or a license to possess or use these materials.

Fire safety management measures establish fire protection policies and practices for the GLE Commercial Facility. The objective of the Fire Protection Program is to prevent and mitigate fire incidents through education, prevention, controls, detection, and extinguishment.

7.1.1 Fire Protection Items Relied on for Safety

Fire protection Items Relied on for Safety (IROFS) are intended to prevent or mitigate chemical and radiological risks associated with postulated fire events and are defined in the Integrated Safety Analysis (ISA) Summary.

7.1.2 Management Policy and Direction

GLE Management commits to a program that promotes life safety, the conservation of property and essential equipment, and the protection of the environment. GLE maintains fire safety awareness among personnel through general employee training (GET). Training programs are described in GLE LA Section 11.3, *Training and Qualifications*.

The primary responsibility for fire protection resides within the Environmental, Health, and Safety (EHS) Organization. The GLE EHS Manager is assisted by the Fire Safety Manager, in accordance with the Fire Safety Program. The personnel qualification requirements for the GLE EHS Manager and the Fire Safety Manager are provided in GLE LA Chapter 2, *Organization and Administration*.

The Facility Safety Review Committee (FSRC) reviews issues affecting the safety of GLE Commercial Facility operations, including fire safety. The FSRC is described in GLE LA Chapter 2.

7.1.3 Fire Protection Program

The GLE Fire Protection Program complies with the criteria in NFPA 801 to ensure fire protection requirements are adequately implemented. The Fire Protection Program implements applicable NFPA and/or other nationally recognized codes and standards to ensure nuclear fire protection requirements are adequately implemented. The Fire Protection Program documents upper level mechanisms by which the GLE Facility Manager achieves and maintains a high degree of fire safety at the GLE Commercial Facility. The GLE Facility Manager ensures the Fire Protection Program is adequately implemented and requirements are provided to GLE personnel. The program is designed to ensure fire safety at the facility as well as to promote protection of life safety, property, essential equipment, the environment and the continuity of operations. The Fire Protection Program is closely integrated within the Design, Operations, and Maintenance Organizations to ensure widespread awareness, while enhancing effective and efficient implementation. The Fire Protection Program is implemented through detailed administrative and implementing procedures. The Fire Protection Program includes the following elements.

7.1.3.1 Management Policy and Direction (Section 7.1.2)

Approved plans and procedures describe the overall management and implementation of the GLE Fire Protection Program. The following ensures fire safety is appropriately incorporated into GLE Operations and that facility modifications are reviewed for fire safety:

- Administrative controls for changes in processes, equipment, or facilities (see GLE LA Section 11.1, *Configuration Management*), and

- Fire protection and management review of planned activities and modifications to ensure building design and operating features are maintained in an analyzed condition.

7.1.3.2 Fire Hazards Analysis (Section 7.2)

A documented Fire Hazards Analysis (FHA) has been initiated, and is updated as necessary, when significant facility design or operation configuration changes are made, to ensure the fire prevention and fire protection requirements of NFPA 801 have been evaluated.

7.1.3.3 Fire Prevention Program

The Fire Protection Program includes a documented Fire Prevention Program, implemented by approved written procedures, that describes the following:

- Communication of basic fire safety information for GLE personnel and contractors, including familiarization with procedures for fire prevention, emergency alarm response, and reporting of fires;

- Requirements for conducting documented facility inspections, including provisions for remedial action to correct conditions that increase fire hazards;

- Description of the general housekeeping practices and the control of transient combustibles;

- Control of flammable and combustible liquids, gases, and oxidizers in accordance with the applicable NFPA codes and standards;

- Control of ignition sources, including hot work (grinding, welding, and cutting) in accordance with NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work (Ref. 7-9)*;

- Fire reports, including an investigation and a statement regarding the corrective action to be taken in accordance with NFPA 901, *Standard Classifications for Incident Reporting and Fire Protection Data (Ref. 7-10);*

- Fire prevention surveillance in accordance with NFPA 601, Standard for Security Services in Fire Loss Prevention (Ref. 7-11);

- Restriction of smoking to designated areas, and

- Safeguarding construction, demolition, and renovating activities in accordance with the criteria within NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations (Ref. 7-12).

7.1.3.4 Inspection, Testing, and Maintenance (Section 7.5.6)

Inspection, Testing, and Maintenance (ITM) of fire protection systems is performed using approved written procedures. The results and follow-up actions are recorded and specific acceptance criteria provided for each test. The ITM Program is implemented to ensure fire protection systems and equipment remains operable and functions properly to detect and control fire, when needed.

7.1.3.5 Control of Impairments

Approved written fire protection system impairment procedures are implemented to include:

- Identification, tagging, and tracking of impaired equipment,
- Identification of personnel to be notified, and
- Determination of potentially needed compensatory fire protection and fire prevention measures such as those listed in the table below.

• **Impairment**	• **Potential Compensatory Fire Protection and Fire Prevention measure**
Sprinkler System Impaired	Establishment of fire watches Elimination of potential ignition sources Combustible controls Process shutdown Evacuation of impairment area Mobilization of fire brigade members
Fire Alarm System Impaired	Establishment of fire watches Elimination of potential ignition sources Combustible controls Process shutdown Evacuation of impairment area Mobilization of fire brigade members
Fire Barrier Impaired (penetration assembly repair or opening protective repair)	Establishment of fire watches Elimination of potential ignition sources Combustible controls Process shutdown Evacuation of impairment area Temporary construction (of fire barriers) Mobilization of fire brigade members
Water Supply Impaired	Temporary water supply

7.1.3.6 Onsite Emergency Response Organizations (Section 7.6.1)

See Section 7.6.1 for a description of the GLE onsite fire brigade and emergency response organization (ERO).

7.1.3.7 Offsite Emergency Response Agencies (Section 7.6.2)

See Section 7.6.2 for a description of the GLE offsite emergency response agencies.

7.1.3.8 Pre-Incident Planning (Section 7.6.3)

Identification of chemical and radiological risks is evaluated through the development of the FHA and integrated with development of the ISA.

7.2 FIRE HAZARDS ANALYSIS

An FHA was performed at the beginning of the facility design process and is revised, as necessary, when significant changes are made to ensure the fire prevention and protection requirements have been evaluated per NFPA 801. The FHA evaluation considers the facility specific design, layout, and anticipated operating needs. Additionally, the FHA considers acceptable means for separation or control of hazards, the control or elimination of ignition sources, and the suppression of fires. The FHA also considers the storage and use of radioactive materials under fire or explosion conditions, which can result in a severe hazard.

The FHA presents a comprehensive, qualitative evaluation of the chemical and radiological releases associated with postulated fire at the GLE Commercial Facility. Based on facility design (construction, fire rated separation [fire barriers], locations of hazardous processes and materials, levels of combustibles, systems response, etc.) and on operations practices, the FHA in concert with the ISA, evaluates credible fire scenarios to establish the radiological and toxic chemical consequences of an unmitigated fire. From these scenarios, the FHA and ISA describe and evaluate preventive and mitigative controls that make up the fire protection IROFS for the GLE Commercial Facility. Evaluation of scenarios for unmitigated fire events includes, as applicable, the building/area construction, fuel loading, process equipment and hazards, possible fire initiators, ventilation system response, propagation potential, and building/area response.

The FHA estimates damage (or thermal insult) to the process and/or monitoring operations, and licensed radiological material. Estimates for potential chemical and radiological releases (consequence analyses) are done outside the FHA, as described in the GLE LA Chapter 3, *Integrated Safety Analysis*. The FHA is reviewed and updated as needed for current conditions and accuracy to ensure effective implementation of the Fire Protection Program is maintained.

7.3 FACILITY DESIGN

7.3.1 Baseline Design Criteria and Defense-In-Depth

The FHA and the ISA demonstrate that the design and construction of the GLE Commercial Facility structures complies with the baseline design criteria of 10 CFR 70.64(a), the defense-in-depth requirements of 10 CFR 70.64(b), and are consistent with the requirements of NFPA 801. The facility design incorporates defense-in-depth concepts such that health and safety are not completely dependent on any single element of the design, construction, maintenance, or operation of the facility.

The GLE Commercial Facility design incorporates limits on areas and equipment subject to contamination for facilities handling radioactive materials. In addition, the design includes facilities, equipment, and utilities intended to facilitate decontamination. The location of the GLE Commercial Facility is such that a fire or explosion event would not affect other important facilities or operations.

The GLE Commercial Facility buildings and supporting infrastructure are described in GLE LA Chapter 1, *General Information.* Additional design details are provided in the GLE ISA Summary. GLE Commercial Facility support buildings that may contain special nuclear material (SNM) or source material are constructed to meet applicable requirements of the International Building Code (IBC) *(Ref. 7-13)* and the general fire-related design criteria discussed in this section. The Operations Building is the primary structure where the enrichment processing systems and enrichment processing support systems are contained. The fire-related design criteria for the Operations Building are described in the following sections.

7.3.2 Building Construction

7.3.2.1 Operations Building

The Operations Building is constructed of noncombustible materials meeting the requirements of NFPA 801, Section 5.5, for fire resistant or noncombustible construction (typically Type I or Type II as defined in NFPA 220, *Standard on Types of Building Construction (Ref. 7-14)*. The Operations Building also meets the requirements of Type IA construction as described in Chapter 6 of IBC. Type IA construction requires structural frame and the exterior and interior bearing wall elements to meet the requirement of 3-hour fire-rated construction.

In accordance with NFPA 101®, *Life Safety Code (Ref. 7-15)*, the Operations Building is classified as a Special Purpose Industrial Occupancy, with a hazard classification of ordinary hazard. Additionally, the Operations Building is a mixed occupancy of High Hazard Group 2 (H-2), High Hazard Group 3 (H-3), and High Hazard Group 4 (H-4)as classified by Chapter 3 of IBC. Fire areas classified as H-2, H-3, or H-4 occupancies are constructed to meet the requirements of Type I (442 or 332) construction as described in NFPA 220.

7.3.2.1.1 *Interior Surface*

The interior surface is designed to meet the requirements of NFPA 801, Section 5.8.1 and 5.8.2. The interior surface finish of walls and ceilings in process and storage areas are Class A in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials (Ref. 7-16)*. The floor finish is Class I in accordance with NFPA 253, *Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source (Ref. 7-17)*. Exit enclosures (egress corridors and exit paths) meet the requirements of NFPA 101®, Section 40.3.3, Class A or B for walls and ceilings and not less than Class II for floors.

7.3.2.1.2 *Storage*

Chemicals, materials, and supplies are stored, to the extent practical, in separate storerooms located in areas where no work with radioactive materials is conducted. Only those quantities of chemicals, materials, and supplies needed for immediate or continuous use are present.

7.3.2.2 *SWSBs*

The SWSBs are constructed of noncombustible materials meeting the requirements of NFPA 801 for fire resistant or noncombustible construction (typically Type I or Type II as defined in NFPA 220). The SWSBs also meet the requirements of Type IA or IB construction as described in Chapter 6 of IBC.

The SWSBs have an Occupancy Classification of S-1 Moderate Hazard Storage in accordance with the IBC. The buildings are also classified as Storage Occupancies in accordance with the *Life Safety Code®*.

7.3.2.2.1 *Interior Surface*

The interior surface finish of walls and ceilings in process and storage areas are Class A in accordance with NFPA 255. The floor finish is Class I in accordance with NFPA 253.

7.3.2.2.2 *Storage*

The SWSBs are used for storage of solid, radioactive, or industrial waste, generated and packaged for transport at the Operations Building. The SWSBs houses waste characterized for both short-term storage, where materials are stored for a periods of less than 90 days; and long-term storage, where materials are stored 90 days or more. Waste is loaded onto transport vehicles from these buildings and sent to the disposal facility. All waste containers boxes and drums, are metal and stacked a maximum of two high.

7.3.3 Fire Area Separation

7.3.3.1 *Operations Building*

The Operations Building is subdivided into separate fire areas, as determined by the FHA, for the purposes of limiting the spread of fire, protecting facility personnel, and limiting consequential damage to the facility. The subdivided design approach provides passive fire protection features, while minimizing:

- The spread of potential contamination,
- Equipment damage and loss,
- Clean-up cost and time,
- Operational down time, and
- Damage to one-of-a-kind types of equipment.

The fire area separation approach employs fire barriers, with fire resistance commensurate with the potential fire severity, between the major process areas (such as, Laser Area) with further subdivision provided, as practicable, to minimize fire areas within the process areas. The minimum fire resistance of fire barriers between fire areas is 2-hours as described in the FHA. The fire resistance of fire barriers within fire areas meets the occupancy separation requirements of IBC (1-hour between sprinklered H-2 and H-3 occupancies). The minimum fire resistance of interior and exterior bearing walls is 3-hours.

Fire rated barriers meet the minimum requirements of the IBC, Chapter 7, *Fire Resistance Rated Construction.* Openings and penetrations within the envelope of each fire area are sealed with protective assemblies (penetration firestop systems, fire dampers, fire/smoke dampers, etc.) consistent with the designated fire rating in accordance with NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls (Ref. 7-18).* Door openings are protected with fire rated doors, frames, and hardware in accordance with NFPA 80, *Fire Door Openings and Other Opening Protectives (Ref. 7-19).* Fire dampers are provided where ventilation ductwork penetrates fire rated barriers in accordance with NFPA 90A, *Installation of Air-Conditioning and Ventilating Systems (Ref. 7-20).*

7.3.3.2 SWSBs

The SWSBs are not subdivided into separate fire areas. Each building is considered a separate fire area.

7.3.4 Power Supply and Distribution Systems

7.3.4.1 Operations Building

Electrical systems are designed in accordance with NFPA 70®, *National Electrical Code® (Ref. 7-21).* 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-Fiber Members (Ref. 7-22).* Less hazardous dielectric fluids are used, where practicable, in place of hydrocarbon-based insulating oils for transformers and capacitors located inside buildings, or in any location where an exposure hazard to important facilities is posed.

The lights, ventilation, and operation of the majority of the equipment are dependent upon a reliable source of electrical power. Transformers, switches, and control panels are located so that maintenance work can be done without direct exposure to process conditions.

7.3.4.2 SWSBs

The SWSBs electrical systems are designed in accordance with NFPA 70. 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. The lights and ventilation are dependent upon a reliable source of electrical power.

7.3.5 Life Safety

7.3.5.1 Operations Building

In accordance with IBC, the Operations Building is classified as mixed occupancy, High Hazard Group 2 (H-2), High Hazard Group 3 (H-3), and High hazard Group 4 (H-4). In accordance with NFPA 101®, the facility is classified as a Special Purpose Industrial Occupancy, with a hazard classification of ordinary hazard. Life safety features (such as, occupancy separation, means of egress, illumination, and exit marking and signage, etc.) meet the requirements of NFPA 101® and IBC. Rated fire barriers in accordance with NFPA 101® and the FHA are provided to prevent unacceptable fire propagation.

7.3.5.2 SWSBs

The SWSBs have an Occupancy Classification of S-1 Moderate Hazard Storage in accordance with the IBC. The Buildings are classified as Storage Occupancies in accordance with NFPA 101®, with a hazard classification of ordinary hazard. Life safety features (such as, occupancy separation, means of egress, illumination, and exit marking and signage, etc.) meet the requirements of NFPA 101® and the IBC.

7.3.6 Ventilation, Containment, and Filtration Systems

7.3.6.1 Operations Building

The design of the ventilation, confinement, and filtration systems is intended to provide effective ventilation both during and immediately following an emergency such as a fire, and is in accordance with applicable NFPA and/or nationally recognized codes and standards. Where shutdown of the ventilation system is not appropriate, fire/smoke dampers are not required for ventilation duct penetrations. When fire/smoke dampers are not used, an alternative means of protecting against fire propagation is provided. Alternative means of protecting against fire propagation include fire rated construction wrapping or encasing the duct for 10 feet on either side of the rated barrier in accordance with NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids (Ref. 7-23).* The rated construction encasing the duct match the rating of the fire barrier penetrated.

Ductwork, accessories, and support systems are designed and tested in accordance with, as applicable, NFPA 801, NFPA 90A, NFPA 90B, *Installation of Warm Air Heating and*

Air-Conditioning Systems (Ref. 7-23), and NFPA 91. Flexible air duct couplings in ventilation and filter systems are noncombustible. Ductwork from areas containing radioactive materials, passing through non-radioactive areas, are noncombustible construction and are protected from possible exposure fires by materials having a fire resistance rating as determined by IBC, NFPA, and/or other nationally recognized codes and standards. Air entry filters are approved filter media that produce a minimum amount of smoke (UL Class I) when subjected to heat.

The Monitored Central Exhaust System (MCES) is designed to automatically balance and maintain negative pressure from areas of lesser potential contamination to areas of higher potential contamination. Ventilation systems serving normally non-contaminated areas exhaust a percentage of the handled air to the atmosphere. The heating, ventilation, and air conditioning (HVAC)/MCES, serving potentially contaminated areas, exhaust 100% of the handled air to the environment through filtered exhaust paths. In addition to removing uranium particulates from room air, the MCES is designed to remove uranium hexafluoride (UF_6) and hydrogen fluoride (HF) from process gas streams and room air during normal and abnormal operating conditions.

High-efficiency particulate air (HEPA) filtration systems and/or high-efficiency gas absorption (HEGA) systems are utilized in various areas as part of the confinement function of the MCES system. HEPA filters will meet the requirements of UL 900, *Test Performance of Air Filter Units (Ref. 7-25)* and UL 586, *High-Efficiency Particulate Air Filter Units (Ref. 7-26)*. The HEPA filters will also meet the spot flame resistance of ASME AG-1, *Code on Nuclear Air and Gas Treatment (Ref. 7-27),* Section FC-5160, *Spot Flame Resistance*. When the amount of SNM in a filter exceeds action limits the filter is replaced.

Smoke control systems are designed in accordance with IBC, NFPA, and/or other nationally recognized codes and standards. Smoke control is also accomplished by the onsite fire brigade, the ERO, and the offsite responding fire departments utilizing portable smoke removal equipment.

7.3.6.2 SWSBs

The design of the ventilation systems for the SWSBs meets the requirements of International Mechanical Code (IMC) and NFPA for ventilation.

7.3.7 Facility Control, Computer, and Telecommunication Rooms

Operations Building control, computer, and telecommunications rooms meet the applicable requirements of NFPA 75, *Standard for the Protection of Information Technology Equipment (Ref. 7-28),* and/or other nationally recognized codes and standards.

7.3.8 Drainage and Control of Contaminated Runoff

Water that may discharge from the Firewater System or from firefighting activities (water runoff) that could be contaminated with radioactive materials is confined in accordance with NFPA 801, Section 5.10, stored, sampled, and treated if necessary. Water runoff from the UF_6 Cylinder Pads is collected in the Retention Basin. Liquid effluent monitoring associated with the Retention Basin is discussed in GLE Environmental Report (ER) Chapter 6, *Environmental Measurements and Monitoring Programs.* Drainage or confinement of firewater within the facility is provided and accomplished by one or more of the following methods:

- Floor drains,
- Floor trenches,
- Open doorways or other wall openings,
- Curbs for confining or directing drainage,
- Equipment pedestals, and
- Pits, sumps, and sump pumps.

7.3.9 Water Control Consideration

Within the GLE Commercial Facility, there are water reactive materials. Fire protection features are provided to ensure effective mitigation, including automatic fire sprinkler suppression, combustible loading controls, automatic detection, fire barriers, ignition controls, and emergency response activities. The fire brigade, the ERO, and/or responding offsite fire departments respond to fire events at the GLE Commercial facility. They are familiar with the types of hazardous materials in the GLE Commercial Facility. The pre-incident plans (see Section 7.6.3, *Pre-Incident Planning*) for fires and explosions include firefighting guidance on the use of water in certain areas of the facility.

7.3.10 Lightning Protection

The lightning protection systems are in accordance with applicable portions of NFPA 780, *Standard for the Installation of Lightning Protection Systems (Ref. 7-29),* and/or other nationally recognized codes and standards.

7.3.11 Wildland Fire Protection

Wildland fire protection was assessed in the FHA in accordance with applicable portions of NFPA 1143, *Standard for Wildland Fire Management (Ref. 7-30)* and NFPA 1144, *Standard for Reducing Structure Ignition Hazards from Wildfire (Ref. 7-31).* The FHA determined the wildland fire threat for the GLE Site is a moderate hazard. Current configurations do not require additional fire protection measures.

7.3.12 Physical Security Concerns

As described in Section 7.3.5, *Life Safety*, the design of buildings and facilities provides for safe egress in case of fire, chemical events, or other emergencies. Security requirements do not prevent safe means of emergency egress as required by the NFPA 101® and IBC. The GLE Physical Security Plan (PSP) addresses the establishment of permanent and temporary Controlled Access Areas. The PSP and Radiological Contingency and Emergency Plan (RC&EP) identify the ingress and egress methodology during both normal and emergency conditions, respectively. This includes emergency response personnel both onsite and offsite.

7.4 PROCESS FIRE SAFETY

GLE has addressed process fire safety through the facility design and operations. Fire hazards are identified and addressed through the ISA and the FHA. The ISA uses the information identified in the FHA and considers the potential accident scenarios and establishes the IROFS necessary to ensure the health and safety of GLE personnel and the public. The GLE Commercial Facility Operations Building and SWSBs are designed in accordance with IBC, NFPA, and other nationally recognized codes and standards. The GLE Commercial Facility hazardous areas are identified as part of the pre-incident plans (otherwise known as pre-fire plans) as discussed in Section 7.6.3, *Pre-Incident Planning*. The ISA methodology is discussed in GLE LA Chapter 3. The ISA Summary provides details of the ISA, including fire hazards and associated IROFS. The following discussion describes the principle process fire hazards associated with the laser-based enrichment technology.

7.4.1 Principal Hazardous Materials

7.4.1.1 Operations Building

The major process material of concern is UF_6. UF_6 is not flammable or combustible; however; UF_6 is not compatible with organics and can react with non-fomblin lubricating oils at high temperatures. The two byproducts resulting from a UF_6 release (in the presence of moist air) are HF gas and uranyl fluoride (UO_2F_2). Neither byproduct presents a process fire safety hazard.

Although UF_6 is not considered a fire hazard, exposure of UF_6 cylinders to heat and/or fire does create the potential for loss of cylinder integrity and an associated UF_6 release hazard. The potential failure of UF_6 cylinders due to exposure to fire is evaluated in the FHA.

7.4.1.2 SWSBs

The material of concern is solid waste. Exposure of solid waste containers to heat and/or fire creates the potential for loss of container integrity and an associated release hazard. The potential failure of solid waste containers due to exposure to fire is evaluated in the FHA.

7.4.2 Principal Fire Hazards

7.4.2.1 Operations Building

7.4.2.1.1 Lasers

Laser-based enrichment technology, which is utilized in the GLE uranium enrichment process, presents a potential hydrogen fire hazard. The Laser Area does not contain radioactive material.

[Proprietary Information withheld from disclosure per 10 CFR 2.390]

Areas where hydrogen is present are designed to meet Class I, Division 2 hazardous locations in accordance with NFPA 70®, Article 500, *Hazardous Locations*. Laser operations and equipment meet the requirements of NFPA 115, *Standard for Laser Fire Protection (Ref. 7-33).*

7.4.2.1.2 Flammable/Explosion Hazards

Process equipment subject to fire or explosion hazards is evaluated in the ISA and FHA. IROFS have been established to prevent or mitigate fire hazards, as may be required by 10 CFR 70.61. In addition to IROFS, the following features, attributes, and controls are in place to prevent a large fire or explosion that could result in a UF_6 release:

- Fire Protection Program;
- Automatic smoke, chemical, and fire detection;
- Compartmentalization with fire barriers;
- Emergency response operations;
- Nitrogen inerting of select equipment;
- Natural or mechanical ventilation or other controls provided to ensure that flammable concentrations do not exceed 25 percent of the LEL.
- Fire rated boundaries;
- Structural steel fire proofing;
- Ignition sources are minimized;
- Robust and/or qualified UF_6 cylinder construction;
- Noncombustible construction; and
- HVAC system response.

The GLE Commercial Facility may generate hydrogen at battery-charging stations throughout the facility. Hydrogen controls in battery-charging stations are provided. Specifically, natural or mechanical ventilation or other controls are provided to ensure that hydrogen concentrations do not exceed 25 percent of the LEL.

7.4.2.1.3 Combustible Liquid Hazards

Combustible liquids are utilized as a cooling medium and as a lubricant in process equipment. Combustible liquid fire hazards are evaluated in the ISA and FHA. IROFS have been established to prevent or mitigate fire hazards, as may be required by 10 CFR 70.61. In addition to IROFS, the following features, attributes, and controls are in place to prevent a large fire that could result in a UF_6 release:

- Fire Protection Program,
- Combustible liquid containment,
- Automatic smoke or heat detection system,

- Fire barriers,
- Emergency response operations, and
- Use of high flashpoint combustible liquids.

7.4.2.1.4 Transient Combustibles

Transient combustibles such as trash, PPE, construction materials accumulate in controlled quantities throughout the Operations Building. Transient combustible fire hazards are evaluated in the ISA and FHA. IROFS have been established to prevent or mitigate fire hazards, as may be required by 10 CFR 70.61. In addition to IROFS, the following features, attributes, and controls are in place to prevent a large fire that could result in a UF_6 release:

- Fire Protection Program,
- Automatic smoke or heat detection system,
- Fire barriers, and
- Emergency response operations

7.4.2.2 SWSBs

7.4.2.2.1 Combustible Liquid Hazards

Combustible liquids are utilized as a lubricant. Combustible liquid fire hazards are evaluated in the ISA and FHA. IROFS have been established to prevent or mitigate fire hazards, as may be required by 10 CFR 70.61. In addition to IROFS, the following features, attributes, and controls are in place to prevent a large fire that could result in a licensed material release:

- Fire Protection Program,
- Emergency response operations, and
- Use of high flashpoint combustible liquids.

7.4.2.2.2 Transient Combustibles

Transient combustibles such as trash, PPE, construction materials accumulate in controlled quantities throughout the SWSBs. Transient combustible fire hazards are evaluated in the ISA and FHA. IROFS have been established to prevent or mitigate fire hazards, as may be required by 10 CFR 70.61. In addition to IROFS, the following features, attributes, and controls are in place to prevent a large fire that could result in a licensed material release:

- Fire Protection Program,
- Emergency response operations

7.5 FIRE PROTECTION SYSTEMS

7.5.1 Firewater Supply System

The existing Wilmington Site firewater supply and distribution system consists of a 300,000 gal (100,000 devoted to fire) Water Storage Tank and Water Reservoir (~675,000 gal) which distributes water throughout an underground 10-inch looped gridded firewater distribution system, supplying water to existing facilities and hydrants, via 1,500 gpm electric and diesel fire pumps.

The fire water supply system for the GLE Commercial Facility is installed, in accordance with NFPA 801, Section 6.2., with fire pumps arrangement and installation meeting the requirements of NFPA 20, *Installation of Stationary Pumps for Fire Protection (Ref. 7-34)*. The system is designed to supply the largest single automatic sprinkler system plus a 250 gpm hose stream allowance. The system is sized to supply water for an Ordinary Hazard, Group 2, sprinkler system in the Operations Building. Therefore, the required water flow for sprinklers is 940 gpm at a residual pressure of 20 psi at the system riser. The firewater distribution system is a looped system with cross connections into the various buildings to prevent a single piping component failure from disabling significant portions of the system. The International Fire Code (IFC) *(Ref. 7-35)*, Table B105.1, for Type I buildings of greater than 295,900 sq ft, requires a minimum firewater flow of 6,000 gpm for four hours. However, IFC, Section B105, exception permits a flow reduction of up to 75% if the building is sprinklered throughout. The GLE Commercial Facility Operations Building is in excess of 1,100,000 sq ft (including the upper elevations) and is provided with automatic fire suppression throughout. Therefore, the minimum firewater flow required is 1,500 gpm for four hours (360,000 gal). Sprinkler system demand for the SWSBs is less than that required to protect the Operations Building.

For reliability, firewater is supplied from two independent supplies, each with adequate capacity to provide continuous water supply at the above flow rate for a minimum duration of four hours. The firewater distribution piping and supplies are designed to IBC seismic requirements.

7.5.2 Fire Detection and Alarm Systems

Automatic fire detection is provided for fire areas in accordance with the requirements of IBC, Section 907; NFPA 101®, Section 40.3.4.1; and NFPA 801, Section 6.8. The type of detection provided is based on the fire hazards present and the need for early warning or very early warning detection as determined by analysis. The fire alarm system is designed and installed per the requirements of NFPA 72®, *National Fire Alarm Code® (Ref. 7-36)*.

Manual pull stations are located at exits and throughout the Operations Building and SWSBs to allow occupants to initiate an alarm. Area detection is provided in the Operations Building for early warning, automatic closing doors, fire/smoke damper operation, and air handler shutdown. Suppression system activation in the Operations Building and SWSBs is also monitored by the fire alarm system.

Operations Building fire/smoke dampers located in supply air ducts are activated by smoke or heat. Smoke detectors are provided in the supply and return of air handling units. Individual air handlers are shut down by the fire alarm system when local duct detectors are in alarm. Fire/smoke dampers located in exhaust ducts at fire barriers are activated by heat detection. Exhaust fans are not shut down by the fire alarm system.

Audible and visible appliances in the Operations Building and the SWSBs provide occupant notification. The fire alarm system communicates with a 24-hour seven day a week ECC. Remote annunciation of alarms is provided at building entry points and control room.

7.5.3 Automatic Suppression Systems

Automatic sprinkler protection is required in the Operations Building and the SWSBs to control fires in accordance with IBC, NFPA 13, Section 4.1, and NFPA 801, Section 6.1.2. Ordinary Hazard, Group 2, sprinkler systems are installed throughout the Operations Building and the SWSBs with a design density of 0.15 gpm per square foot (ft^2) over the most hydraulically remote 4,000 ft^2 area.

Automatic sprinkler protection may be omitted from a room or space where sprinklers are considered undesirable because of the nature of the contents in accordance with IBC, Section 903.3.1.1.1. See Section 7.3.9, *Water Control Consideration,* for additional information.

In those areas where automatic sprinkler systems are not provided, alternative fire protection is considered. Alternatives may include an automatic clean agent extinguishing system in accordance with NFPA 2001, *Clean Agent Fire Extinguishing Systems (Ref. 7-37).* The omission of automatic sprinklers from any area is subject to approval by the Authority Having Jurisdiction.

7.5.4 Standpipes

Class I standpipe systems installed in the Operations Building in accordance with NFPA 14, *Standard for the Installation of Standpipe and Hose Systems (Ref. 7-38)*, are provided in each required exit stairway as required by IBC. Hose connections are located at each intermediate landing as specified by NFPA 14, Section 7.3.

7.5.5 Portable Extinguishers

Fire extinguishers are provided throughout the Operations Building and the SWSBs in accordance with NFPA 10, *Portable Fire Extinguishers (Ref. 7-39),* as required by NFPA 801. In areas where water control is considered, carbon dioxide and dry chemicals are provided so that an uncontrolled moderator source is not created.

7.5.6 Inspection, Testing, and Maintenance of Fire Protection Systems

Fire protection systems and features are inspected, tested, and maintained in accordance with the requirements in NFPA 25, *Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems (Ref. 7-40),* and other applicable NFPA codes and standards.

7.6 FIRE EMERGENCY RESPONSE READINESS

7.6.1 Onsite Emergency Response Organization

NFPA 801, Section 4.7, requires a fire emergency organization that meets the requirements of either an on-site industrial fire brigade (NFPA 600, *Standard on Industrial Fire Brigades [Ref. 7-41]*), or a Fire Department (NFPA 1500, *Fire Department Occupational Safety and Health Program [Ref. 7-42]*). Due to the facility's remote location and the lack of sufficient local fire department staff capabilities relative to fire involving nuclear materials, the GLE Commercial Facility provides for a fully staffed onsite fire brigade that is trained for interior structure fire fighting. The size and complexity of the fire emergency organization is based on the size of the facility, presence of fire hazards, and the availability of offsite fire fighting response capability. Documented training and drills are conducted to demonstrate proficiency. 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 the hot and warm zones. GLE has around the clock staffing of the fire brigade with a minimum of five fire brigade staff members per shift dedicated to GLE.

The Wilmington Site ERO is comprised of two teams that provide emergency response support. These two teams include the ERO, which is responsible for supplementing the fire brigade, as well as, fire suppression and hazardous material control activities and the Emergency Medical Technicians (EMTs), which are responsible for emergency medical services. In addition, the ERO provides support services for bomb threat searches, severe weather preparedness, emergency preparedness, confined space evaluations, hazard prevention and elimination, community service and education, and offsite mutual aid assistance.

The New Hanover County Department of Fire Services will be notified when:

- A fire is beyond the incipient stage; or
- The scope of a fire exceeds the capabilities of onsite resources.

7.6.2 Offsite Emergency Response Agencies

Per the RC&EP, response agreements are in place to request emergency offsite assistance when needed. Most responding agencies are located in close proximity to the Wilmington Site. Current response agreements in place include Castle Hayne Volunteer Fire Rescue, which in-turn could call in additional mutual aid departments listed below:

- Wrightsboro Volunteer Fire and Rescue,
- Ogden Volunteer Fire and Rescue,
- New Hanover County Fire and Rescue,
- Federal Point Volunteer Fire and Rescue,
- Myrtle Grove Volunteer Fire and Rescue,
- City of Wilmington Fire Department, and

- New Hanover County Forestry Service.

The offsite emergency response agencies listed above provide fire suppression, rescue (including confined space), and hazardous materials response support activities. The agencies listed below provide the services indicated.

- New Hanover Sheriff's Office provides law enforcement, crowd, and traffic control,
- New Hanover County Department of Emergency Management provides coordination of mass casualty, communications, radiological detection, and multi-agency coordination activities, and
- New Hanover Regional Medical Center and New Hanover Regional Emergency Medical Services provide medical treatment and transport to the hospital (including treatment and transport of radiologically contaminated personnel).

7.6.3 Pre-Incident Planning

NFPA 801, Section 4.8.1 requires written pre-fire plans (also known as pre-incident plans). Pre-fire plans are developed with the assistance of the facility fire emergency organization. NFPA 801, Section A.4.8.1, specifies the minimum content of pre-fire plants as follows:

- Fire and chemical hazards in area,
- Radiation hazards,
- Egress access,
- Emergency lighting,
- Fire protection systems/equipment in area,
- Special fire-fighting instructions (water controlled [moderation] consideration areas, lasers),
- Ventilation systems/airflow path,
- Utilities, and
- Special considerations on adjoining areas.

Pre-fire plans are developed in accordance with NFPA 801 and NFPA 1620, *Recommended Practice for Pre-Incident Planning (Ref. 7-43)*. Once developed, these plans are provided to the fire brigade, the onsite ERO, and offsite emergency response agencies.

7.6.4 Emergency Response Personnel Training and Qualification

Onsite ERO members are required to complete initial training to become ERO members and continuing education classes to maintain ERO membership. The primary purpose of the onsite ERO is to supplement the fire brigade and provide quick response personnel who are familiar with the GLE Commercial Facility and the Wilmington Site, and trained in firefighting techniques, first aid procedures, and emergency response to mitigate emergency incidents. Members of the fire brigade are the initial responders and they will receive training that fulfils the requirements described in NFPA 600.

7.6.5 Fire Drills

ERO training requirements and drill frequencies necessary to demonstrate proficiency are implemented in accordance with the RC&EP. Drills are critiqued and documented as outlined in the RC&EP.

7.6.6 Fire Investigations and Fire Reports

A Fire Prevention Program is implemented to include fire reports (including an investigation and a statement on the corrective action to be taken).

7.7 REFERENCES

7-1 10 CFR 30.33, *General Requirements for Issuance of Specific Licenses*, U.S. Nuclear Regulatory Commission, 2008.

7-2 10 CFR 40.32, *General Requirements for Issuance of Specific Licenses*, U.S. Nuclear Regulatory Commission, 2008.

7-3 10 CFR 70.22, *Contents of Applications*, U.S. Nuclear Regulatory Commission, 2008.

7-4 10 CFR 70.61, *Performance Requirements*, U.S. Nuclear Regulatory Commission, 2008.

7-5 10 CFR 70.62, *Safety Program and Integrated Safety Analysis*, U.S. Nuclear Regulatory Commission, 2008.

7-6 10 CFR 70.64, *Requirements for New Facilities or New Processes at Existing Facilities*, U.S. Nuclear Regulatory Commission, 2008.

7-7 10 CFR 70.65, *Additional Content of Applications*, U.S. Nuclear Regulatory Commission, 2008.

7-8 NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials*, National Fire Protection Association, 2008.

7-9 NFPA 51B; *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work,* National Fire Protection Association, 2009.

7-10 NFPA 901, *Standard Classifications for Incident Reporting and Fire Protection Data,* National Fire Protection Association, 2006.

7-11 NFPA 601, *Standard for Security Services in Fire Loss Prevention,* National Fire Protection Association, 2005.

7-12 NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, National Fire Protection Association, 2004.

7-13 *International Building Code*, International Code Council, 2006.

7-14 NPFA 220, *Standard on Types of Building Construction*, National Fire Protection Association, 2009.

7-15 NFPA 101®, *Life Safety Code®*, National Fire Protection Association, 2009.

7-16 NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials,* National Fire Protection Association, 2006.

7-17 NFPA 253, *Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source,* National Fire Protection Association, 2006.

7-18 NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*, National Fire Protection Association, 2009.

7-19 NFPA 80, *Fire Door Openings and Other Opening Protectives,* National Fire Protection Association, 200

7-20 NFPA 90A, *Installation of Air Conditioning and Ventilating Systems*, National Fire Protection Association, 2009.

7-21 NFPA 70®, *National Electrical Code®*, National Fire Protection Association, 2008.

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7-23 NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, National Fire Protection Association, 2004.

7-24 NFPA 90B, *Installation of Warm Air Heating and Air-Conditioning Systems*, National Fire Protection Association, 2009.

7-25 UL 900, *Test Performance of Air Filter Units,* Underwriters Laboratories, 7th Edition, September 2004.

7-26 UL 586, *High-Efficiency Particulate Air Filter Units,* Underwriters Laboratories, 8th Edition, August 2009.

7-27 ASME AG-1-2009, *Code on Nuclear Air and Gas Treatment,* American Society of Mechanical Engineers, September 2009.

7-28 NFPA 75, *Standard for the Protection of Information Technology Equipment*, National Fire Protection Association, 2009.

7-29 NFPA 780, *Standard for the Installation of Lightning Protection Systems*, National Fire Protection Association, 2008.

7-30 NFPA 1143, *Standard for Wildland Fire Management*, National Fire Protection Association, 2009.

7-31 NFPA 1144, *Standard for Reducing Structure Ignition Hazards from Wildfire,* National Fire Protection Association, 2008

7-32 NFPA 69, *Standard on Explosion Prevention Systems*, National Fire Protection Association, 2008.

7-33 NFPA 115, *Standard for Laser Fire Protection*, National Fire Protection Association, 2008.

7-34 NFPA 20, *Installation of Stationary Pumps for Fire Protection*, National Fire Protection Association, 2007.

7-35 , *International Fire Code*, International Code Council 2006

7-36 NFPA 72®, *National Fire Alarm Code®,* National Fire Protection Association, 2007.

7-37 NFPA 2001, *Clean Agent Fire Extinguishing Systems*, National Fire Protection Association, 2008.

7-38 NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, National Fire Protection Association, 2007.

7-39 NFPA 10, *Portable Fire Extinguishers*, National Fire Protection Association, 2007.

7-40 NFPA 25, *Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, National Fire Protection Association, 2008.

7-41 NFPA 600, *Standard on Industrial Fire Brigades*, National Fire Protection Association, 2005.

7-42 NFPA 1500, *Fire Department Occupational Safety and Health Program*, National Fire Protection Association, 1500.

7-43 NFPA 1620, *Recommended Practice for Pre-Incident Planning*, National Fire Protection Association, 2003.

CHAPTER 11
REVISION LOG

Rev.	Effective Date	Affected Pages	Revision Description
0	04/30/2009	ALL	Initial Application Submittal.
1	03/31/2010	6, 8, 11, 12, 19, 21, 33, 38-40, 42, 46, 50, 51	Incorporate RAIs responses submitted to the NRC via MFN-09-578 dated 09/04/2009; MFN-09-801 dated 12/28/2009; and MFN-10-056 dated 02/10/2010.
2	06/18/2010	39, 40	Revised Section 11.8.2.1 to clarify the graded approach to applying management measures.

TABLE OF CONTENTS

TABLES

FIGURES

NONE

11. MANAGEMENT MEASURES

This chapter describes the management measures established by GE-Hitachi Global Laser Enrichment LLC (GLE) that are applied to Items Relied on for Safety (IROFS). GLE commits 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. Implementation of the management measures ensures the GLE Commercial Facility can be operated safely, and provides adequate protection of the workers, the public, and the environment from credible hazards presented in the Integrated Safety Analysis (ISA).

The GLE management measures provide oversight and assurance that the GLE Safety Program is maintained and functions properly. GLE applies management measures in a graded approach based on unmitigated risks as described in the ISA Summary. According to criteria defined in approved written procedures, the relative importance of an IROFS is 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 are assigned to assure the IROFS are functional when needed.

11.1 CONFIGURATION MANAGEMENT

The objective of the Configuration Management (CM) Program is to ensure the information used to design, construct, operate, and maintain IROFS is current. Safety controls (IROFS) are structures, systems, and components (SSCs) and procedures that prevent or mitigate the risk of credible accidents. The elements of the CM Program provide consistency among the GLE Commercial Facility design and operations, physical configuration, and documentation.

11.1.1 Configuration Management Policy

GLE commits to maintain a formal CM Program in accordance with 10 CFR 70.72, *Facility Changes and Change Process (Ref. 11-1)*. The CM process is implemented by approved written procedures and ensures that changes from the GLE Commercial Facility Technical Design Baseline are identified and controlled. The CM Program includes the following activities:

- 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 reviews for changes, and
- Periodic performance assessment of specific safety controls to ensure conformance to design basis documentation.

The level of CM applied to the SSCs, processes, equipment, software, and personnel activities is based on the associated quality level (QL) designation. QLs are defined in GLE License Application (LA) Section 11.8.2, *Quality Assurance Program.*

The CM Program is managed by the CM Manager. During design and construction, the CM Manager reports to the Engineering Manager. During the operational phase, the CM Manager reports to the Operations Manager. See GLE LA Chapter 2, *Organization and Administration*, for additional information on the GLE organization.

During the design phase, CM is based on the design control, and associated procedural controls, to establish and maintain the Technical Design Baseline. Design documents, including the ISA, provide design input, analysis, and/or results specifically for IROFS. Design documents undergo interdisciplinary review prior to initial issue and during each subsequent revision. During the construction phase of the project, changes to drawings and specifications issued for construction, procurement, or fabrication are systematically reviewed, verified, evaluated for impact (including impact to the ISA), and approved prior to implementation. Proper implementation is verified and reflected in the design basis documentation.

In order to provide continued safe and reliable operation of GLE Commercial Facility SSCs, controls are implemented to ensure the quality of the SSCs is not compromised by planned changes (modifications). The following items are addressed prior to implementing a facility change:

- Technical basis for the change,
- Impact on safety, health, and control of licensed material,
- Required modifications to existing procedures, to include any necessary training prior to operation,
- Authorization requirements for the change,
- For temporary changes, the approved duration (expiration date) of the change, and
- Impacts or modifications to the ISA, ISA Summary, and any other component of the overall safety program.

11.1.2 Design Requirements

Procedures define the development, application, and maintenance of the design specifications and requirements. Design requirements are developed to support safety functions, environmental impact-oriented functions, and mission-based functions. IROFS identified in the ISA Summary and design documents are identified in more detail during the final design. Design requirements for IROFS and other SSCs are developed with the baseline design criteria defined in 10 CFR 70.64, *Requirements for New Facilities or New Processes at Existing Facilities (Ref. 11-2).* The design requirements to support the IROFS and other SSCs are developed by the Engineering Organization and documented in design documents. Prior to approval, the design documents are reviewed to determine adequacy, accuracy, and completeness. After approval, the design documents and the ISA Summary provide the

Technical Design Baseline for the facility. Design documents and the ISA are controlled documents. Changes to design documents or the ISA are subject to the Change Control Process. See GLE LA Section 11.8.3, *Design Control*, for additional information on the Design Control Process.

11.1.3 Document Control

Document Control, as defined in approved written procedures, includes creation, revision, storage, tracking, distribution, and retrieval of applicable information, to include, but not limited to, manuals, instructions, drawings, procedures, design documents, specifications, plans, and other documents that pertain to the CM function. Procedures are established to control the life-cycle of documents. Appropriate measures have been established to ensure documents are adequately reviewed, approved, and released for use by authorized personnel.

Document control is implemented in accordance with approved written procedures. An electronic document management system (EDMS) is used to file project records and to make available the latest revision (that is, the controlled copy) of controlled documents. Indices of controlled documents, which are uniquely numbered (including revision number), are maintained and available to affected personnel. Controlled documents are maintained in the EDMS until cancelled or superseded. A cancelled or superseded controlled document continues to be maintained as a record. Hardcopy distribution of controlled documents is provided when needed in accordance with approved written procedures (for example, when the EDMS is not available or the complexity of a task requires that the procedure be in-hand).

11.1.4 Change Control

GLE maintains approved written procedures describing the CM process for controlling design changes, including approval to install facility, process, or equipment design changes. Per approved written procedures, a trained safety reviewer is required to review and approve changes to controlled documents to determine if the ISA is impacted by the proposed change. If there is an impact to the ISA, the change is flagged for review and approval by an ISA Team in accordance with the process described in the ISA Summary. Approved written procedures also detail the controls and define the distinction between types of changes, ranging from a replacement with an identical design authorized as part of normal maintenance, to new or different designs which require specified review and approval.

During the design phase the method of ensuring consistency between documents, including consistency between design changes and the ISA, is the interdisciplinary review process. When the project enters the construction phase, changes to documents issued for construction, fabrication, and procurement are documented, reviewed, approved, and posted against each affected design document. Vendor drawings and data also undergo an interdisciplinary review to ensure compliance with procurement specifications and drawings, and to incorporate interface requirements into controlled documents.

During the operations phase, changes to design are documented, reviewed, and approved prior to implementation. GLE's change process fully implements the provisions of 10 CFR 70.72. Measures are provided to ensure responsible facility personnel are made aware of design changes and modifications that may affect the performance of their duties. After completion of a modification to a SSC, the appropriate area manager, or designee, shall ensure that applicable testing has been completed to ensure correct operation of the system(s) affected by the modification and documentation regarding the modification is complete. In order to ensure operators are able to operate a modified system safely, when a modification is complete, necessary documents (such as, the revised process description, checklists for operation and flow sheets) are made available to the Operations and Maintenance Organizations once the modified system becomes "operational." Appropriate training on the modification is completed prior to the system being placed in operation. A formal notice of a modification being completed is distributed to appropriate managers. As-built drawings incorporating the modification are completed promptly. These records shall be identifiable and retained for the duration of the facility license.

11.1.5 Assessments

Planned internal and independent assessments are performed to evaluate the application and effectiveness of management measures and implementation of programs related to facility safety. Periodic assessments of the CM Program are conducted to determine the programs effectiveness and correct any identified deficiencies. These assessments include review of documentation and system walk downs of the as-built facility. CM assessments are performed, at a minimum, on an annual basis. Individuals not involved in the area being assessed will conduct independent assessments.

11.2 MAINTENANCE

The purpose of planned and scheduled maintenance of IROFS is to assure systems are kept in a condition of readiness to perform designed functions when required. Area managers are responsible for assuring the operational readiness of safety controls in assigned areas of the GLE Commercial Facility.

The Maintenance function utilizes a systems-based program to plan, schedule, track, and maintain records for maintenance activities. Maintenance procedures and instructions are an integral part of the Maintenance Program. Maintenance procedures are described in GLE LA Section 11.4, *Procedures.* 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.

The selection and qualification of Maintenance personnel is documented and implemented through approved written procedures. Contractors working on or performing activities that could affect IROFS are required to follow the same procedures as Maintenance personnel. Maintenance activities generally fall into one of the four categories described below.

11.2.1 Corrective Maintenance

Corrective maintenance refers to situations where repairs, replacements, or major adjustments such as re-calibration occur. GLE commits to promptly perform corrective actions to remediate unacceptable performance deficiencies in IROFS. The Maintenance Planning and Control System provides documentation and records of SSCs that have been repaired or replaced. When a component of a specified safety control is repaired or replaced, the component is functionally verified via post-maintenance testing to ensure it has the capability to perform the planned and designed function when called upon to do so. If the performance of a repaired or replaced safety control could be different from that of the original component, the change to the safety control is specifically approved under the CM Program and preoperationally tested to ensure it will perform its desired function when called upon to do so.

11.2.2 Preventive Maintenance

Preventive maintenance (PM) is performed on a periodic basis to prevent failures, facilitate performance, and maintain or extend the life of equipment. PMs help ensure IROFS are available and reliable. The bases for PM tasks are developed through a review of manufacturer recommendations, available industry standards, and historical operating information, where available. PMs are included in the work control process to facilitate planning, scheduling, and execution of these tasks.

Establishment of a PM task is coordinated by the Maintenance Organization and requires input from various disciplines within the Engineering and Operations Organizations. The formal documented bases for the tasks are developed, evaluated, and approved by the Engineering Organization. PM tasks may be changed, new tasks added or deleted, and recommendations made by Operations, Maintenance, or Engineering personnel. Feedback from PM, corrective maintenance, and incident investigations is used, as appropriate, to modify the frequency or scope of a PM activity. Specifically, preventive measures to alleviate premature failure may be added to the PM activity, or a reduction in frequency of a particular PM due to as-found conditions indicating that the PM is occurring more often than necessary.

After conducting PM on IROFS, and prior to returning an IROFS to operational status, functional testing of the SSC, if necessary, is performed to ensure the IROFS performs its intended safety function. Records pertaining to PM are maintained in accordance with the Records Management (RM) System.

11.2.3 Surveillance and Monitoring

The ISA Summary identifies the IROFS that are to be available and reliable to perform their design function for the prevention or mitigation of credible events. 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.

GLE utilizes active engineered controls that are integrated into routine operations to the degree practical. The IROFS are monitored as a routine part of the operating process. IROFS associated with passive engineered systems are typically fixed physical design features to maintain safe process conditions. Availability and reliability of IROFS is maintained through preoperational audits and periodic verifications as prescribed in the ISA, and includes consideration of the importance of the IROFS as well as available quality and reliability information. IROFS relying on geometry-based controls, where the geometry is subject to undetected change in routine operation, are periodically verified on a schedule commensurate with the potential for change in the parameters of interest.

Surveillances are included in the work control process to permit timely planning, scheduling, establishment of system or facility conditions, execution of the activity, and creation of documentation that identifies the results of the surveillance. The established frequencies are determined by the IROFS degree of safety importance. The results of surveillance activities are trended to support the determination of performance trends for IROFS. When potential performance degradation is identified, PM frequencies are adjusted or other corrective actions are taken as appropriate.

Incident investigations may identify the root cause of a failure that is related to the type or frequency of maintenance. The lessons learned from such investigations are factored into the Surveillance and Monitoring Program and the PM Program, as appropriate. Maintenance procedures prescribe compensatory measures, if appropriate, for surveillance tests of IROFS that can only be performed while equipment is out of service.

11.2.4 Functional Testing

Functional testing of IROFS is 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. GLE 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 are recorded and maintained.

Administrative controls that are identified as IROFS are documented in approved written procedures. Administrative controls are assured to be available and reliable during operations by applying the applicable management measures described in this LA Chapter, including the use of procedures and the employee training programs. See GLE LA Section 11.3, *Training and Qualifications*, and Section 11.4 for additional information on how these management measures are applied to administrative controls.

11.2.4.1 Preoperational Testing

Preoperational testing at the facility consists of testing conducted to initially determine various facility parameters and to initially verify the capability of SSCs to meet performance requirements. 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 is performed beginning with the introduction of uranium hexafluoride (UF_6) and ending with the startup. The purpose of initial startup testing is to ensure safe and orderly UF_6 feeding, and to verify parameters assumed in the ISA. Records of the preoperational and startup tests required prior to operation are maintained. These records include testing schedules and results for IROFS.

11.2.4.2 Post-Maintenance Testing

Post-maintenance testing (PMT) is established to provide assurance that IROFS will perform their intended function following maintenance activities. This test confirms the maintenance performed was satisfactory, the identified deficiency has been corrected, and the maintenance activity did not adversely affect the reliability of the item. This test is performed, with acceptable results, prior to returning the equipment to service.

PMT requirements are developed and included in work packages during the work planning process. The Engineering Organization may provide support to the Operations and Maintenance Organizations in identifying PMT requirements. The PMT meets applicable codes and technical requirements and specifies acceptance criteria. The results of the PMT are documented and retained in the work package with other documentation generated during the maintenance evolution.

11.2.5 Calibration

To assure that IROFS are available and reliable to perform their design function, those components that require calibration to provide a measurement used for safety-related purposed will be calibrated according to approved procedures developed utilizing manufacturer's recommended procedures or, lacking such guidance, procedures developed by knowledgeable professionals following applicable codes and standards. The calibration processes utilizes calibration standards traceable to the National Institute of Standards and Technology (NIST). If no nationally recognized standard exists, the basis for calibration is documented. Calibration setpoints for devices performing safety functions are developed to assure that the device provides the necessary activation of the safety function consistent with the parameter limit and time requirements for initiation of the action. The parameter and activation time limits are established during development of the IROFS description in the Quantitative Risk Analysis (QRA) and are often based on calculation limits provided in the Criticality Safety Analysis (which are generally absolute outside bounds on the parameter) or on other consensus standards (for example, AEGL exposure limits). Given the parameter limit, the activation time requirements, and the context for which the parameter is utilized, the device setpoints are developed using methodology found in appropriate standards (for example, ANSI/ANS 67.04.01-2000, *Setpoints for Nuclear Safety-Related Instrumentation)*, and implemented through approved engineering procedures.

Procedures for the setpoint determination address determination of the calibration ranges of test devices, measuring and test instrumentation for use in the calibration, calibration standard requirements, and the acceptable response of the devices in response to the calibration standard. The functional tests that provide checks on the instruments are provided acceptable tolerance ranges for satisfactory operation. Devices that fail to satisfy the function test tolerances are recalibrated. Setpoint calculations and functional test tolerances are documented in design calculations that are referenced in the IROFS Boundary Definition Packages and available as the basis for development of calibration and functional testing procedures development and training. Calibration and function testing procedures require the documentation of the as-found and as-left condition or the trip point of the device to allow evaluation of the instrument drift characteristics to be used for evaluating/modifying the calibration periodicity or setpoint requirements based on historical device performance.

11.3 TRAINING AND QUALIFICATIONS

The Training Program is designed to ensure personnel who perform activities relied on for safety have the applicable knowledge and skills necessary to design, operate, and maintain the GLE Commercial Facility in a safe manner. Performance-based training is used for analyzing, designing, developing, conducting, and evaluating training. Personnel are trained and tested as necessary to ensure they are qualified on practices important to public and worker safety, safeguarding licensed material, and protection of the environment. Exceptions from training requirements may be granted when justified and documented in accordance with approved written procedures and approved by the appropriate level of management.

11.3.1 Organization and Management of the Training Function

Training Programs for personnel who perform activities relied on for safety, are provided through shared responsibility between the Environmental, Health, and Safety (EHS) disciplines and line management. Line managers are responsible for the content and effective conduct of training for assigned personnel. Training responsibilities for line managers are included in position descriptions, and line managers are given the authority to implement training for assigned personnel. The GLE Training function provides support to line management. Performance-based training is used as the primary management tool for analyzing, designing, developing, conducting, and evaluating training. Area managers are responsible for the content and effective conduct of training for Operations personnel.

Approved written procedures establish the requirements for indoctrination and training of personnel performing activities relied on for safety and ensures the Training Program is conducted in a reliable and consistent manner. Lesson plans or training guides are used for classroom and on-the-job training (OJT) to provide a consistent subject matter. When design changes or facility modifications are implemented, updates of applicable lesson plans are included in the change control process of the CM Program. Personnel may be exempt from training if an individual's prior training, qualifications, and job performance history provides information demonstrating that the individual has achieved the necessary required skills. Exemptions from training shall be documented and approved by management.

Training records are maintained to support management information needs associated with personnel training, job performance, and qualifications. Training records are retained in accordance with RM approved written procedures.

11.3.2 Types of Required Training

Training is provided for each individual at the GLE Commercial Facility, commensurate with assigned roles and responsibilities. Training and qualification requirements are met prior to personnel fully assuming the duties of safety-significant positions, and before assigned tasks are independently performed.

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 shall be applicable to, but not restricted to, those personnel who have a direct relationship to the operation, maintenance, testing, or other technical aspects of IROFS.

Contractor personnel shall meet the minimum training and qualification requirements. The line manager responsible for the contracted activity shall verify contractor training. The Radiological Contingency and Emergency Plan (RC&EP) provides additional information on personnel training for emergency response activities. Training courses are kept up-to-date to reflect facility modifications and changes to procedures when applicable.

- Required training may be grouped into one of five categories:
- General Employee Training (GET),
- Nuclear Safety Training,
- Industrial Safety Training,
- Technical Training, and
- Professional Development.

These categories of training are discussed in the following sections. Specific training requirements associated with the Emergency Response Organization (ERO) are addressed in the RC&EP.

11.3.2.1 General Employee Training

GET encompasses those Quality Assurance (QA), Radiation Protection (RP), Industrial Safety, Environmental Protection, Security and Emergency Response, and administrative procedures established by management and in accordance with applicable regulations. The Industrial Safety Training complies with 29 CFR 1910, *Occupational Safety and Health Standards (Ref. 11-3)*, and 10 CFR 19, *Notices, Instructions, and Reports to Workers: Inspection and Investigations (Ref. 11-4)*. Continuing training is conducted in these areas, as necessary, to maintain proficiency. All personnel (including contractors) must participate in GET. However, certain support personnel, depending on normal work assignment, may not participate in all topics of GET. Temporary maintenance and service personnel receive GET to the extent necessary to assure safe execution of assigned duties. Certain portions of GET may be included in New Employee Orientation. GET topics are listed below:

- General administrative controls and procedures and their use,
- QA policies and procedures,
- Nuclear safety (criticality and radiological),
- Industrial safety,
- RC&EP and implementing procedures associated with alarm response and evacuation,
- Fire protection and fire brigade,
- New employee orientation, and

- Environmental Protection.

11.3.2.2 Nuclear Safety Training

Training Programs are established for various job functions (for example, operations, RP technicians, contractor personnel) commensurate with criticality and RP responsibilities. Visitors to Radiological Controlled Areas (RCAs) are trained in the formal Training Program or are escorted by trained personnel.

Formal nuclear safety training includes information about radiation and radioactive materials, risks involved in receiving low-level radiation exposure in accordance with 10 CFR 19.12, *Instruction to Workers (Ref. 11-5)*, basic criteria and practices for RP, nuclear criticality safety (NCS) principles in conformance with applicable objectives contained in the American National Standards Institute (ANSI)/American Nuclear Society (ANS) 8.19-2005, *Administrative Practices for Nuclear Criticality Safety (Ref. 11-6)*, and ANSI/ANS 8.20-1991, *Nuclear Criticality Safety Training (Ref. 11-7)*.

The training policy requires employees to complete nuclear safety training prior to unescorted access in an RCA. Methods for evaluating the understanding and effectiveness of the training include passing an initial examination covering formal training contents and observations of operational activities during scheduled audits and inspections. Such training is typically computer based training, but may be performed by authorized instructors. The Training Program contents are reviewed on a scheduled basis by the NCS and RP functions to ensure the Training Program contents are current and adequate. Previously trained employees who are allowed unescorted access to an RCA are retrained annually at a minimum. The effectiveness of the Training Program is evaluated by either an initial training exam or a re-training exam. Visitors are trained commensurate with the scope of their visit and/or are escorted by trained employees.

11.3.2.3 Industrial Safety Training

Orientation of new or transferred employees to industrial safety is an important part of establishing the proper safety attitude among GLE employees, and insuring employees are aware of safety procedures, rules, and hazards involved in assigned duties. New employee orientation may include, as appropriate, the review of:

- Occupational Safety and Health Administration (OSHA) General Duty Clause,
- Employee/Employer Responsibilities,
- General Site Safety Rules,
- Hazard Communication Training,
- Fire Extinguisher Training,
- Emergency Evacuation Procedure,
- Job Hazards Analysis (JHA) and Chemical Job Hazards Analysis (CJHA), and
- Lockout/Tagout Awareness.

11.3.2.4 Technical Training

Technical training is designed, developed, and implemented to assist Operations and Maintenance personnel gain an understanding of the applicable fundamentals, procedures, and technical practices common to a nuclear fuel enrichment facility. Technical training consists of initial training, OJT, continuing training, and special training, as applicable to specific assigned technical duties. This may include, but is not limited to: process specific training; mechanical maintenance; controls, instrumentation, electrical maintenance; and chemistry.

11.3.2.5 Professional Development

Professional development is a broad category implemented to assist GLE personnel in gaining additional understanding of fundamentals and technical practices common to their assigned job functions. Professional development typically utilizes internal or external professionals via formal workshop, tutorials, and select training programs.

11.3.3 Job-Specific Training Requirements

Operator training is performance-based and incorporates the structured elements of analysis, design, development, implementation, and evaluation commensurate with assigned duties. Minimum training requirements are developed for positions with activities that are relied on for safety. Initial identification of job-specific training requirements is based on individual employee experience. Entry-level criteria (such as, education, technical background, and experience) for these positions are contained in position descriptions. Job-specific training is performance-based and established with the relevant technical EHS safety discipline and Operations leadership to develop a list of qualifications for assigned duties. Changes to facilities, processes, equipment, or job duties are incorporated into revised lists of qualifications.

11.3.4 Basis of Training and Objectives

The Training Program is designed to prepare initial and replacement personnel for safe, reliable, and efficient operation of the GLE Commercial Facility. Emphasis is placed on safety requirements where human actions are important to safety.

Learning objectives are established to identify the training content and to define satisfactory trainee performance for the task, or a group of tasks, selected for training from the job analysis. Learning objectives state the requisite knowledge, skills, and abilities the trainee must demonstrate. The conditions under which the required actions take place and the standards of performance required of the trainee are also determined in development of the learning objectives. Learning objectives are sequenced within training materials based on the relationship to one another. Learning objectives are documented in lesson plans and training guides, and are revised as necessary, based on changes in procedures, facility SSCs, or job scope.

11.3.5 Organization of Instruction

Lesson plans are developed from learning objectives, which are based on job performance requirements. Lesson plans are reviewed by line management and by the responsible organization for the subject matter. Lesson plans are approved prior to issue or use.

11.3.6 Evaluation of Trainee Accomplishment

Trainee understanding and proficiency is evaluated through observation, demonstration, oral, or documented examinations, as appropriate. Such evaluations measure the trainee's skill and knowledge of job performance requirements. Evaluations are performed by individuals qualified in the training subject matter. Operator training and qualification requirements are met prior to process safety related tasks being independently performed or prior to startup, following significant changes to safety controls.

11.3.7 On-the-Job Training

OJT is a systematic method of providing the required job related skills and knowledge for a position. OJT is conducted in the work environment. Applicable tasks and related procedures make up the OJT Qualifications Program for each technical area which is designed to supplement and complement training received through formal classroom, laboratory, or simulator training. The objective of the program is to assure the trainee's ability to proficiently perform job duties as required for the assigned role. Completion of OJT is demonstrated through actual task actions using the conditions encountered during the performance of assigned duties including the use of references and tools, and equipment conditions reflecting the actual task to the extent practical.

11.3.8 Evaluation of Training Effectiveness

Periodic evaluations of Training Program content and requirements are performed to assess program effectiveness. The trainees provide feedback after completion of classroom or computer based training sessions to provide data for this evaluation. These evaluations identify program strengths and weaknesses, determine whether training content matches current job needs, and determines if corrective actions are needed to improve program effectiveness.

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. Evaluation objectives applicable to the overall organization and management of the Training Program may include, but are not limited to:

- Management and administration of training programs,
- Development and qualification of the matrix organization,
- Design and development of training programs, content, and conduct of training, and trainee examinations and evaluations,

- Training Program interface with the CM Program, and
- Training Program assessments and evaluations.

11.3.9 Personnel Qualification

The qualification requirements for key management positions are described in GLE LA Chapter 2. Qualification and training requirements for Operations personnel shall be established and implemented in accordance with approved written procedures.

11.3.10 Provisions for Continuing Assurance

Continuing or periodic retraining shall be established, when applicable, to ensure personnel remain proficient. Periodic training is generally 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 QA Program changes resulting in new or changed information. The results of the retraining are documented.

11.4 PROCEDURES

GLE utilizes a hierarchy of policies, plans, and procedures to document management expectations and commitments, as well as to provide instructions and guidance to GLE personnel. Activities involving licensed special nuclear material (SNM) or IROFS are conducted in accordance with approved written procedures. Policies and plans are upper tier documents that define and describe senior management expectations and guidelines for safe operation of the GLE Commercial 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.

11.4.1 Types of Procedures

Procedures are categorized as management control procedures or operating procedures/instructions. Management control procedures describe administrative and general practices approved and issued by management at a level appropriate to the scope of the practice. These procedures direct and control activities across the various organizational functions, and assign functional responsibilities and requirements for these activities. Operating procedures provide specific direction for task-based work and are used to directly control process operations at the workstation.

Compliance with GLE procedures is mandatory. If any aspect of a procedure is unclear or incorrect as written, personnel shall safely stop the operation and/or activity and contact management. The operation and/or activity shall not restart until corrective action has been taken. If a situation is not defined in the procedure content or an unexpected response is obtained, management notification is also required. Deviations from operating procedures and unforeseen alternations in process conditions that affect nuclear criticality safety shall be reported to management, investigated promptly, corrected as appropriate, and documented.

11.4.1.1 Management Control Procedures

Management control procedures are used for activities that support the process operations. These procedures are used to manage activities such as design, CM, procurement, construction, RP, maintenance, QA, training and qualification, audits and assessments, incident investigations, RM, NCS, industrial safety, and reporting requirements.

11.4.1.2 Operating Procedures/Instructions

Operating procedures/instructions include direction for normal operations, off-normal operations, maintenance, alarm response, and emergency operations caused by failure of an IROFS or human error. These procedures provide reasonable assurance of RP, NCS, industrial safety, security and emergency preparedness, and environmental protection. Operating procedures/instructions contain the following elements, as applicable:

- Purpose,
- Regulations, policies, and guidelines governing the procedure,

- Type of procedure,
- Steps for each operating process phase,
- Initial startup,
- Normal operations,
- Temporary operations,
- Emergency operations and shutdown,
- Normal shutdown,
- Startup following an emergency or extended downtime,
- Hazards and safety considerations,
- Operating limits,
- Precautions necessary to prevent exposure to hazardous chemicals (resulting from operations with SNM) or to licensed SNM,
- Measures to be taken if contact or exposure occurs,
- IROFS associated with the process and associated functions, and
- The timeframe for which the procedure is valid.

Maintenance procedures involving IROFS for corrective and preventive maintenance, testing after maintenance, and surveillance maintenance activities describe the following, as needed:

- Qualifications of personnel authorized to perform the maintenance or surveillance,
- Controls on, and specification of, any replacement components or materials to be used,
- Post-maintenance testing to verify operability of the equipment,
- Tracking and RM of maintenance activities,
- Safe work practices (such as, lockout/tagout, confined space entry; moderation control or exclusion area requirements; radiation or hot work permits; and criticality, industrial, and environmental issues),
- Pre-maintenance activities require reviews of the work to be performed, including procedure reviews for accuracy and completeness, and

- Steps that require notification of affected parties (technicians and supervisors) before performing work and on completion of maintenance work. The discussion includes potential degradation of IROFS during the planned maintenance.

Alarm response procedures provide information that identifies the symptoms of the alarm, possible causes, automatic actions, the immediate operator action to be taken, and the required supplementary actions. Off-normal procedures describe actions to be taken during unusual or out-of-the ordinary situations. Emergency operating procedures direct actions necessary to mitigate potential events or events in progress that involve needed protection of onsite personnel; public health and safety; and the environment.

11.4.2 Procedure Development Process

11.4.2.1 Identification

Line managers, or designees, are responsible for the identification of procedures for assigned functional areas. Area managers are responsible for the identification of procedures incorporating control and limitation requirements established by the NCS, RP, Environmental Protection, and Industrial Safety functions. ISAs are used to identify procedures necessary for human actions important to safety. Approved written procedures have a unique identifier assigned by the Document Control function.

11.4.2.2 Development

Line managers, or designees, are responsible for procedure development. Procedure development is accomplished in accordance with approved written procedures. Procedures are initiated, developed, and controlled by the Document Control Program. Nuclear safety control requirements for workers are incorporated into the appropriate operating, maintenance, and test procedures for uranium enrichment operations.

Activities that require skills normally possessed by qualified personnel do not require detailed step-by-step delineation in a procedure. These activities are performed in accordance with documents of a type appropriate to the circumstances such as planning sheets, job descriptions, external manuals, or other applicable form.

11.4.2.3 Verification/Validation

Prior to initial use, procedures are verified and validated. Verification is a process that ensures the technical accuracy of the procedure. Validation verifies that the procedure can be performed as written. The document owner verifies the procedure during procedure development or during the change process. There are two basic attributes of the verification process. The first is the technical accuracy verification. This verification ensures technical information including formulas, set points, and acceptance criteria are correctly identified in the procedure. The second is administrative, in that it verifies the procedure format and style and verifies that the procedure meets the requirements in the approved written CM procedures.

The applicable guidance in NUREG-0700, *Human-System Interface Design Review Guidelines (Ref. 11-8)*, and NUREG-0711, *Human Factors Engineering Program Review Model (Ref. 11-9),* is used to perform the procedural verification and validation.

The purpose of procedure validation is to ensure that no technical errors or human factor issues were inadvertently introduced during the procedure development or review process. Validation is required for new procedures and for procedure changes. Validation is performed in the field by qualified personnel, and may be accomplished by detailed scrutiny of the procedure as part of a walk-through exercise or as part of a walk-through drill (particularly for emergency or off-normal procedures). If the particular system or process is not available for a walk-through validation, talk-through may be performed in the particular training environment. Performance of procedure validation is documented.

11.4.2.4 Review/Approval

Drafts of new procedures and procedure changes are distributed for technical reviews, safety discipline reviews (such as, NCS, Industrial Safety, and RP), and cross-discipline reviews, as needed. Comments/questions generated during the review process are resolved with the originating organizations. Following the resolution of review comments, procedures are approved. Approval authority rests with the applicable organization manager responsible for the activity. Managers have the responsibility to ensure that appropriate training is completed on new and revised procedures.

The QA function reviews QA implementing procedures for compliance and consistency with the QA Program and to ensure that the provisions of the QA Program are effectively incorporated into QA implementing procedures.

11.4.2.5 Issuance and Distribution

Controlled documents and approved revisions are distributed in a controlled manner in accordance with the Document Control Program. Line managers, or designees, shall be responsible for ensuring personnel doing work that requires the use of procedures have access to controlled copies of the required procedures.

11.4.3 Temporary Changes to Procedures

Temporary changes to procedures can be made, provided the change does not result in a change to the ISA as determined by the 10 CFR 70.72 review; and the change does not constitute an intent change (that is, a change in scope, method, or acceptance criteria that has safety significance). Temporary procedure changes must be documented per approved written procedures. Temporary procedure changes may be used for an identified period of time, which should not exceed 30 days or a period for which the temporary condition exists, whichever is greater. Temporary changes needing to exceed this period are assessed to ensure it is appropriate to extend the use of the temporary change or if a permanent change should be processed. Temporary changes may be made permanent once the change is reviewed and approved per the requirements of Section 11.4.2, *Procedure Development Process.*

11.4.4 Temporary Procedures

Temporary procedures are typically issued to address changes in normal conditions not addressed in operating procedures. These conditions can be related to safety, quality, production, or maintenance concerns. Three types of temporary procedures are used: (1) emergency; (2) standard (valid for up to 90 days from initial start); and (3) long-term (valid for periods not to exceed one year). Long-term temporary procedures are issued for major projects that require a long-term startup phase before facility acceptance and/or process qualification. New temporary procedures of this type require equivalent signatures to new operating procedures.

11.4.5 Periodic Reviews

Periodic reviews of procedures are performed to assure their continued accuracy and usefulness. At a minimum, operating procedures are reviewed every three years, and emergency procedures are reviewed annually. In addition, procedures are reviewed following unusual incidents (such as, an accident, unexpected transient, significant operator error, or equipment malfunction) to determine if changes are appropriate based on the cause and corrective action determination for the particular incident. Periodic reviews of controlled documents shall be conducted at a frequency listed in Table 11-1, *Procedure Periodic Reviews.*

11.4.6 Use and Control of Procedures

Line managers and area managers ensure procedures are made readily available in the work area and that personnel are trained to the requirements of the procedures; compliance is mandatory. Personnel are trained to immediately report inadequate procedures or the inability to follow procedures.

11.4.7 Records

The Safety Program design requires the establishment and maintenance of approved written procedures for EHS limitations and requirements to govern the safety aspects of operations. Requirements for procedure control and approval authorities are documented.

11.4.8 Topics to be Covered in Procedures

Activities defined in Section 11.4.1, *Types of Procedures*, are the minimum activities to be covered by controlled documents. Maintenance activities listed below may be covered by approved written procedures, documented work instructions, or drawings; whichever is appropriate to the circumstance. The list below is not intended to be all-inclusive, as many other activities carried out during operations may be covered by procedures not included in the list. Similarly, this listing is not intended to imply that procedures need to be developed with the same titles as those in the list. This listing provides guidance on topics to be covered rather than specific procedures.

Management Control Procedures

- Training
- Audits and inspections
- Investigations and reporting
- Records management 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

System Procedures that Address Start-Up, Operation, and Shutdown

- Electrical power
- Ventilation
- Shift routines, shift turnover, and operating practices
- Sampling
- UF_6 cylinder handling
- UF_6 material handling equipment

- Decontamination operations
- Facility air and nitrogen
- Cooling, sanitary, and facility water
- Temporary changes in operating procedures
- Purge and evacuation vacuum systems
- Installation and removal of centrifuge machines

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

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_6 valves
- Testing of cranes
- UF_6 cylinder inspection and testing
- Centrifuge assembly/installation

Emergency Procedures

- Toxic chemical releases (including UF_6)

11.5 AUDITS AND ASSESSMENTS

GLE implements a system of audits and assessments to help ensure that the EHS functions, as described in this LA are adequate and effectively implemented. The system is designed to ensure comprehensive program oversight at least once every three years.

11.5.1 Activities to be Audited or Assessed

11.5.1.1 Assessments

Management performs assessments 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. Personnel from the area being assessed may perform the assessment, provided that they do not have direct responsibility for the specific activity being assessed. Results of assessments are documented. The responsible line manager resolves any observations from these programmatic assessments. In addition, GLE 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. Assessment results are documented and reported as specified in the approved written procedures. Provisions are made for reporting and corrective action, where warranted, in accordance with the Corrective Action Program.

11.5.1.2 Audits

Representatives of the NCS, RP, and Industrial Safety functions conduct formal scheduled safety audits of uranium enrichment and process support areas in accordance with approved written procedures. These audits are performed to determine if operations conforms to NCS, RP, and Industrial Safety requirements. Audit results are reported in writing to the GLE Facility Manager, the GLE EHS Manager, the NCS Manager, area managers, the manager of the safety function being audited, and other line management as appropriate.

11.5.2 Scheduling of Audits and Assessments

An assessment of each management measure (such as, CM) is performed annually. The assessment may focus on a single organizational element or the entire organization. NCS and RP audits are performed quarterly (at intervals not to exceed 110 days) under the direction of the manager of the NCS and RP functions. Facility personnel conduct weekly nuclear criticality safety walkthroughs of uranium enrichment and process support areas in accordance with approved written procedures. Walkthrough findings are documented and sent to the affected line manager or area manager for resolution. In addition, GLE commits to perform triennial independent assessments of its safety program elements. The Environmental Protection function develops an audit schedule for the Environmental Protection Program on an annual basis.

11.5.3 Procedures for Audits and Assessments

Industrial safety audits are performed under the direction of the Industrial Safety Manager. Audit results are communicated in writing to the responsible line manager, GLE Facility Manager, area managers, and to the GLE EHS Manager. Environmental Protection audits are conducted in accordance with approved written procedures to ensure operational activities conform to documented environmental requirements.

Required corrective actions are documented and approved by management and tracked to completion by the EHS function. Records of the audit or inspection, instructions and procedures, persons conducting the audits or inspections, audit or inspection results, and corrective actions for identified violations of license conditions are maintained in accordance with procedural requirements for a minimum period of three years.

11.5.4 Qualifications and Responsibilities for Audits and Assessments

Personnel performing audits do not report to the audited organization and have no direct responsibility for the function being audited. The audit team consists of appropriately trained and experienced individuals. The responsible line manager, or area manager, is responsible for nonconformance corrective action commitments in accordance with approved written procedures. The Environmental Protection Manager, or delegate, is responsible for resolution of identified nonconformances associated with the Environmental Protection Program. Audit results in the form of corrective action items are reported to the GLE Facility Manager and staff for monitoring of closure status.

11.6 INCIDENT INVESTIGATIONS

Incident investigations are performed to assure that the upset condition(s) is understood and appropriate corrective actions are identified and implemented to prevent recurrence. Management Measures include documenting upset conditions in unusual incident reports (UIRs). UIRs are documented and the associated corrective actions tracked to completion. The objectives of the incident investigation and reporting procedures are to establish the validity of the data related to the incident, to develop and implement corrective action plans (CAPs) when appropriate, to document an event which was or could become a danger to persons or property, and to ensure that proper levels of GLE Management and public agencies are notified.

11.6.1 Incident Identification, Categorization, and Notification

GLE commits to maintain a system to identify, track, investigate, and implement corrective actions for abnormal events (unusual incidents). Through this system, GLE will investigate abnormal events that may occur during operation of the facility, determine the specific or generic root cause(s) and generic implications, recommend corrective actions, and report to the U.S. Nuclear Regulatory Commission (NRC) as required by 10 CFR 70.50, *Reporting Requirements (Ref. 11-10)*, and 10 CFR 70.74, *Additional Reporting Requirements (Ref. 11-11)*. The Corrective Action System includes the following requirements and features:

- Operates in accordance with approved written procedures;
- Document, track, and report abnormal events to GLE management;
- Identify abnormal events associated with IROFS or their associated management measures;
- Consider 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 (PNC);
- UIRs require investigation, a determination of root or most probable (proximate) cause, and the identification of required corrective action(s);
- More significant UIRs and PNCs require a formal, systematic determination of root cause (typically using an independent qualified team), creation of a CAP, and a higher level management review and approval of the investigation and corrective actions;
- Issue monthly reports covering the status of UIRs and PNCs to GLE management;
- Grade events for the purpose of an ongoing management evaluation of facility performance and used as one element in driving safety culture focus;
- Maintain records of the events and the documented evidence of closure for a minimum of three years; and

- Use UIR and PNC information where appropriate when performing ISAs.

11.6.2 Conduct of Incident Investigations

Incident investigations are implemented according to approved written procedures. The investigation process includes a prompt risk-based evaluation. The investigator(s) is independent from the function(s) involved with the incident under investigation and are assured of no retaliation for participating in investigations. Investigations shall begin within 48 hours of the abnormal event, or sooner, depending on safety significance of the event. The record of IROFS failures, as required by 10 CFR 70.62(a)(3), *Safety Program and Integrated Safety Analysis (Ref. 11-12)*, shall be reviewed as part of the investigation. Record revisions necessitated by post-failure investigation conclusions shall be made within five working days of the completion of the investigation.

Qualified internal or external investigators are appointed to serve on investigating teams when required. The teams include at least one process expert and at least one team member trained in root cause analysis.

GLE maintains 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. For each abnormal event, the incident report includes a description, contributing factors, a root cause analysis, findings, and recommendations. Relevant findings are reviewed with affected personnel. Details of the event sequence are compared with accident sequences already considered in the ISA, and the ISA Summary will be modified, if necessary, to include evaluation of the risk associated with accidents of the type actually experienced. The Incident Investigation Process consists of the following steps:

- Investigate the problem;
- Derive an understanding of the issues and drivers, and determine the fundamental or root cause(s);
- Develop appropriate corrective and preventive actions;
- 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;
- Compile adequate records (hard copy or electronic files) to demonstrate completion or closure of the corrective actions;
- Conduct an investigation to determine if the corrective action(s) was appropriate;
- Assure identified corrective actions are completed in an appropriate and timely manner;
- Input the corrective action completion data, documentation, and any related notes of interest in a hard copy or electronic copy file;

- Provide appropriate GLE management with closure documentation for internal type items (such as, UIRs) or input the closure documentation electronically into the controlled electronic file in sufficient detail to demonstrate closure of the action; and

- Provide the Licensing Organization with closure documentation for external agency items (that is, NRC, State of North Carolina, American Nuclear Insurers, Factory Mutual, etc.) or input the documentation electronically into the controlled electronic file.

11.6.3 Written Follow-Up Report

Upon completion of the incident investigation, a report on the incident and the associated investigation is made to ensure sufficient corrective and preventive actions has been defined and completed. The report contains sufficient detail to demonstrate closure of the action. At least quarterly, a status report is issued by the EHS function and distributed to individuals responsible for corrective actions and management.

11.6.4 Corrective Actions

The line managers and area managers have the responsibility to ensure proper action is taken to control the incident in the assigned area of responsibility to include: consulting EHS for a determination as to whether or not the investigation of an incident is required, notifying appropriate management, participating in the investigation as required, and assuring adequate corrective actions are completed. The line managers and area managers are responsible for reviewing and approving the corrective actions associated with each UIR in their area of responsibility. This is accomplished by the creation of a corrective action within each UIR.

11.7 RECORDS MANAGEMENT

11.7.1 Records Management Program

RM shall be performed in a controlled and systematic manner in order to provide identifiable and retrievable documentation. Applicable design specifications, procurement documents, or other documents specify the QA records to be generated by, supplied to, or held in accordance with approved written procedures. QA records are not considered valid until they are authenticated and dated by authorized personnel.

The GLE QA Program requires procedures for reviewing, approving, handling, identifying, retention, retrieval, and maintenance of QA records. These records include the results of tests and inspections required by applicable codes and standards, construction, procurement and receiving records, personnel certification records, design calculations, purchase orders, specifications and amendments, procedures, incident investigation results and approvals or corrective action taken, various certification forms, source surveillance and audit reports, component data packages, and any other QA documentation required by specifications or procedures. These records are maintained at locations where they can be reviewed and audited to establish that the required quality has been assured.

For computer codes and computerized data used for activities relied on for safety, as specified in the ISA Summary, procedures are established for maintaining readability and usability of older codes and data as computing technology changes. For example, procedures allow older forms of information and codes for older computing equipment to be transferred to contemporary computing media and equipment.

RM shall maintain a Master File to which access is controlled. Documents in the Master File shall be legible and identifiable as to the subject to which they pertain. Documents shall be considered valid only if stamped, initialed, signed or otherwise authenticated, and dated by authorized personnel. Documents in the Master File may be originals or reproduced copies. Computer storage of data may be used in the Master File. In order to preclude deterioration of records in the Master File, the following requirements are applicable:

- Records shall not be stored loosely. Records shall in binders or placed in folders or envelopes. Records shall be stored in steel file cabinets.
- Special processed records, such as, radiographs, photographs, negatives, microfilm, which are light-sensitive, pressure-sensitive, and/or temperature-sensitive, shall be packaged and stored as recommended by the manufacturer of these materials.
- Computer storage of records shall be done in a manner to preclude inadvertent loss and to ensure accurate and timely retrieval of data. Dual-facility records storage uses an electronic data management system and storage of backup tapes in a fireproof safe.

The Master File storage system shall provide for the accurate retrieval of information without undue delay. Approved written instructions shall be prepared regarding the storage of records in a Master File, and a supervisor shall be designated the responsibility for implementing the requirements of the instructions. These instructions shall include, but not necessarily be limited to, the following:

- A description of the location(s) of the Master File and an identification of the location(s) of the various record types within the Master File;
- The filing system to be used;
- A method for verifying that records received are in good condition and in agreement with any applicable transmittal documents. This is not required for documents generated within a section for use and storage in the same sections' satellite files;
- A method for maintaining a record of the records received;
- The criteria governing access to and control of the Master File;
- A method for maintaining control of and accountability for records removed from the Master File; and
- A method for filing supplemental information and for disposing of superseded records.

Record storage areas (including satellite files) shall be evaluated to assure records are adequately protected from damage by fire.

11.7.2 Record Retention

Records appropriate for ISAs, IROFS, the application of management measures to IROFS, NCS and RP activities, training/retraining, occupational exposure of personnel to radiation, releases of radioactive materials to the environment, and other pertinent safety activities are maintained in such a manner as to demonstrate compliance with license conditions and regulations.

Records of criticality safety analyses (CSAs) are maintained in sufficient detail and form to enable independent review and audit of the calculational method and results. Records associated with personnel radiation exposures are generated and retained in such a manner as to comply with the relevant requirements of 10 CFR 20, *Standards for Protection Against Radiation (Ref. 11-13)*. In addition, the following RP records are maintained for at least three years:

- Records of the Facility Safety Review Committee (FSRC) meetings,
- Surveys of equipment for release to unrestricted areas,
- Instrument calibrations,

- Safety audits,
- Personnel training and retraining,
- Radiation work permits,
- Surface contamination surveys,
- Concentrations of airborne radioactive material in the facility, and
- Radiological safety analyses.

Records associated with Environmental Protection activities described in GLE LA Chapter 9, *Environmental Protection*, are generated and retained in such a manner as to comply with the relevant requirements of 10 CFR 20.

11.7.3 Organization and Administration

11.7.3.1 Responsibilities

The Quality Assurance and Infrastructure Program Manager is responsible for the RM Program during the design and construction phases of the project. The Infrastructure Program Manager is 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 record keeping requirements are met.

11.7.3.2 Training and Qualifications

Appropriately trained and qualified personnel manage the RM Program. No specific experience related to the control of documents or management of records is required, although previous technical or RM experience is recommended.

11.7.3.3 Employee Training

General training in RM is provided to employees as part of the general topics covered in GET. Specific professional development training shall be provided on an as needed basis.

11.7.3.4 Examples of Records

The following are examples of the types of records maintained by the RM Program.

General Information

- Construction records
- Safety analyses, reports, and assessments

- Facility and equipment descriptions and drawings
- Design criteria, requirements, and bases for IROFS
- Records of facility changes and associated ISAs
- Records of site characterization measurements and data
- Records pertaining to onsite disposal of radioactive or mixed wastes in surface landfills
- Procurement records, including specifications for IROFS

Organization and Administration

- Administrative procedures with safety implications
- Change control records for Material Control and Accounting (MC&A) Program
- Organization charts, position descriptions, and qualification records
- Safety and health compliance records, medical records, personnel exposure records
- QA records
- Safety inspections, audits, assessments, and investigations
- Safety statistics and trends

Integrated Safety Analysis

- ISA and ISA-related analyses

Radiation Safety

- Bioassay data
- Exposure records
- Radiation protection (and contamination control) records
- Radiation training records
- Radiation work permits

Nuclear Criticality Safety

- Nuclear criticality control approved written procedures and statistics

- NCS evaluations
- Records pertaining to nuclear criticality inspections, audits, investigations
- Records pertaining to nuclear criticality incidents, unusual occurrences, or accidents
- Records pertaining to NCS evaluations

Chemical Safety

- 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
- Chemical process safety training

Fire Safety

- Fire Hazard Analysis
- Fire prevention measures, including hot-work permits and fire watch records
- Records pertaining to inspection, maintenance, and testing of fire protection equipment, and records pertaining to fire protection training and retraining of response teams
- Pre-fire emergency plans

Emergency Management

- Emergency plan(s) and procedures, and comments on emergency plan from outside emergency response organizations
- Emergency drill records
- Memoranda of understanding (MOU) with outside emergency response organizations
- Records of actual events, records pertaining to the training and retraining of personnel involved in Emergency Preparedness functions, and records pertaining to the inspection and maintenance of emergency response equipment and supplies

Environmental Protection

- Environmental release and monitoring records
- Environmental report and supplements to the environmental report, as applicable

Decommissioning

- Decommissioning records, cost estimates, and procedures
- Financial assurance documents
- Site characterization data
- Final survey data

Management Measures

- Configuration Management
  - Safety analyses, reports, and assessments that support the physical configuration of process designs and changes to those designs
  - Validation records for computer software used for safety analyses or MC&A
  - ISA documents, including process descriptions, facility drawings and specifications, purchase specifications for IROFS
  - Approved current operating procedures and emergency operating procedures
- Maintenance
  - Record of IROFS failures (required by 10 CFR 70.62)
  - PM records, including trending and root cause analysis
  - Calibration and testing data for IROFS
  - Corrective maintenance records
- Training and Qualification
  - Personnel training and qualification records
  - Training procedures and modules
- Operating procedures and functional test procedures
- Audits and Assessments of safety and environmental activities

- Incident Investigations
  - Investigation reports
  - Changes recommended by investigation reports, how and when implemented
  - Summary of reportable events for the term of the license
  - Incident investigation policy
- Records Management
  - Policy
  - Material storage records
  - Records of receipt, transfer, and disposal of radioactive material
- Other QA Elements
  - Inspection records
  - Test records
  - Corrective action records

11.8 OTHER QUALITY ASSURANCE ELEMENTS

GLE has developed a QA Program that applies to the design, construction, operation, and decommissioning of the GLE Commercial Facility. Application of the QA Program is mandatory for items (SSCs, equipment, and activities) identified as IROFS in accordance with 10 CFR 70.4, *Definitions (Ref. 11-14)*, 10 CFR 70.61, *Performance Requirements (Ref. 11-15)*, 10 CFR 70.64, and 10 CFR 21, *Reporting of Defects and Noncompliance (Ref. 11-16)*. The QA Program, in conjunction with the other management measures, ensures IROFS will be available and reliable to perform the required safety functions when needed.

11.8.1 Organization

GLE operates to a documented organizational structure in which responsibility and authority is clearly identified. GLE LA Chapter 2 describes the organizational structure of GLE. The GLE QA Program defines the roles and responsibilities of personnel related to QA. Personnel who are responsible for ensuring that appropriate QA has been established have the authority, access to work areas, and organizational independence to carry out their responsibilities.

11.8.2 Quality Assurance Program

The GLE QA Program applies to GLE workers at all levels of the organization, including contractor personnel, who perform quality-affecting activities associated with safety related aspects of the GLE Commercial Facility. The QA Program is risk-informed and utilizes only those elements and principles appropriate for assuring the quality-related aspects of the facility.

GLE contractors may work under the GLE QA Program or their respective QA Programs per approved written procurement procedures. Contractor QA Programs shall be consistent with the requirements of the GLE QA Program for quality-affecting activities. The interfaces between contractors and GLE shall be documented. GLE and contracted personnel have the responsibility to identify quality problems.

The QA Program states GLE policies, assigns responsibilities, and specifies requirements governing implementation of the QA Program for the design, construction, operation, and decommissioning of the GLE Commercial Facility. Specific processes and controls, which implement the provisions of the QA Program, are delineated in approved written procedures. When work cannot be accomplished as specified in implementing QA procedures, or accomplishment of such work would result in an unsafe condition, work is stopped until proper corrective action is taken. If procedures cannot be used as written, then work is stopped until the procedures are modified.

The QA Program is applied to the design, fabrication, testing, operation, procurement, inspection, maintenance, and modification of IROFS and activities affecting those IROFS. The QA Program is applied in a graded approach based on an item's importance to safety.

As part of the license application process, NRC and GLE agreed, as noted in RAI-ISAS-FS-1, that the QA Program would be applied separately to fire safety systems IROFS items and activities. The following sections describe the QA elements applied to IROFS, with the exception of fire safety systems IROFS. Appendix A of the GLE Quality Assurance Program Description details the QA elements applied to fire safety system IROFS. In summary, the fire safety system IROFS are designed, fabricated, installed, inspected, and maintained according to the requirements of the design documents, National Fire Protection Association (NFPA) Codes and Standards, Manufacturer's requirements, and Underwriters Laboratories (UL) listing requirements.

Personnel performing or managing activities affecting quality are indoctrinated or trained on the QA Program and the appropriate QA implementing procedures. Each manager is responsible for the applicable indoctrination, training, and qualification of their personnel. Line management of the organizations implementing the QA Program, or portions thereof, regularly assesses the adequacy of the program for which they are responsible through an appropriate combination of reviews, self-assessments, or audit processes, thereby assuring its effective implementation. Responsible line managers regularly assess the adequacy and effective implementation of the QA Program through methods such as review meetings and reviewing audit reports and CAPs.

Three QA Levels have been established and apply throughout the life of the facility from design and construction through testing, startup, operation, maintenance, modification, and decommissioning. The three QA levels are defined below.

11.8.2.1 QA Level 1

QA Level 1 (QL-1) is applied to single (sole) IROFS preventing or mitigating a high consequence event. Management measures are applied to each QL-1 IROFS consistent with the type of IROFS to assure that the IROFS remains reliable at its credited failure frequency when called upon to be available. Also, all applicable QA Program requirements, as detailed in NEDE-33451, *Quality Assurance Program Description,* are applied to QL-1 IROFS in a manner necessary to achieve this goal.

11.8.2.2 QA Level 2

QA Level 2 (QL-2) is applied where two or more IROFS are credited to prevent or mitigate a high consequence event, or where any single (sole) IROFS prevents or mitigates an intermediate consequence event. Management measures are applied to QL-2 IROFS consistent with the type of IROFS to assure that the IROFS remains reliable at its credited failure frequency when called upon to be available. All applicable QA Program requirements are also applied to QL-2 IROFS in a manner necessary to achieve this goal.

The extent that attributes of management measures and QA program elements are applied to QL-1 and QL-2 IROFS will be determined by evaluating the factors that contribute to reliability of each IROFS. The following QA elements are applied equally to QL-1 and QL-2 IROFS: 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 actions; and quality assurance records. For the QA elements listed above, the management measures that flow from these elements will be the same, regardless of whether the IROFS is QL-1 or QL-2.

For the remaining QA elements (instructions, procedures, and drawings; control of special processes; inspection; test control; inspection, control, testing, and operating status; audits; provisions for change), the management measure(s) applied to those aspects of the activity that influence reliability of the IROFS will be determined by evaluating the design, function, and task analyses associated with operating and maintaining the IROFS and by assigning the characteristic to the attribute taking into consideration the following:

- Risk significance,
- Applicable regulations, industry codes, and standards,
- Complexity or uniqueness of an item/activity and the environment in which it has to function,
- Quality history of the item in service or activity,
- Degree to which functional compliance can be demonstrated or assessed by test, inspection, or maintenance methods,
- Anticipated life span,
- Degree of standardization,
- Importance of data generated, and
- Reproducibility of results.

The management measure and QA element attributes assigned to each IROFS will be approved through the CM process associated with ISA baseline documents and specifically through approval of the IROFS Boundary Definition Packages as the design matures, procedures and training are developed, and pre-operational readiness reviews are conducted.

11.8.2.3 QA Level 3

QA Level 3 (QL-3) is applied to items that are neither QL-1 nor QL-2. QL-3 items are controlled in accordance with standard commercial practice and do not require application of management measures.

11.8.3 Design Control

GLE approved written procedures outline a program to provide design control for IROFS including the management measures necessary to assure successful operation (see Section 11.1, *Configuration Management*). The Engineering Organization utilizes approved written procedures to control the design process including inputs, analysis, outputs, reviews/checks/approvals, change control, technical interfaces, and administrative activities. Design procedures assure applicable requirements are correctly translated into design documents.

Design is based on sound engineering judgment, scientific principles, applicable codes, and standards. Design management ensures that design documents are prepared, reviewed, checked, and approved by qualified individuals. Design documents include requirement documents, drawings, reports, criteria, specifications, analysis, computer programs, system descriptions, technical reports, and the ISA. Work scope and responsibilities between design groups and disciplines are defined. The Engineering function includes:

- Organizations within which the Design Control System is to be implemented;
- Design interface responsibilities between internal and external organizations;
- Exchange of technical information between internal and external organizations;
- Use of approved written design procedures;
- Establishment of technical requirements and design standards;
- Selections and performance of design practices, including review methods;
- Preparation of design documents;
- Extent of design reviews, including technical reviews, peer reviews, modeling, and alternate calculations, as appropriate;
- Design output document control, including review, approval, release status identification, distribution, and revision of documents;
- Determination and specification of acceptance criteria, required tests and inspections, and program requirements for records;
- Maintenance and retention of design documents; and
- Controls for design change.

Determination of the required rigor of design control is based upon the design phase and the ISA performed in compliance with 10 CFR 70, *Domestic Licensing of Special Nuclear Material (Ref. 11-17)*. The ISA establishes the identification and functions of IROFS, and the significance to safety of functions performed by those IROFS. The design of SSCs that involve a higher than normal level of risk, including those SSCs designated as IROFS, are subject to a greater degree of design control and verification.

Design output documents for IROFS such as specifications, system descriptions, and drawings contain requirements for appropriate inspections, testing, and maintenance. Useful life expectancy is a design consideration to facilitate development of GLE Commercial Facility decommissioning, disassembly, and disposal plans. Software used to produce or manipulate data that is used directly in the design, analysis, and operation of SSCs relied on for safety is developed, validated, and controlled. Approved written procedures are used to implement these software controls. Commercially available software is not validated but the results are independently reviewed and verified. The details and implementation of requirements pertaining to design control are performed in accordance with applicable approved written procedures.

11.8.4 Procurement Control

Provisions for control of the procurement process (sourcing), procurement documents, and procured material, components, and services are described in approved written procurement procedures. 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. Requirements are established for content, review, approval, and change of procurement documents. Changes to the procurement documents shall be subject to the same degree of control as used in the preparation of the original procurement document.

QL-1 and QL-2 items may be procured as commercially available items provided they are subjected to a dedication process. Items and services that are not relied on for safety may be designated as QL-2 or QL-3 and may be procured as commercially available items.

In accordance with 10 CFR 21, the procurement process procedures include requirements that GLE confirm each supplier/vendor approved to provide basic components has an approved process in place that implements the requirements of 10 CFR 21. In cases where commercial-grade items are to be procured and then dedicated for use as IROFS or parts thereof, the procurement process procedures include requirements that GLE define to the supplier those elements of the supplier's process controls that are mandatory and any other requirements necessary to assure critical characteristics will be met.

11.8.5 Instructions, Procedures, and Drawings

Activities affecting the availability or reliability of IROFS are prescribed by and accomplished in accordance with documented specifications, requirements, procedures, instructions, and drawings of a type appropriate to the circumstances. These documents include or reference appropriate acceptance criteria for determining that prescribed activities have been satisfactorily accomplished. Standard guidelines for the format, content, review, and approval processes for GLE documents are established (see Section 11.4).

Adherence to policies and procedures is mandatory. In the case of conflict or error involving a procedure, the activity in question shall be placed in a safe condition and the procedure shall be corrected or changed before proceeding to implement the procedure.

11.8.6 Document Control

Documents and changes to documents that prescribe or specify quality requirements or activities affecting the availability and/or reliability of IROFS are controlled in a manner that assures the use of correct documents. Such documents, including changes thereto, are reviewed for adequacy and approved for release in accordance with approved written procedures.

Procedures and instructions assure that documents are: prepared; reviewed for adequacy, correctness, and completeness by a qualified individual; approved for release; and used when performing the activity. Obsolete or superseded documents are removed or appropriately identified. Approved written procedures identify documents to be controlled; responsibility for preparing, reviewing, approving, and issuing documents to be used; and require the establishment of current and updated distribution lists. Procedures are maintained under revision control.

11.8.7 Control of Purchased Items and Services

The procurement of items and services is controlled to ensure conformance with requirements. The controls provide for the following, as appropriate: 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.

Procurement activities are planned and documented to assure a systematic approach to the procurement process. The Procurement function is responsible for procurement planning and bid evaluation. The QA function provides procurement QA support such as verification, surveillance, or qualification of the suppliers QA Program; receipt inspections; installation inspections; and review of procurement documents during receipt inspections. The Engineering function assists the QA and Procurement functions by performing evaluations of supplier's technical capabilities. The Engineering function is also responsible for determining specific methods of acceptance to be applied to purchased items and reviewing the specific method of acceptance to be applied to services. The Engineering function is also responsible for the approval of dispositions and technical evaluation of supplier nonconformances for items and services dispositioned as "repair" or "use-as-is."

Supplier selection is based, in part, on an evaluation of the supplier's capability to provide items or services in accordance with the requirements of procurement documents. 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 actual use. Measures are established to interface with the supplier and to verify supplier's performance, as necessary.

A supplier working to the GLE QA Program shall be indoctrinated or trained on the QA Program and the applicable approved written procedures that govern the work being performed. Supplier work performed under the GLE QA Program is subject to the same controls implemented for GLE personnel.

Supplier-generated documents are reviewed for acceptability. Acceptability verification activities are based on quality level, complexity, and quantity of items or services provided. Technical documents used as input to design processes, such as analyses, calculations, or drawings require an independent technical review. Supplier furnished material, equipment, or services related to safety are reviewed for acceptability by performing, as appropriate, one or more of the following:

- Monitoring, witnessing, or observing activities performed by the supplier;
- Receiving inspection; and/or
- Post-installation testing.

Supplier nonconformances may be identified either by GLE or by the supplier. Nonconforming items are not released for use until the nonconforming condition is reviewed and accepted by GLE and the implementation of the disposition is verified, except under conditional release provisions. Records of supplier nonconformance are maintained.

11.8.8 Identification and Control of Materials, Parts, and Components

Controls are established for QL-1 and QL-2 items and services to assure that only correct and accepted items and services are used or installed. Identification is maintained on the items, in documents traceable to the items, or in a manner that assures identification is established and maintained as described in this section.

Items are identified and controlled, as necessary, from initial receipt and fabrication of the items, up to and including installation and use, to assure that only correct and accepted items are used or installed. Physical identification is used to the maximum extent possible. When physical identification is either impractical or insufficient to control the item, physical separation, procedural controls, or other means are employed. When markings are used, measures are established to ensure the markings are clear, legible, or machine readable, and do not have a detrimental affect on the function or service life of the item. Markings are transferred to each part of an identified item when subdividing and are not to be obliterated by surface treatments or coatings unless other means of identification are provided.

Traceability of items to specific records is provided when specified by codes, standards, or specifications. Where specified, items having a limited operating or shelf life are identified and controlled to preclude use of items whose operating or shelf life has expired.

11.8.9 Control of Special Processes

Special processes affecting quality of items and services are controlled. Procedures, instructions, drawings, checklists, travelers, work orders, or other appropriate means are used to control special processes. These means assure that special process parameters are controlled and that specified environmental conditions are maintained.

Special processes that control or verify quality (such as, those used in welding, heat treating, and nondestructive examination) are performed by qualified personnel using approved written procedures in accordance with specified requirements, codes, or standards. When the outcome of the process is highly dependent on personal skills, such individuals are certified in accordance with specified requirements. When the outcome is highly dependent on control of process parameters, the process and equipment are pre-qualified in accordance with specified requirements. Special process procedures prescribe the necessary equipment, process parameters, calibration, and acceptance criteria. Records are maintained of currently qualified personnel, processes, and equipment for special processes.

11.8.10 Inspections

Planned inspections are performed, as required, to verify conformance of items or activities to specified requirements. Inspection requirements are specified in approved written procedures, with provisions for documenting and evaluating the inspection results. Personnel performing inspections are qualified based on experience, education, or certification, as appropriate. Personnel other than those who performed or directly supervised the work being inspected, perform inspection for acceptance. Inspection planning may utilize hold points, where applicable, to ensure work does not bypass required inspections. The hold points are established in documents that control the work. Work does not proceed beyond an inspection hold point without specific documented consent of the designated inspection representative.

The planning of inspection activities, methods, and attributes is based on the importance of the item or activity to be inspected; mandatory inspections required by codes, standards, regulatory requirements and commitments; the complexity of the item or activity; and the quality history of the process. Inspection planning includes characteristics to be inspected; responsibility; method; measuring and test equipment; acceptance criteria; and referenced instructions and design documents. When a sample is used to verify acceptability of a group of items, the sampling procedure is documented and clearly identifies the sampling basis.

If inspection of completed work is impossible or disadvantageous, indirect verification by process monitoring is provided. Both inspection and process monitoring are provided, when necessary, to ensure quality.

Final inspections include record review of the results and resolution of any nonconformance(s) identified by prior inspections. Acceptance by final inspection verifies conformance of the item to specified requirements. Modifications, repairs, or replacements of items performed subsequent to final inspection require re-inspection or re-test, appropriate to the circumstances, to verify acceptability.

11.8.11 Test Control

Tests required for conformance verification of an item or computer program to specified requirements and to demonstrate satisfactory performance for service are planned and executed. Characteristics to be tested and test methods to be employed are specified. Test results are documented and their conformance with acceptance criteria is evaluated. Tests required to collect data, such as for siting or design input, shall be planned, executed, documented, and evaluated.

Tests include design verification tests, acceptance tests, preoperational and operational tests, and post-maintenance tests. Planning for tests may include mandatory hold points, as required. Test procedures contain the following information, as appropriate:

- Test purpose or objectives, responsibilities, characteristics to be tested, hold points, and test methods to be employed;
- References and related documents;

- Provisions for ensuring that prerequisites for a given test have been met, to include, as applicable: calibrated instrumentation, appropriate equipment, trained personnel, condition of test equipment and the item to be tested, and provisions for data acquisition;
- Adequate instrumentation is available and suitable environmental conditions are maintained;
- Provisions for documenting and evaluating the test results for conformance with acceptance criteria; and
- Qualifications for test personnel.

Approved written test procedures, may incorporate appropriate sections of related documents (such as, American Society for Testing and Materials' [ASTM] methods, external manuals, maintenance instructions, or approved drawings. Such documents must include adequate instructions to ensure the required quality of work. Test records contain the following information: item tested, test date, tester or data recorder, type of observation, test procedure or reference, results and acceptability, actions taken in connection with any deviations noted, and person evaluating the results.

11.8.12 Control of Measuring and Test Equipment

Measuring and Test Equipment (M&TE) used in activities affecting the availability or reliability of IROFS are controlled, calibrated, and adjusted at specified intervals to maintain equipment performance within required limits. Procedures ensure that devices and standards used for measurement, tests, and calibration activities are of the proper type, range, and accuracy. These procedures will assure that these devices and standards are stored and controlled in an appropriate environment to prevent degradation and compromise. Calibration control is not necessary for rulers, tape measures, levels, and other such devices. A list of devices and standards is established to identify those items within the Calibration Control System. This identification listing includes, as a minimum, the due date of the next calibration and any use limitations (when it is calibrated for limited use). M&TE is 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 is documented. M&TE is properly handled and stored to maintain accuracy.

Where appropriate, instruments will be calibration checked consistent with Manufacturer's recommendations and the calibration check data documented and trended for instrument degradation. When M&TE is found to be out of calibration, as-found data are recorded and an evaluation is made and documented as to the validity of previous inspection and test results and of the acceptability of items previously inspected or tested. Out-of-calibration devices are tagged or segregated and are not used until re-calibrated. When M&TE is found to be out of calibration, it is repaired or replaced or if the item/model is inadequate for the conditions, it will be substituted with a more suitable item. Additionally, calibrations are performed when personnel performing measurements and tests deem the accuracy of the equipment suspect. Records are maintained and equipment is suitably marked or otherwise identified to indicate its calibration status.

11.8.13 Handling, Storage, and Shipping Controls

Material and equipment are handled, stored, and shipped in accordance with design and procurement requirements to protect against damage, deterioration, or loss. Special coverings, equipment, and protective environments are specified and provided where necessary for the protection of particular items from damage or deterioration. When such special protective features are required, their existence is verified and monitored as necessary to ensure they continue to serve the intended function.

Special handling tools and equipment are provided where necessary to ensure items can be handled safely and without damage. Special handling tools and equipment are controlled and maintained in a manner such that they will be ready and fit to serve the intended function when needed. Such control includes periodic inspection and testing to verify special handling tools and equipment has been properly maintained.

Operators of special equipment are experienced or trained as required. Attention is given to marking and labeling items during packaging, shipment, and storage. Additional marking or labeling is provided as necessary to ensure that items can be properly maintained and preserved. This includes indication of the presence of special environments or the need for special control. Special handling, preservation, storage, cleaning, packaging, or shipping instructions are established and used when essential to maintain acceptable quality.

11.8.14 Inspection, Test, and Operating Status

Approved written procedures are established to ensure the status of inspection and test activities are either marked or labeled on the item, or in documents traceable to the item. This activity is required when it is necessary to ensure 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. Status indicators (such as, physical location and tags, markings, work controlling documents, stamps, inspection records, or other suitable means) are utilized when required. This includes indicating the operating status of systems and components (for example, by tagging valves and switches) to prevent inadvertent operation. Authority for the application and removal of tags, markings, labels, and stamps is specified.

11.8.15 Control of Nonconforming Items

Items and related activities that do not conform to specified requirements are controlled to prevent inadvertent installation or use. Nonconforming items are identified in a manner that does not adversely affect the end use of the item, by markings, tagging, and other appropriate methods. Nonconforming items are segregated, when practical, by placing them in a clearly identified and designated area until properly dispositioned. When segregation is impractical or impossible due to physical conditions (that is, size, weight, or access limitations), other measures are employed to preclude inadvertent use of the item.

Nonconforming items are reviewed and dispositioned as "reject," "rework," "repair," or "use-as-is." Further processing, delivery, installation, or use of the nonconforming item is controlled pending an evaluation and approved disposition by personnel as authorized in approved written procedures, and documented notification to affected organizations is provided.

The responsibility and authority for the evaluation and disposition of nonconforming items is defined. The personnel performing evaluations to determine the dispositions have demonstrated competence in the specific area being evaluated, have an adequate understanding of the requirements, and have access to pertinent background information. The disposition of nonconforming items is identified and documented as required to carryout the disposition. Technical justification for the acceptability of nonconforming items dispositioned "repair" or "use-as-is" is documented and subject to design control measures described in Section 11.8.3. The disposition process includes consideration of the need for design documents to be "as-built" to facilitate operations, maintenance, or modification. The as-built records, if the disposition determines such records to be required, reflect the accepted deviation. Repaired or reworked items are re-examined in accordance with the original acceptance criteria unless the nonconforming item disposition has established alternate acceptance criteria. Nonconformance documentation identifies the nonconforming item, describes the nonconformance, contains the disposition and any re-inspection requirements, and contains the appropriate signatures approving the disposition.

11.8.16 Corrective Action

Conditions adverse to quality are identified and corrected as soon as practical. In the case of a significant condition adverse to quality, the cause of the condition is determined, and corrective action is taken to preclude recurrence. 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. 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.

11.8.17 Quality Assurance Records

GLE produced QA records that furnish documentary evidence of quality, shall be specified, prepared, and maintained in accordance with applicable regulatory requirements and applicable approved written procedures. QA records shall be legible, identifiable, and retrievable, and shall be protected against damage, deterioration, and loss for the specified record retention duration. A RM Program and Records Center shall be established as early as practicable, consistent with the work activities and in compliance with QA Program requirements. Specific requirements and responsibilities for generation, classification, retention, receiving, storage, and preserving of QA records are established in approved written procedures.

11.8.18 Assessments and Audits

Audits are performed to verify compliance with the QA Program and to determine its effectiveness. Audits of organizations performing quality-affecting activities associated with safety related aspects of the facility are performed at a frequency commensurate with the status and importance of the activity. Audits are performed on both internal and external organizations providing products or services to the project. Audits are performed in accordance with plans, procedures, or checklists by personnel who do not have direct responsibility for performing the activities being audited. A plan is prepared for each audit to identify the audit scope, requirements, audit personnel, activities to be audited, applicable documents, organizations to be audited, schedule, and approved written procedures, instructions, or checklists. Auditors (including technical specialists) have training or experience commensurate with the scope, complexity, or special nature of the audit.

Organizations being audited provide access and assistance to the audit personnel. Objective evidence is examined to determine if the QA Program elements are being implemented effectively. Conditions requiring prompt corrective action are reported immediately to the management of the audited organization. Audit results are documented, and reported to and reviewed by responsible management. Management of the audited organization or activity investigates adverse audit findings, schedules corrective action, including measures to prevent recurrence (if appropriate), and notifies the QA Organization of the action taken. Adequacy of audit responses is evaluated by the QA Organization and verification of corrective action is documented. Follow-up action is taken to verify the implementation and effectiveness of the corrective action and to determine if repetitive problems require further corrective action. Audit records include audit plans, audit reports, written responses to the audit findings, and the record of completion of corrective action.

11.8.19 Provisions for Change

The QA Program is reviewed and revised as necessary to reflect any changes that occur during the design, construction, operation, and decommissioning phases. In addition, the QA Program is revised when corrective actions, regulatory, organizational, or work scope changes warrant changes to the QA Program.

The QA Program is maintained current through design, construction, operation, and decommissioning of the facility. The QA Program is kept current as the design, construction, operation, and decommissioning activities progress and appropriate changes are made based on any of the following:

- Lessons learned from audit and assessment findings;
- Program improvements identified from analysis of trends;
- Changes due to regulations, commitments, re-organizations, revised project schedule, or program improvements from continuous review of assessment results and process improvement initiatives.

QA Program changes are controlled by 10 CFR 70.72. Changes not requiring NRC approval prior to implementation are submitted to the NRC annually, in accordance with 10 CFR 70.72.

11.9 REFERENCES

11-1. 10 CFR 70.72, *Facility Changes and Change Process*, U.S. Nuclear Regulatory Commission, 2008.

11-2. 10 CFR 70.64, *Requirements for New Facilities or New Processes at Existing Facilities,* U.S. Nuclear Regulatory Commission, 2008.

11-3. 29 CFR 1910, *Occupational Safety and Health Standard,* Occupational Safety and Health Administration, 2008.

11-4. 10 CFR 19, *Notices, Instructions, and Reports to Workers: Inspection and Investigation,* U.S. Nuclear Regulatory Commission, 2008.

11-5. 10 CFR 19.12, *Instruction to Workers*, U.S. Nuclear Regulatory Commission, 2008.

11-6. ANSI/ANS 8.19-2005, *Administrative Practices for Nuclear Criticality Safety,* American Nuclear Society, January 2005.

11-7. ANSI/ANS 8.20-1991 (R1999), *Nuclear Criticality Safety Training*, American Nuclear Society, January 1991.

11-8. NUREG-0700, *Human-System Interface Design Review Guidelines,* U.S. Nuclear Regulatory Commission, Revision 2, May 2002.

11-9. NUREG-0711, *Human Factors Engineering Program Review Model,* U.S. Nuclear Regulatory Commission, Revision 2, February 2004.

11-10. 10 CFR 70.50, *Reporting Requirements*, U.S. Nuclear Regulatory Commission, 2008.

11-11. 10 CFR 70.74, *Additional Reporting Requirements*, U.S. Nuclear Regulatory Commission, 2008.

11-12. 10 CFR 70.62, *Safety Program and Integrated Safety Analysis,* U.S. Nuclear Regulatory Commission, 2008.

11-13. 10 CFR 20, *Standards for Protection Against Radiation*, U.S. Nuclear Regulatory Commission, 2008.

11-14. 10 CFR 70.4, *Definitions*, U.S. Nuclear Regulatory Commission, 2008.

11-15. 10 CFR 70.61, *Performance Requirements*, U.S. Nuclear Regulatory Commission, 2008.

11-16. 10 CFR 21, *Reporting of Defects and Noncompliance,* U.S. Nuclear Regulatory Commission, 2008.

11-17. 10 CFR 70, *Domestic Licensing of Special Nuclear Material*, U.S. Nuclear Regulatory Commission, 2008.

Table 11-1. Procedure Periodic Reviews.

Document	Review Frequency	Reviewing and Approving Functional Manager
Business Policy	When changed	CEO of affected GEH business unit(s)
Management Control Procedure	When changed [a]	Area manager, line manager, and affected EHS functions (radiation, criticality, environmental, industrial [d], or material control and accounting)
Operating Procedure	Every 3 Years [c]	Area manager, line manager, and affected EHS functions (radiation, criticality, environmental, industrial [d], or material control and accounting)
Nuclear Safety Instruction	Every 2 Years [b]	Radiation and criticality safety
Environmental Protection Instruction	Every 2 Years [b]	Environmental protection
Emergency Procedure	Annually	Area manager, line manager, and affected EHS function

[a] The safety awareness portions of these procedures are reviewed and updated by the appropriate environment, health, and safety (EHS) function when warranted based on process related facility change requests.

[b] Every two (2) years means a maximum interval of 26 months.

[c] Every three (3) years means a maximum interval of 39 months.

[d] EHS function - industrial means normal worker safety, chemical safety, and fire and explosion protection.

HITACHI

Global Laser Enrichment

NEDE-33545
Rev 2
Class I
June 2010

DECOMMISSIONING FUNDING PLAN

FOR THE

GE-HITACHI GLOBAL LASER ENRICHMENT LLC COMMERCIAL FACILITY

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DECOMMISSIONING FUNDING PLAN
FOR THE
GE-HITACHI GLOBAL LASER ENRICHMENT LLC
COMMERCIAL FACILITY

Revision 2

Reviewed by:

Julie Olivier, GLE Licensing Manager — 6/9/10 Date

Approved by:

Craig M. Steven, Chief Financial Officer — 6/15/10 Date

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REVISION LOG

Rev.	Effective Date	Affected Pages	Revision Description
0	05/13/2009	ALL	Initial revision.
1	03/17/2010	4, 6, 12, 13, 16, 18, 19, 25, 45-47	Incorporate RAI responses submitted to the NRC via MFN-09-801 dated 12/28/02009 and MFN-10-008 dated 01/13/2010
2	06/18/2010	74	Added Appendix F

TABLE OF CONTENTS

TABLES

ACRONYMS

CFR	Code of Federal Regulations
CPI	Consumer Price Index
DFP	Decommissioning Funding Plan
DUF_6	Depleted Uranium Hexafluoride
DOE	U.S. Department of Energy
FY	Fiscal Year
GLE	GE-Hitachi Global Laser Enrichment LLC
GNF-A	Global Nuclear Fuel-Americas
LA	License Application
NRC	U.S. Nuclear Regulatory Commission
NUREG	nuclear regulation
SWU	separative work units
UF_6	uranium hexafluoride

1. INTRODUCTION

GE-Hitachi Global Laser Enrichment LLC (GLE) hereby submits, pursuant to the provisions of the Atomic Energy Act of 1954, as amended, and the rules and regulations of the U.S. Nuclear Regulatory Commission (NRC), its Decommissioning Funding Plan (DFP) for the GLE Commercial Facility in Wilmington, North Carolina. This DFP sets forth the information required by 10 CFR 70, *Domestic Licensing of Special Nuclear Material (Ref. 1),* regarding GLE's plans for funding the decommissioning of the GLE Commercial Facility and disposition of depleted uranium generated as a result of GLE Commercial Facility operations.

As indicated below, GLE presently intends to provide for decommissioning funding through a Surety Instrument in accordance with applicable requirements of 10 CFR 70. However, GLE may later choose to utilize alternate financial assurance methods. Alternate funding methods, if chosen, will be prepared using the guidance provided in (NUREG)-1757, Volume 3, *Consolidated NMSS Decommissioning Guidance – Financial Assurance, Recordkeeping, and Timeliness (Ref. 2),* Appendix A and will satisfy the requirements of 10 CFR 70. The actual funding instruments to be used will be executed prior to the commencement of enrichment operations. In the interim, appropriate model documentation for the Surety Instrument funding method is provided in Appendix A and B of this plan. Upon execution of the funding instruments, GLE will supplement this portion of its application.

2. GENERAL INFORMATION

2.1 GLE Commercial Facility Description

The GLE Commercial Facility is located at the existing Global Nuclear Fuel-Americas, LLC (GNF-A) property near Wilmington, North Carolina. The GLE Commercial Facility encompasses the construction, start-up, operation, and maintenance of a uranium enrichment plant using laser--based technology that will produce six million separative work units (SWU) annually at full capacity. GLE License Application (LA) Chapter 1, *General Information*, provides further information regarding the various facilities associated with the GLE Commercial Facility.

2.2 Licensed Material

The GLE LA seeks authorization to operate a uranium enrichment facility to enrich uranium hexafluoride (UF_6) using a laser-based technology. Uranium enriched in the ^{235}U isotope up to the licensed limit of eight weight percent ^{235}U will be withdrawn and shipped from the facility. Material depleted in the ^{235}U isotope (UF_6 tails) will also be withdrawn and stored onsite pending further disposition. As a uranium enrichment facility, the GLE Commercial Facility requires a DFP pursuant to 10 CFR 70.25(a)(1), *Financial Assurance and Recordkeeping for Decommissioning (Ref. 3)*.

2.3 Schedule

Construction of the GLE Commercial Facility will commence following the issuance of a license by the NRC.

2.4 Period of Operation

The LA seeks authorization to operate for a period of 40 years.

2.5 Decommissioning Costs

GLE has prepared a site-specific decommissioning cost estimate for the decommissioning of the GLE Commercial Facility and disposition of the UF_6 tails. This cost estimate utilizes current information regarding the proposed activities and associated costs of decommissioning the six million SWU facility.

The cost estimate and associated funding mechanisms will be adjusted over time in accordance with the applicable provisions of 10 CFR 70, as described in Section 5 of this plan.

2.6 Decommissioning Funding

As set forth in this DFP, GLE presently intends to utilize a Surety Instrument to provide reasonable assurance of the availability of decommissioning funds when needed. This funding mechanism is in accordance with the provisions of 10 CFR 70 with respect to decommissioning financial assurance for license applicants. However, as described in Section 1 of this plan, GLE may choose to utilize alternate financial assurance methods, subject to review and approval by the NRC.

As described in Section 4 and requested in GLE LA Chapter 1, GLE is requesting an appropriate exemption to incrementally fund the disposition of UF_6 tails. Under the proposed exemption, financial assurance will be available when needed and will be made available as the decommissioning liability is incurred.

3. DECOMMISSIONING COST ESTIMATE

Pursuant to 10 CFR 70.25(e) and the guidance provided in NUREG-1757, GLE has evaluated the estimated costs of decommissioning the GLE Commercial Facility. These estimated costs involve facility decommissioning costs and UF_6 tails disposition costs.

3.1 Facility Decommissioning Cost Estimate

The GLE Commercial Facility will be decommissioned such that the facilities can be released for unrestricted use. The estimated costs for decommissioning are patterned after NRC guidance in NUREG-1757, Volume 3, Appendix A, as set forth in the tables contained in Appendix C of this DFP and as noted below:

(NOTE: To maintain consistent table sequence numbers with those presented in NUREG-1757, Volume 3, Appendix A, Tables 3.1 through 3.3 are not used.)

- Facility Description Summary (Table C3.4),
- Number and Dimensions of Facility Components (Table C3.5),
- Planning and Preparation (Table C3.6),
- Decontamination or Dismantling of Radioactive Facility Components (Table C3.7),
- Restoration of Contaminated Areas on Facility Grounds (Table C3.8),
- Final Radiation Survey (Table C3.9),
- Site Stabilization and Long-Term Surveillance (Table C3.10),
- Total Work Days by Labor Category (Table C3.11),
- Worker Unit Cost Schedule (Table C3.12),
- Total Labor Costs by Major Decommissioning Task (Table C3.13),
- Packaging, Shipping, and Disposal of Radioactive Wastes (Table C3.14),
- Equipment/Supply Costs (Table C3.15),
- Laboratory Costs (Table C3.16),
- Miscellaneous Costs (Table C3.17),
- Total Decommissioning Costs (Table C3.18), and
- Total Labor Distribution (Table C3.20).

GLE LA Chapter 10, *Decommissioning*, describes specific features that simplify the eventual facility decommissioning and minimize worker exposure by minimizing the level and potential spread of radioactive contamination during operation. The estimated decommissioning costs are based on decontaminating the GLE Commercial Facility to the radiological criteria for unrestricted use in 10 CFR 20.1402, *Radiological Criteria for Unrestricted Use (Ref. 4)*. The total estimated cost of facility decommissioning in fiscal year (FY) 2009 dollars, including a 25% contingency but excluding tails disposition costs, is $186.9 million (see Table C3.18). GLE plans to provide financial assurance for the full facility decommissioning costs at startup. The assumptions utilized in the decommissioning cost estimate are listed in Table C3.21 of Appendix C.

3.2 UF_6 Tails Disposal Cost Estimate

Cost estimates to dispose of UF_6 tails generated during GLE Commercial Facility operation are presented in Tables C3.19 and C3.19a. As requested in GLE LA Chapter 1, GLE plans to incrementally fund that portion of its total decommissioning costs associated with the disposition of UF_6 tails generated by facility operation. Specifically, GLE will provide financial assurance for the disposition of UF_6 tails based on the expected amount of UF_6 tails to be generated annually, in a forward-looking manner. At full capacity, the GLE Commercial Facility will generate approximately 10,500 MT of UF_6 tails annually. GLE estimates that it will take approximately six years for the GLE Commercial Facility to ramp up to the full capacity of six million SWU per year. Table C3.19 provides detailed information about the projected UF_6 tails generated during each of the first six years of operation and the expected per year UF_6 tails generated each year thereafter.

GLE has developed a UF_6 tails disposal cost estimate for the GLE Commercial Facility based on the U.S. Department of Energy's (DOE's) estimated cost of disposal provided in DOE's April 23, 2009 letter to GLE (see Appendix E). That letter estimates that the cost of DOE converting and disposing of GLE's projected UF_6 tails inventory would range from $3.76 to $5.764 per kg of UF_6 tails in FY 2007 dollars. To determine a per kg of UF_6 tails cost, GLE: (1) conservatively used DOE's maximum cost of $5.64 per kg; (2) escalated that amount to FY 2009 dollars using the Consumer Price Index (CPI) All Urban Consumers, U.S. City Average, All Items; (3) added transportation costs from the GLE Commercial Facility to the DOE facility in Piketon, Ohio (expressed in FY 2009 dollars); and (4) added a 25% contingency. As a result, GLE conservatively estimates that UF_6 tails disposal costs for the GLE Commercial Facility will be $7.75/kg UF_6 tails (Table C3.19a).

However, it is important to note that this estimate depends on a number of factors and assumptions. Some variables include: location(s) for processing GLE depleted uranium, transportation costs, escalation rate(s) of various construction cost components; de-escalation rate(s) of future operating costs (to present day dollars); volume of tails disposed; revenue/avoided disposal cost from sale of conversion products (for example, hydrogen fluoride) or higher assay tails (tail stripping); construction and operations budget contingencies; and DOE oversight costs.

The ultimate means of disposition of UF_6 tails is to be determined. GLE intends to evaluate possible commercial uses of UF_6 tails. UF_6 tails that are not commercially reused will be converted to a stable form at DOE's depleted uranium hexafluoride (DUF_6) conversion facilities and/or other licensed facilities. After conversion, the more stable form will be disposed of in accordance with applicable statutory authorizations and requirements. UF_6 tails are stored in steel cylinders until they can be processed in accordance with the disposal strategy established and selected by GLE. Depending on technological developments and the existence of facilities available prior to GLE Commercial Facility shutdown, the tails may have commercial value and may be marketable for further enrichment or other processes. However, for the purposes of calculating the UF_6 tails disposition costs, GLE assumes that the total quantity of tails generated during GLE Commercial Facility operation are processed by the DOE DUF_6 conversion facility in Piketon, Ohio.

During the first year of operation, the GLE Commercial Facility will produce approximately 1.74 million kgs of UF_6 tails. As discussed above, GLE conservatively estimates the disposal cost for the UF_6 tails to be $7.75 per kg UF_6 (which includes 25% contingency). Accordingly, GLE conservatively estimates that it will cost approximately $13.5 million to dispose of the UF_6 tails from that first year of production. GLE projects that the GLE Commercial Facility will generate approximately 391.5 million kgs of UF_6 tails over its 40 year operating life. Accordingly, GLE conservatively estimates that the total cost to dispose of UF_6 tails generated over the life of the GLE Commercial Facility is $3.04 billion.

3.3 Total Decommissioning Cost Estimates

GLE will provide financial assurance instruments for NRC review six months in advance of startup that total approximately $200 million ($185 million to provide financial assurance for full facility decommissioning + $13.5 million to provide financial assurance for the first year's generation of UF_6 tails). GLE's total decommissioning liability is the sum of the total facility decommissioning costs and the tails disposition costs for all years. GLE's total liability for decommissioning the GLE Commercial Facility, including applicable contingencies, is $3.22 billion.

4. DECOMMISSIONING FUNDING MECHANISM

GLE presently intends to utilize a Surety Instrument to provide reasonable assurance of decommissioning funding, pursuant to 10 CFR 70.25(f). Accordingly, GLE provides with this application model documentation related to the use of the surety instrument method of providing decommissioning financial assurance.[1] However, as described in Section 1 of this plan, GLE may choose to utilize alternate financial assurance methods. At least six months prior to startup, GLE will provide NRC the financial assurance instrument that GLE intends to execute. Upon finalization of the specific funding instruments to be utilized, and at least 21 days prior to the commencement of enrichment operations, GLE will supplement its application to include the signed, executed documentation.

GLE's surety bond will provide an ultimate guarantee that decommissioning costs will be paid in the unexpected event that GLE is unable to meet its decommissioning obligations at the time of decommissioning. A copy of a model surety bond is provided in Appendix A of this plan. GLE describes below the particular attributes it presently anticipates including in the surety bond.

With respect to the surety bond, GLE presently anticipates providing for 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 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. A copy of a model standby trust is provided as Appendix B of this plan.

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1 The model documentation is derived from NUREG-1757, Volume 3, Appendix A.9.

5. ADJUSTING DECOMMISSIONING COSTS AND FUNDING

Pursuant to 10 CFR 70.25(e), GLE will update the decommissioning cost estimate for the GLE Commercial Facility and the financial assurance over the life of the facility. Table 5-1, *GLE Anticipated Financial Assurance Events*, summarizes GLE's anticipated financial assurance events, the costs provided for at the time of that financial assurance event, and the various deadlines to provide information to the NRC. As shown on the last row of Table 5-1, GLE will periodically adjust its decommissioning estimates, at a minimum, every three years, consistent with the requirements of 10 CFR 70.25(e) and the NRC final rule 68 FR 57327, *Financial Assurance for Materials Licensees – Parts 30, 40, 70 (Ref. 5)*. The method for adjusting the cost estimate will consider the following:

- Changes in general inflation (for example, labor rates, consumer price index),
- Changes in price of goods (for example, packing materials),
- Changes in price of services (for example, shipping and disposal costs),
- Changes in facility condition or operations, and
- Changes in decommissioning procedures or regulations.

A record of the updating effort and results will be retained for review (see further discussion regarding record keeping below).

6. RECORD KEEPING PLANS RELATED TO DECOMMISSIONING FUNDING

Pursuant to 10 CFR 70.25(g), GLE will keep records of information that could have a material effect on the ultimate costs of decommissioning until termination of the license. Information maintained in these records includes:

- Records of spills or other unusual occurrences involving the spread of contamination in and around the facility, equipment, or site. Records of spills or other unusual occurrences may be limited only to instances when contamination remains after any cleanup procedures or when there is reasonable likelihood that contaminants may have spread to inaccessible areas as in the case of possible seepage into porous materials such as concrete. These records will include any known information on identification of involved radionuclides, quantities, forms, and concentrations;
- As-built drawings and modifications of structures and equipment in areas where radioactive materials are used and/or stored, including locations that possibly could be inaccessible (for example, buried pipes which may be subject to contamination); and
- A list contained in a single document that is updated, at a minimum, every two years and includes the following:
  - (1) Areas designated and formerly designated as Restricted Areas as defined under 10 CFR 20.1003, *Definitions (Ref. 6)*,
  - (2) Areas outside of Restricted Areas that require documentation under 10 CFR 70.25(g)(1),
  - (3) Areas outside of Restricted Areas where current and previous wastes have been buried as documented under 10 CFR 20.2108, *Records of Waste Disposal (Ref. 7)*,
  - (4) Areas outside of Restricted Areas that contain material such that, if the license expired, GLE would be required to either decontaminate the area to meet the criteria for decommissioning in 10 CFR 20, Subpart E, *Radiological Criteria for License Termination (Ref. 8)*, or would apply for NRC approval for disposal under 10 CFR 20.2002, *Method for Obtaining Approval of Proposed Disposal Procedures (Ref. 9)*.
- Records of the cost estimate performed for the DFP, and records of the funding method used for assuring funds, including a copy of the financial assurance mechanism and any supporting documentation.

7. REFERENCES

1. 10 CFR 70, *Domestic Licensing of Special Nuclear Material,* U.S. Nuclear Regulatory Commission, 2008.

2. NUREG-1757, Volume 3, *Decommissioning NMSS Funding Guidance – Financial Assurance, Recordkeeping, and Timeliness*, U.S. Nuclear Regulatory Commission, September 2003.

3. 10 CFR 70.25, *Financial Assurance and Recordkeeping for Decommissioning*, U.S. Nuclear Regulatory Commission, 2008.

4. 10 CFR 20.1402, *Radiological Criteria for Unrestricted Use*, U.S. Nuclear Regulatory Commission, 2008.

5. 68 FR 57327, *Financial Assurance for Materials Licensees – Parts 30, 40, 70*, U.S. Nuclear Regulatory Commission, 2008.

6. 10 CFR 20.1003, *Definitions*, U.S. Nuclear Regulatory Commission, 2008.

7. 10 CFR 20.2108, *Records of Waste Disposal*, U.S. Nuclear Regulatory Commission, 2008.

8. 10 CFR 20, Subpart E, *Radiological Criteria for License Termination*, U.S. Nuclear Regulatory Commission, 2008.

9. 10 CFR 20.2002, *Method for Obtaining Approval of Proposed Disposal Procedures*, U.S. Nuclear Regulatory Commission, 2008.

Table 5-1. GLE Anticipated Financial Assurance Events.

Type of Financial Assurance Event	Cost Provided for by Financial Assurance	Deadline to Provide Instrument to NRC	Deadline to Provide Executed Instrument to NRC
Full facility decommissioning – financial assurance	Full facility decommissioning funding Financial Assurance	At least six months prior to startup	At least 21 days prior to startup
Startup UF_6 tails disposition financial assurance	First year of UF_6 tails production	At least six months prior to startup	At least 21 days prior to startup
UF_6 tails production in years 2-40	Annual UF_6 tails production (that is, tails production for the next year)	At least six months prior to beginning new year	At least 21 days prior to beginning new year
Updates to facility decommissioning estimate	Revising facility decommissioning	At least every three years	At least 21 days prior to beginning new year

APPENDIX A – MODEL SURETY BOND

Date bond executed: ______________________

Effective date: ______________________

Principal: [*Insert legal name and business address of licensee*]

Type of organization: [*Insert "proprietorship," "partnership," or "corporation"*]

State of incorporation: ____________________ (if applicable)

NRC license number, NRC Docket number, name, address of facility, and amount for decommissioning activities guaranteed by this bond: ______________________________

Surety: [*Insert name and business address*]

Type of organization: [*Insert "proprietorship," "partnership," or corporation"*]

State of incorporation: ____________________ (if applicable)

Surety's qualification in jurisdiction where license facility is located.

Surety's bond number: ____________________

Total penal sum of bond: $____________________

Know all persons by these presents, that we, the Principal and Surety hereto, are firmly bound to the U.S. Nuclear Regulatory Commission (hereinafter called NRC) in the above penal sum for the payment of which we bind ourselves, our heirs, executors, administrators, successors, and assigns jointly and severally; provided that, where the Sureties are corporations acting as co-sureties, we, the Sureties, bind ourselves in such sum "jointly and severally" only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as it is set forth opposite the name of such Surety; but if no limit of liability is indicated, the limit of liability shall be the full amount of the penal sum.

WHEREAS, the U.S. Nuclear Regulatory Commission, an agency of the U.S. Government, pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, has promulgated regulations in Title 10, Chapter I, of the Code of Federal Regulations, Part [*insert 30, 40, 70, or 72*], applicable to the Principal, which require that a license holder or an applicant for a facility license provide financial assurance that funds will be available when needed for facility decommissioning;

NOW, THEREFORE, the conditions of the obligation are such that if the Principal shall faithfully, before the beginning of decommissioning of each facility identified above, fund the standby trust fund in the amount(s) identified above for the facility;

Or, if the Principal shall fund the standby trust fund in such amount(s) after an order to begin facility decommissioning is issued by NRC or a U.S. District Court or other court of competent jurisdiction;

Or, if the Principal shall provide alternative financial assurance, and obtain NRC's written approval of such assurance, within 30 days after the date a notice of cancellation from the Surety is received by both the Principal and NRC, then this obligation shall be null and void; otherwise it is to remain in full force and effect.

The Surety shall become liable on this bond obligation only when the Principal has failed to fulfill the conditions described above. Upon notification by NRC that the Principal has failed to perform as guaranteed by this bond, the Surety shall place funds in the amount guaranteed for the facility into the standby trust fund.

The liability of the Surety shall not be discharged by any payment or succession of payments hereunder, unless and until such payment or payments shall amount in the aggregate to the penal sum of the bond, but in no event shall the obligations of the Surety hereunder exceed the amount of said penal sum.

The Surety may cancel the bond by sending notice of cancellation by certified mail to the Principal and to NRC provided, however, that cancellation shall not occur during the 90 days beginning on the date of receipt of the notice of cancellation by both the Principal and NRC, as evidenced by the return receipts.

The Principal may terminate this bond by sending written notice to NRC and to the Surety 90 days prior to the proposed date of termination, provided, however, that no such notice shall become effective until the Surety receives written authorization for termination of the bond from NRC.

The Principal and Surety hereby agree to adjust the penal sum of the bond yearly so that it guarantees a new amount, provided that the penal sum does not increase by more than 20 percent in any one year and no decrease in the penal sum will take place without the written permission of NRC.

If any part of this agreement is invalid, it shall not affect the remaining provisions that will remain valid and enforceable.

In Witness Whereof, the Principal and Surety have executed this financial guarantee bond and have affixed their seals on the date set forth above.

The persons whose signatures appear below hereby certify that they are authorized to execute this surety bond on behalf of the Principal and Surety.

Principal

[*Signatures*]
[*Names*]
[*Titles*]
[*Corporate Seal*]

Corporate Surety

[*Name and address*]

State of Incorporation:____________________

Liability limit: $_________________________

[*Signatures*]
[*Names and titles*]
[*Corporate Seal*]

[*For every co-surety, provide signatures, names and titles, corporate seal, and other information in the same manner as for the Sureties above*].

Bond Premium: $_______________________

Model Certification of Financial Assurance

CERTIFICATION OF FINANCIAL ASSURANCE

Principal: [*Legal names and business address of licensee*]
NRC license number, name and address of the facility

Issued to: U.S. Nuclear Regulatory Commission

I certify that [*insert name of licensee*] is licensed to possess the following types of [*insert all that apply: "sealed sources or plated foils with a half-life great than 120 days licensed under 10 CFR Part 30," "unsealed byproduct material with a half-life greater than 120 days licensed under 10 CFR Part 30," "source material in a readily dispersible form licensed under 10 CFR Part 40," and "unsealed special nuclear material licensed under 10 CFR Part 70"*] in the following amounts:

Type of Material	Amount of Material

[*List materials and quantities of materials noted above. For* ***byproduct materials*** *and* ***special nuclear materials,*** *list separately the type and amount of* ***each isotope*** *authorized by the license.*]

I also certify that financial assurance in the amount of [*insert the total of all prescribed amounts calculated from Checklist 2, or the amount of the site-specific cost estimate, in US dollars*] has been obtained for the purpose of decommissioning as prescribed by 10 CFR Part [*insert 30, 40, or 70*].

[*Signatures and titles of officials of institution*]
[*Corporate seal*]
[*Date*]

APPENDIX B – STANDBY TRUST AGREEMENT

TRUST AGREEMENT, the Agreement entered into as of [*insert date*] by and between [*insert name of licensee*], a [*insert name of State*] [*insert "corporation," "partnership," or "proprietorship"*], herein referred to as the "Grantor," and [*insert name and address of a trustee acceptable to NRC*], the "Trustee."

WHEREAS, the U.S. Nuclear Regulatory Commission (NRC), an agency of the U. S. Government, pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, has promulgated regulations in Title 10, Chapter I of the *Code of Federal Regulations, Part* [*insert 30, 40, 70, 72*]. These regulations, applicable to the Grantor, require that a holder of, or an applicant for, a materials license pursuant to 10 CFR Part [*insert 30, 40, 70, or 72*] provide assurance that funds will be available when needed for required decommissioning activities.

WHEREAS, the Grantor has elected to use a [*insert "letter of credit," "line of credit," "surety bond," "insurance policy," "parent company guarantee," or "self-guarantee"*], to provide [*insert "all" or "part"*] of such financial assurance for the facilities identified herein; and

WHEREAS, when payment is made under a [*insert "letter of credit," "line of credit," "surety bond," "insurance policy," "parent company guarantee," or "self-guarantee"*], this standby trust shall be used for the receipt of such payment; and

WHEREAS, the Grantor, acting through its duly authorized officers, has selected the Trustee to be the trustee under this Agreement, and the Trustee is willing to act as trustee;

NOW, THEREFORE, the Grantor and the Trustee agree as follows:

Section 1. Definitions. As used in this Agreement:

(a) The term "Grantor" means NRC licensee who enters into this Agreement and any successors or assigns of the Grantor.

(b) The term "Trustee" means the trustee who enters into this Agreement and any successor Trustee.

Section 2. Costs of Decommissioning. This Agreement pertains to the costs of decommissioning the materials and activities identified in License Number [*insert license number*] issued pursuant to 10 CFR Part [*insert 30, 40, 70, 72*], as shown in Schedule A.

Section 3. Establishment of Fund. The Grantor and the Trustee hereby establish a standby trust fund (the Fund) for the benefit of NRC. The Grantor and the Trustee intend that no third party have access to the Fund except as provided herein.

Section 4. Payments Constituting the Fund. Payments made to the Trustee for the Fund shall consist of cash, securities, or other liquid assets acceptable to the Trustee. The Fund is established initially as consisting of the property, which is acceptable to the Trustee, described in Schedule B attached hereto. Such property and any other property subsequently transferred to the Trustee are referred to as the "Fund," together with all earnings and profits thereon, less any payments or distributions made by the Trustee pursuant to this Agreement. The Fund shall be held by the Trustee, IN TRUST, as hereinafter provided. The Trustee shall not be responsible nor shall it undertake any responsibility for the amount of, or adequacy of the Fund, nor any duty to collect from the Grantor, any payments necessary to discharge any liabilities of the Grantor established by NRC.

Section 5. Payment for Required Activities Specified in the Plan. The Trustee shall make payments from the Fund to the Grantor upon presentation to the Trustee of the following:

(a) A certificate duly executed by the Secretary of the Grantor attesting to the occurrence of the events, and in the form set forth in the attached Certificate of Events, and

(b) A certificate attesting to the following conditions;

(1) that decommissioning is proceeding pursuant to an NRC-approved plan;

(2) that the funds withdrawn will be expended for activities undertaken pursuant to that plan; and

(3) that NRC has been given 30 days prior notice of [*insert name of licensee*]'s intent to withdraw funds from the escrow fund.

No withdrawal from the Fund for a particular license can exceed 10 percent of the remaining funds available for that license unless NRC written approval is attached.

In addition, the Trustee shall make payments from the Fund as NRC shall direct, in writing, to provide for the payment of the costs of required activities covered by this Agreement. The Trustee shall reimburse the Grantor or other persons as specified by NRC from the Fund for expenditures for required activities in such amounts as NRC shall direct in writing. In addition, the Trustee shall refund to the Grantor such amounts as NRC specifies in writing. Upon refund, such funds shall no longer constitute part of the Fund as defined herein.

Section 6. Trust Management. The Trustee shall invest and reinvest the principal and income of the Fund and keep the Fund invested as a single fund, without distinction between principal and income, in accordance with general investment policies and guidelines which the Grantor may communicate in writing to the Trustee from time to time, subject, however, to the provisions of this section. In investing, reinvesting, exchanging, selling, and managing the Fund, the Trustee shall discharge its duties with respect to the Fund solely in the interest of the beneficiary and with the care, skill, prudence, and diligence under the circumstances then prevailing which persons of prudence, acting in a like capacity and familiar with such matters, would use in the conduct of an enterprise of a like character and which like aims; except that:

(a) Securities or other obligations of the Grantor, or any other owner or operator of the facilities, or any of their affiliates as defined in the Investment Company Act of 1940, as amended (15 U.S.C. 80a-2(a)), shall not be acquired or held, unless they are securities or other obligations of the Federal or a State government;

(b) The Trustee is authorized to invest the Fund in time or demand deposits of the Trustee, to the extent insured by an agency of the Federal government, and in obligations of the Federal government or State and Municipal bonds rated BBB or higher by Standard & Poor's or Baa or higher by Moody's Investment Services; and

(c) For a reasonable time, not to exceed 60 days, the Trustee is authorized to hold uninvested cash, awaiting investment or distribution, without liability for the payment of interest thereon.

Section 7. Commingling and Investment. The Trustee is expressly authorized in its discretion:

(a) To transfer from time to time any or all of the assets of the Fund to any common, commingled, or collective trust fund created by the Trustee in which the Fund is eligible to participate, subject to all of the provisions thereof, to be commingled with the assets of other trusts participating therein; and

(b) To purchase shares in any investment company registered under the Investment Company Act of 1940 (15 U.S.C. 80a-l et seq.), including one that may be created, managed, underwritten, or to which investment advice is rendered, or the shares of which are sold by the Trustee. The Trustee may vote such shares in its discretion.

Section 8. Express Powers of Trustee. Without in any way limiting the powers and discretion conferred upon the Trustee by the other provisions of this Agreement or by law, the Trustee is expressly authorized and empowered;

(a) To sell, exchange, convey, transfer, or otherwise dispose of any property held by it, by public or private sale, as necessary to allow duly authorized withdrawals at the joint request of the Grantor and NRC or to reinvest in securities at the direction of the Grantor;

(b) To make, execute, acknowledge, and deliver any and all documents of transfer and conveyance and any and all other instruments that may be necessary or appropriate to carry out the powers herein granted;

(c) To register any securities held in the Fund in its own name, or in the name of a nominee, and to hold any security in bearer form or in book entry, or to combine certificates representing such securities with certificates of the same issue held by the Trustee in other fiduciary capacities, to reinvest interest payments and funds from matured and redeemed instruments, to file proper forms concerning securities held in the Fund in a timely fashion with appropriate government agencies, or to deposit or arrange for the deposit of such securities in a qualified central depository even though, when so deposited, such securities may be merged and held in bulk in the name of the nominee or such depository with other securities deposited therein by another person, or to deposit or arrange for the deposit of any securities issued by the U.S. Government, or any agency or instrumentality thereof, with a Federal Reserve Bank, but the books and records of the Trustee shall at all times show that all such securities are part of the Fund;

(d) To deposit any cash in the Fund in interest-bearing accounts maintained or savings certificates issued by the Trustee, in its separate corporate capacity, or in any other banking institution affiliated with the Trustee, to the extent insured by an agency of the Federal government; and

(e) To compromise or otherwise adjust all claims in favor of or against the Fund.

Section 9. Taxes and Expenses. All taxes of any kind that may be assessed or levied against or in respect of the Fund and all brokerage commissions incurred by the Fund shall be paid from the Fund. All other expenses incurred by the Trustee in connection with the administration of this Trust, including fees for legal services rendered to the Trustee, the compensation of the Trustee to the extent not paid directly by the Grantor, and all other proper charges and disbursements of the Trustee shall be paid from the Fund.

Section 10. Annual Valuation. After payment has been made into this standby trust fund, the Trustee shall annually, at least 30 days before the anniversary date of receipt of payment into the standby trust fund, furnish to the Grantor and to NRC a statement confirming the value of the Trust. Any securities in the Fund shall be valued at market value as of no more than 60 days before the anniversary date of the establishment of the Fund. The failure of the Grantor to object in writing to the Trustee within 90 days after the statement has been furnished to the Grantor and NRC shall constitute a conclusively binding assent by the Grantor, barring the Grantor from asserting any claim or liability against the Trustee with respect to the matters disclosed in the statement.

Section 11. Advice of Counsel. The Trustee may from time to time consult with counsel with respect to any question arising as to the construction of this Agreement or any action to be taken hereunder. The Trustee shall be fully protected, to the extent permitted by law, in acting on the advice of counsel.

Section 12. Trustee Compensation. The Trustee shall be entitled to reasonable compensation for its services as agreed upon the writing with the Grantor. (See Schedule C).

Section 13. Successor Trustee. Upon 90 days notice to NRC and the Grantor, the Trustee may resign; upon 90 days notice to NRC and the Trustee, the Grantor may replace the Trustee; but such resignation or replacement shall not be effective until the Grantor has appointed a successor Trustee, the successor accepts the appointment, the successor is ready to assume its duties as Trustee, and NRC has agreed, in writing, that the successor is an appropriate Federal or State government agency or an entity that has the authority to act as a trustee and whose trust operations are regulated and examined by a Federal or State agency. The successor Trustee shall have the same powers and duties as those conferred upon the Trustee hereunder. When the resignation or replacement is effective, the Trustee shall assign, transfer, and pay over to the successor Trustee the funds and properties then constituting the Fund. If for any reason the Grantor cannot or does not act in the event of the resignation of the Trustee, the Trustee may apply to a court of competent jurisdiction for the appointment of a successor Trustee or for instructions. The successor Trustee shall specify the date on which it assumes administration of the trust, in a writing sent to the Grantor, NRC, and the present Trustee, by certified mail 10 days before such change becomes effective. Any expenses incurred by the Trustee as a result of any of the acts contemplated by this section shall be paid as provided in Section 9.

Section 14. Instructions to the Trustee. All orders, requests, and instructions by the Grantor to the Trustee shall be in writing, signed by such persons as are signatories to this Agreement or such other designees as the Grantor may designate in writing. The Trustee shall be fully protected in acting without inquiry in accordance with the Grantor's orders, requests, and instructions. If NRC issues orders, requests, or instructions to the Trustee these shall be in writing, signed by NRC or its designees, and the Trustee shall act and shall be fully protected in acting in accordance with such orders, requests, and instructions. The Trustee shall have the right to assume, in the absence of written notice to the contrary, that no event constituting a change or a termination of the authority of any person to act on behalf of the Grantor or NRC hereunder has occurred. The Trustee shall have no duty to act in the absence of such orders, requests, and instructions from the Grantor and/or NRC, except as provided for herein.

Section 15. Amendment of Agreement. The Agreement may be amended by an instrument in writing executed by the Grantor, the Trustee, and NRC, or by the Trustee and NRC if the Grantor ceases to exist. All amendments shall meet the relevant regulatory requirements of NRC.

Section 16. Irrevocability and Termination. Subject to the right of the parties to amend this Agreement as provided in Section 15, this trust shall be irrevocable and shall continue until terminated at the written agreement of the Grantor, the Trustee, and NRC, or by the Trustee and NRC if the Grantor ceases to exist. Upon termination of the trust, all remaining trust property, less final trust administration expenses, shall be delivered to the Grantor or its successor.

Section 17. Immunity and Indemnification. The Trustee shall not incur personal liability of any nature in connection with and act or omission, made in good faith, in the administration of this trust, or in carrying out any directions by the Grantor or NRC issued in accordance with this Agreement. The Trustee shall be indemnified and saved harmless by the Grantor or from the trust fund, or both, from and against any personal liability to which the Trustee may be subjected by reason of any act or conduct in its official capacity, including all expenses reasonably incurred in its defense in the event the Grantor fails to provide such defense.

Section 18. This Agreement shall be administered, construed, and enforced according to the laws of the State of [*insert name of State*].

Section 19. Interpretation and Severability. As used in this Agreement, words in the singular include the plural and words in the plural include the singular. The descriptive headings for each section of this Agreement shall not affect the interpretation or the legal efficacy of this Agreement. If any part of this agreement is invalid, it shall not affect the remaining provisions which will remain valid and enforceable.

IN WITNESS WHEREOF the parties have caused this Agreement to be executed by the respective officers duly authorized and the incorporate seals to be hereunto affixed and attested as of the date first written above.

[*Insert name of licensee (Grantor)*]
[*Signature of representative of Grantor*]
[*Title*]

ATTEST:
[*Title*]
[*Seal*]

[*Insert name and address of Trustee*]
[*Signature of representative of Trustee*]
[*Title*]

ATTEST:
[*Title*]
[*Seal*]

Schedule A

This Agreement demonstrates financial assurance for the following cost estimates or prescribed amounts for the following licensed activities:

U.S. NUCLEAR REGULATORY COMMISSION LICENSE NUMBER(S)	NAME AND ADDRESS OF LICENSEE	ADDRESS OF LICENSED ACTIVITY	COST ESTIMATES FOR REGULATORY ASSURANCES DEMONSTRATED BY THIS AGREEMENT

The cost estimates listed here were last adjusted and approved by NRC on [*insert date*].

Schedule B

DOLLAR AMOUNT __________
AS EVIDENCED BY _________________

Schedule C

[*Insert name, address, and phone number of Trustee.*]
Trustee's fees shall be $____________ per year.

Model Specimen Certificate of Events

[*Insert name and address of trustee*]

Attention: Trust Division

Gentlemen:

In accordance with the terms of this Agreement with you dated ______________, I, ____________, Secretary of [*insert name of licensee*], hereby certify that the following events have occurred:

1. [*Insert name of licensee*] is required to commence the decommissioning of its facility located at [*insert location of facility*] (hereinafter called the decommissioning).
2. The plans and procedures for the commencement and conduct of the decommissioning have been approved by the United States Nuclear Regulatory Commission, or its successor, on _____________ (copy of approval attached).
3. The Board of Directors of [*insert name of licensee*] has adopted the attached resolution authorizing the commencement of the decommissioning.

____

Secretary of [*insert name of licensee*]

____

Date

Model Specimen Certificate of Resolution

I, ___________________, do hereby certify that I am Secretary of [*insert name of licensee*], a [*insert State of incorporation*] Limited Liability Company (LLC), and that the resolution listed below was duly adopted at a meeting of this LLC's Board of Directors on _____________________, 20____.

IN WITNESS WHEREOF, I have hereunto signed my name and affixed the seal of this LLC this _____________ day of ________________, 20____.

____

Secretary

RESOLVED, that this Board of Directors hereby authorizes the President, or such other employee of the Company as he may designate, to commence decommissioning activities at [*insert name of facility*] in accordance with the terms and conditions described to this Board of Directors at this meeting and with such other terms and conditions as the President shall approve with and upon the advice of Counsel.

Model Letter of Acknowledgment

STATE OF ______________________________

To Wit:______________________________

CITY OF ______________________________

On this ____ day of __________, before me, a notary public in and for the city and State aforesaid, personally appeared ______________________ and she/he did depose and say that she/he is the [*insert title*] of _______________ [if applicable, insert *",national banking association"* or *", State banking association"*], Trustee, which executed the above instrument; that she/he knows the seal of said association; that the seal affixed to such instrument is such corporate seal; that it was so affixed by order of the association; and that she/he signed her/his name thereto by like order.

____
[Signature of notary public]

My Commission Expires: ____________________
[*Date*]

Model Power of Attorney

[*Insert Name of Issuing Company*]
Principal Bond Office: [*Insert Business Address of Issuing Company*]

KNOW ALL MEN BY THESE PRESENTS:

That [*Insert Name of Issuing Company*] does hereby appoint

[*Insert Names of Attorney(s)-in-Fact*]

its true and lawful Attorney(s)-in-Fact, with full authority to execute on its behalf bonds, undertakings, recognizances and other contracts of indemnity and writings obligatory in the nature thereof, issued in the course of its business, and to bind the respective company thereby.

IN WITNESS WHEREOF, [*Insert Name of Issuing Company*] have executed these presents [*Affix Company Seal*] this [*Insert Date*] day of [*Insert Month/Year*]

____
[*Insert Name of Company Official/Title*]

STATE OF [*Insert State*] }
COUNTY OF [*Insert County*] } ss.

On this [*Insert Date*] day of [*Insert Month*], 200[*Insert Year*], before me came the above named officer of [*Insert Issuing Company*], to me personally known to be the individual and officer described herein, and acknowledged that he executed the foregoing instrument and affixed the seals of said corporations thereto by authority of his office.

____
[*Insert Notary Name*] Notary

CERTIFICATE

Excerpts of Resolutions adopted by the Boards of Directors of [*Insert Issuing Company Name*] on [*Insert Date of Resolutions*]:

"**RESOLVED**, that the Chairman of the Board, the President, or any Vice President be, and hereby is, authorized to appoint Attorneys-in-Fact to represent and act for and on behalf of the Company to execute bonds, undertakings, recognizances and other contracts of indemnity and writings obligatory in the nature thereof, and to attach thereto the corporate seal of the Company, in the transaction of its surety business;

"**RESOLVED**, that the signatures and attestations of such officers and the seal of the Company may be affixed to any such Power of Attorney or to any certificate relating thereto by facsimile, and any such Power of Attorney or Certificate bearing such facsimile signatures or facsimile seal shall be valid and binding upon the Company when so affixed with respect to any bond, undertaking, recognizance or other contract of indemnity or writing obligatory in the nature thereof;

"**RESOLVED**, that any such Attorney-in-Fact delivering a secretarial certification that the foregoing resolutions still be in effect may insert in such certification the date thereof, said date to be not later than the date of delivery thereof by such Attorney-in-Fact."

I, [*Insert Name*], Secretary of [*Insert Name of Issuing Company*] do hereby certify that the foregoing excerpts of Resolutions adopted by the Boards of Directors of this corporation, and the Powers of Attorney issued pursuant thereto, are true and correct, and that both the Resolutions and the Powers of Attorney are in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the facsimile seal of each corporation

[*Affix Company Seal*] this [*Insert Date*] day of [*Insert Month/Year*]

____

[*Name of Issuing Company*] Secretary

APPENDIX C– DECOMMISSIONING COST ESTIMATE TABLES

Table C3.4. Facility Description Summary.

NRC License Number and Types

10 CFR Part 40 and 70 – to construct and operate a uranium enrichment facility

Types and quantities of materials under the licenses listed above

140,000,000 kg of natural/depleted UF_6

2,600,000 kg of enriched UF_6

Description of How Licensed Materials Are Used

The facility enriches uranium for use in the manufacturing of nuclear fuel used in commercial power plants. The process feeds natural uranium to a laser-based enrichment cascade. The final products are enriched uranium and depleted uranium, which are temporarily and safely stored onsite.

Description of Facility, Including Buildings, Rooms, Grounds, and Description of Where Particular Types of Material Are Used

The Operations Building includes the following process and support areas:

Cylinder Shipping and Receiving Area – Receive cylinders from offsite; weigh cylinders; provide interim storage of cylinders inside the Operations Building; prepare cylinders and transfer them to onsite transfer vehicles for transfer between the Operations Building and the UF_6 Cylinder Pads; provide interim storage of product, feed, and sample/blend cylinders; prepare cylinders and transfer to other process areas within the Operations Building; prepare product cylinders for offsite shipment and intra-site transfer; and prepare 48-inch tails and heel cylinders for offsite shipment.

UF_6 Feed and Vaporization Area – Receive UF_6 feed cylinders from the Cylinder Shipping and Receiving Area; purge the light gases contained within the feed cylinders; capture the light gases for disposal; vaporize the UF_6 contained within the feed cylinders; feed the vaporized UF_6 to the feed header between the vaporization area and the separation unit within the Operations Building; maintain design basis UF_6 feed rates to the feed header within the design basis temperature and pressure range; and recover residual UF_6 from the feed cylinders to meet U.S. Department of Transportation (DOT) offsite cylinder shipping requirements for empty cylinders.

Product Withdrawal Area - Receive empty UF_6 cylinders from interim storage within the Cylinder Shipping and Receipt Area; maintain design basis UF_6 product withdrawal rates from the enrichment system main discharge header; separate the light gases from the UF_6 for disposal; and provide filled 30- and 48-inch cylinders with ≤ 8.00 wt% ^{235}U for interim storage and later disposition.

Tails Withdrawal Area – Receive empty UF_6 cylinders from interim storage within the Cylinder Shipping and Storage Area; maintain design-basis UF_6 tails withdrawal rates from the enrichment system main discharge header; separate the light gases from the UF_6 for disposal; and provide filled UF_6 cylinders with ≤ 0.72 wt% ^{235}U for interim storage and later disposition.

Cascade/Gas Handling Area – Contains the equipment necessary to perform the laser enrichment process.

Blending Area – Receive 30- or 48-inch donor cylinders from interim storage within the Cylinder Shipping and Receiving Area; purge the light gases contained within the cylinders; capture the light gases for disposal; vaporize the UF_6 contained within the donor cylinders; feed the vaporized UF_6 to receiver cylinders; recover residual UF_6 from the donor cylinders to meet DOT cylinder shipping requirements for empty cylinders; and provide empty donor cylinders and filled receiver cylinders for interim storage.

Sampling Area – Receive filled UF_6 cylinders from interim storage within the Cylinder Shipping and Receipt Area; purge the light gases contained within the cylinders; capture the reactive light gases for disposal and vent the nonreactive light gases; homogenize and sample the UF_6 contained within the cylinders; and maintain design basis UF_6 cylinder rates to support a six million SWU facility.

Decontamination/Maintenance Area – Provides a place for personnel to remove contamination from, and make repairs to, equipment and process components used in UF_6 systems, waste handling systems, and other areas of the facility.

Laboratory Area – Mass spectroscopy equipment, wet chemistry activities, safety and regulatory testing and analysis, standard analytical laboratory equipment, and fume collection and exhaust hoods.

Laser Area – Operate the laser systems that are part of the laser-based technology; and produce the specific wavelength of light required to affect the uranium isotope necessary for the enrichment process.

UF_6 Cylinder Pads – Tails Pad – Storage of depleted UF_6 cylinders; Product Pad – Storage of enriched uranium cylinders; and In-process Pad – Storage of feed material, cylinders containing heels, and empty cylinders.

Administrative Buildings – Two of the administrative buildings primarily contain office space for the GLE support staff and conference rooms. The third administrative building contains the personnel Entry Control Facility that is designed to facilitate and control the passage of authorized facility personnel and visitors.

Waste Storage Buildings – Used to store solid low-level radioactive waste. The waste is packaged in transportation containers and surveyed prior to being stored in the warehouse.

Quantities of Materials or Waste Accumulated Before Shipping or Disposal

See Tables C3.5

Table C3.5. Number and Dimensions of Facility Components (Total Volume).

[This table contains Proprietary and Security-Related Information and is withheld from public disclosure per 10 CFR 2.390.]

Table C3.6. Planning and Preparation (Work Days).

Activity	Project Mgt	Health Physics	Eng	Chem/Lab	Clerical	Laborer	Craft Labor	Supervision
Planning and design of site characterization								
Administrative activities								
Prepare for decommissioning phase								
Decommissioning planning and design								
Prepare integrated work sequence and schedule								
Prepare activity specifications								
Prepare detailed work procedures								
Prepare decommissioning plan								
NRC review period								
Perform site characterization survey								
Design and specify equipment, special items, and materials								
Procure non-engineered standard equipment								
Final status survey plan preparation and NRC review								
Other (specify)								
TOTALS =								
NOTE: Numbers are based on an 8-hour work day.								

[The contents of this table contain Proprietary Information and are withheld from public disclosure per 10 CFR 2.390.]

Table C3.7. Decontamination and/or Dismantling of Radioactive Facility Components (Work Days).

[This table contains Proprietary and Security-Related Information and is withheld from public disclosure per 10 CFR 2.390.]

Table C3.8. Restoration of Contaminated Areas on Facility Grounds (Work Days).

Activity	Project Management	Health Physics	Engineering	Chem/Lab	Clerical	Laborer	Craft Labor	Supervision
(Note 1)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL =	0	0	0	0	0	0	0	0

Note 1: No facility grounds contamination is anticipated because routine radiological surveys will detect any contamination and remove it. If an accidental release of radiological material was to occur, and the facility grounds were contaminated, the DFP will be updated to include any remediation costs to be incurred during final decommissioning.

Table C3.9. Final Radiation Survey (Work Days).

Activity	Project Management	Health Physics	Engineering	Chem/Lab	Clerical	Laborer	Craft Labor	Supervision
Final Status Survey of Structures								
Final Status Survey of Site								
Final Status Survey Report ORISE verification and NRC Review								
Total =								

NOTE 1. Health Physics days includes Health Physics project oversight and contracted staff for final status survey (FSS) survey.

NOTE 2. Planning for FSS is done during planning and prep period.

NOTE 3: Numbers are based on an 8-hour workday.

[The contents of this table contain Proprietary Information and are withheld from public disclosure per 10 CFR 2.390.]

Table C3.10. Site Stabilization and Long-Term Surveillance (Work Days).

Activity	Project Management	Health Physics	Engineering	Chem/Lab	Clerical	Laborer	Craft Labor	Supervision
(Note 1)	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL =	0	0	0	0	0	0	0	0

NOTE 1. Site stabilization and long-term surveillance (that is, institutional controls) will not be required because the site will be released for unrestricted use. osts associated with maintaining site controls after GLE Commercial Facility operations cease, but before license termination, are contained in FTE and Total Labor Costs Tables. These costs include critical programs such as Nuclear Criticality Safety, Radiation Protection, Environmental Monitoring, Material Control and Accountability, and Items Relied For Safety (IROFS) maintenance.

Table C3.11 Total Work Days by Labor Category.

Activity	Project Management	Health Physics	Engineering	Chem/Lab	Clerical	Laborer	Craft Labor	Supervision
Planning and preparation								
Decontamination and dismantling of radioactive facility components								
Restoration of contaminated areas on facility grounds								
Final radiation survey								
Site stabilization and long term surveillance								
Total =								
NOTE 1: Numbers are based on an 8-hour workday.								

[The contents of this table contain Proprietary Information and are withheld from public disclosure per 10 CFR 2.390.]

Table C3.12. Worker Unit Cost Schedule.

Labor Cost Component	Project Management	Health Physics	Engineering	Chem/Lab	Clerical	Laborer	Craft Labor	Supervision
Avg Salary & Fringe ($/year)								
Avg. Cost Per Day								
Total Person Days Worked								

NOTE 1: Based on 2080 hrs per year and an 8-hour workday.
NOTE 2: Salary and fringe costs include 15% contractor overhead and profit.
NOTE 3: Salary, fringe, and cost per day are the average rates for numerous positions in each labor category.

[The contents of this table contain Proprietary Information and are withheld from public disclosure per 10 CFR 2.390.]

Table C3.13. Total Labor Costs by Major Decommissioning Task.

Task	Project Management	Health Physics	Engineering	Chem/Lab	Clerical	Laborer	Craft Labor	Supervision	TOTAL
Planning and Preparation									
Decontamination and Dismantling of Radioactive Facility Components									
Restoration of Contaminated Areas on Facility Grounds									
Final Radiation Survey									
Site Stabilization and Long Term Surveillance									
TOTALS =									

[The contents of this table contain Proprietary Information and are withheld from public disclosure per 10 CFR 2.390.]

Table C3.14. Packaging, Shipping, and Disposal of Radioactive Wastes.

PACKAGING MATERIAL COSTS				
Waste Type	**Volume (ft3)**	**Number of Containers**	**Type of Container**	**Total Packaging Costs**
Class A				
Class A - Oversized				
DAW				
Macroencapsulation				
Classified Processing - Contaminated				
Classified Processing - Clean				
TOTAL =				

SHIPPING COSTS				
Waste Type	**Volume / Weight**	**Unit Cost**	**Distance Shipped (miles)**	**Total Shipping Costs**
Class A				
Class A - Oversized				
DAW				
Macroencapsulation				
Classified Processing - Contaminated				
Classified Processing - Clean				
TOTAL =				
NOTE 1: Assume all shipments are going to Energy Solutions				

[The contents of this table contain Proprietary and Security-Related Information and are withheld from public disclosure per 10 CFR 2.390.]

WASTE DISPOSAL COSTS			
Waste Type	**Disposal Volume (ft3)**	**Unit Cost ($/ft3)**	**Total Disposal Costs**
Class A			
Class A - Oversized			
DAW			
Macroencapsulation			
TOTAL =			
NOTE 1. Assumed all shipments are going to Energy Solutions			
NOTE 2. Macroencapsulation disposal of gloveboxes			

WASTE PROCESSING COSTS				
Waste Type	**Disposal Volume (ft3)**	**Disposal Weight (lbs)**	**Unit Cost ($/lb)**	**Total Disposal Costs**
Classified Processing - Contaminated				
Classified Processing - Clean				
TOTAL =				

[The contents of this table contain Proprietary and Security-Related Information and are withheld from public disclosure per 10 CFR 2.390.]

Table C3.15. Equipment/Supply Costs.

Equipment/Supplies	Quantity	Unit Cost	Total Equipment/ Supply Cost
Non Engineered Standard Equipment			
Small Tools			
D&D Equipment			
FSS Equipment			
HP Supplies			
Safety Equipment			
TOTAL =			

[The contents of this table contain Proprietary Information and are withheld from public disclosure per 10 CFR 2.390.]

Table C3.16. Laboratory Costs.

Activity	Total Cost
Sampling	
Transport of Samples	
Testing & Analysis	
Other (specify)	
TOTAL =	
NOTE 1. Assumed mobile lab on site.	

[The contents of this table contain Proprietary Information and are withheld from public disclosure per 10 CFR 2.390.]

Table C3.17. Miscellaneous Costs.

Activity	Total Cost
Fees	
Insurance	
Utilities	
Taxes	
Supplies & Services	
Security	
Training Costs	
TOTAL =	
NOTE 1. Fees include NRC Annual Inspection Fees ($708,333), NRC FSS Review fees ($71,400), and ORISE fees for FSS ($573,075).	
NOTE 2. Supplies and services includes miscellaneous costs like phones, office supplies, computers, etc.	

[The contents of this table contain Proprietary Information and are withheld from public disclosure per 10 CFR 2.390.]

Table C3.18. Total Decommissioning Costs.

Task/Component	Cost ($000)	Percentage
Planning and Preparation	$3,736	2.5%
Decontamination and Dismantling of Radioactive Facility Components	$24,080	16.2%
Restoration of Contaminated Areas on Facility Grounds	$0	0.0%
Final Radiation Survey	$11,797	8.0%
Site Stabilization and Long Term Surveillance	$0	0.0%
Packing Material Costs	$140	0.1%
Shipping Costs	$13,060	8.8%
Waste Disposal Costs	$65,530	44.2%
Equipment/Supply Costs	$13,121	8.9%
Laboratory Costs	$689	0.5%
Misc. Costs	$15,913	10.8%
SUBTOTAL =	$148,000	100.0%
25% Contingency (facility)	$37,000	
TOTAL =	**$185,000**	
UF_6 Tails Disposal =	$2,430,000	
25% Contingency (tails)	$607,500	
UF_6 Tails Disposal Total =	**$3,038,000**	
GRAND TOTAL =	**$3,223,000**	

Table C3.19. Estimated Volume of Annual Depleted Uranium Generated

Operating Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7 (and annually thereafter)
MSWU generated	1	2	3	4	5	6	6+
DUF_6 generated (kg)	1,739,970.39	3,479,940.78	5,219,911.17	6,959,881.56	8,699,851.95	10,439,822.34	10,439,822.34
Number of 48Y cylinders of DUF_6 generated	140	280	420	560	700	840	840
DUF_6 disposal cost without 25% contingency	$10,800,000	$21,600,000	$32,400,000	$43,200,000	$53,900,000	$64,700,000	$64,700,000
DUF_6 disposal cost with 25% contingency	$13,500,000	$27,000,000	$40,500,000	$54,000,000	$67,400,000	$81,000,000	$81,000,000
40 years TOTAL with 25% contingency							**$3,038,000,000**

NOTE 1: Kg DUF_6 is based on the assumption that the operating feed assay is 0.71%, the operating product assay is 4.95%, and the operating tails assay is 0.25%.

NOTE 2: The number of cylinders of DUF6 is equal to the kg DUF_6 divided by the maximum capacity of a 48Y cylinder (12501 kg).

NOTE 3: Estimated tails disposition costs is from Table C3.19a

APPENDIX C– DECOMMISSIONING COST ESTIMATE TABLES

Table C3.19a Total Disposal Cost Per Kilogram of UF_6 Tails.

DOE Estimate based on Letter from F. Marcinowski to A. Kennedy, dated April 23, 2009 (Maximum Value)	$5.64 per kg UF_6 Tails
Escalate to FY 2009 dollars	4.06%
DOE Estimate (Maximum Value) in FY 2009 dollars	$5.87 per kg UF_6 Tails
Transportation Costs from GLE Commercial Facility to Piketon, Ohio (in FY 2009 dollars) Note – See detailed explanation below.	$0.33 per kg UF_6 Tails
Total Disposal Cost per kg of UF_6 Tails Without Contingency	$6.20 per kg UF_6 Tails
Contingency Percentage (over and above Contingency Applied by DOE)	25%
Total Disposal Cost per kg of UF_6 Tails With Contingency	$7.75 per kg UF_6 Tails

Explanation of DUF_6 Tails Shipping Costs

As shown in the table below, the shipping cost from the proposed facility to the DOE processing site was calculated and was included in the costs for the DUF_6 tails disposal. To calculate the shipping costs per Kg of DUF_6 tails the estimated number of kilograms per shipment was estimated at 11,793 kg as supplied by the proposed cylinder manufacturer, Westerman Companies. The total number of kg's to be shipped was estimated at 391,493,337.66 kg and an estimated number of shipments over the life of the facility calculated at approximately 33,197 shipments. A round trip shipping mileage was calculated. Cost per mile for trucking and fuel surcharge was supplied by Hittman Transport Services. A per shipment cost for loading, unloading, and permits and fees was also applied. These charges resulted in a per shipment cost of $3,880.72. The total shipping cost was calculated and allowances for valve protection of the cylinders and shipping saddles were included. The total shipping cost was then divided by the total number of kilograms of DUF_6 tails to estimate a unit transportation cost of $0.33/kg.

Mileage:	1,136	miles
Description	Unit Cost	Unit
Detention - loading	$75.00	$/Ea
Detention - unloading	$75.00	$/Ea
Permits & Fees	$300.00	$/Ea
Rate per mile	$2.65	per mile
Fuel surcharge:	$0.37	per mile
	$3,880.72	per shipment
Number of Kg per shipment	11,793.00	kg/shipment
Total Number of Kg's of DUF6	391,493,337.66	
Total # of shipments =	33,197.00	
Valve Protection Costs	$ 250,000.00	Allowance
Shipping Saddles/Cradles	$ 500,000.00	Allowance
Shipping Cost =	$129,578,629.30	
Transportation Cost Per Kg Waste =	$0.33	$/ Kg

Table C3.20. Total Labor Distribution

Activity	Project Management	Health Physics	Engineering	Chem/Lab	Clerical	Laborer	Craft Labor	Supervision
Planning and Preparation								
Decontamination and Dismantling of Radioactive Facility Components								
Restoration of Contaminated Areas on Facility Grounds								
Final Radiation Survey								
Site Stabilization and Long Term Surveillance								
Total FTE's (Full Time Equivalents) =								
NOTE 1: Based on an 8-hour workday								

[The contents of this table contain Proprietary Information and are withheld from public disclosure per 10 CFR 2.390.]

Table C3.21. Assumptions.

1. The Commercial Facility will be decommissioned such that the facilities can be released for unrestricted use. The estimated costs for decommissioning are presented in accordance with NRC guidance in NUREG-1757, Volume 3, Appendix A.

2. Decommissioning costs are calculated in FY 2009 dollars.

3. Costs are not included for the removal or disposal of non-radioactive structures, areas and materials beyond that necessary to terminate the NRC license and release the site for unrestricted use.

4. Overhead and profit on contractor labor is assumed to be 15%.

5. Decommissioning planning and preparations occur prior to facility shutdown.

6. Security, fees, insurance, taxes, and utilities costs incurred during the planning and preparations period are considered to be an operational cost and are not included in this estimate.

7. Assumed contingency rate of 25% is applied.

8. This estimate's material inventory is based on the site drawings and information furnished by GEH.

9. Restoration of contaminated areas on facility grounds and site stabilization are assumed to not be required. Long Term Surveillance of site will not be required.

10. The site surrounding the Operations Building, the UF_6 Cylinder Pads, and lagoons are assumed to be clean. All UF_6 cylinders are assumed to have been removed from site at the time of facility shutdown. UF_6 cylinder cradles are assumed to be clean and are left in place.

11. Disposal rates were calculated using the rates listed in Addendum 10 of the "GEH Waste Disposal Agreement" with EnergySolutions, LLC. Disposal rates were escalated by 4.06% to FY 2009 dollars using the US Department of Labor BLS, Consumer Price Index (CPI) All Urban Consumers, US City Average, All Items.

12. All Class A waste is assumed to be disposed of at EnergySolutions' facility in Clive, Utah, in accordance with the existing Waste Disposal Agreement between EnergySolutions and GEH. The following FY 2009 disposal rates will be applied: **[Proprietary Information has been redacted and withheld from public disclosure per 10 CFR 2.390.]**

13. Classified components are to be processed offsite at the EnergySolutions' Bear Creek facility.

14. Assumed mode of transportation for waste is by truck.

15. Sealand containers are rented at a cost of $450/month each.

16. Clean scrap metal is assumed to be recycled at no cost to the project by metal recycler. Concrete debris is assumed to be processed by size reduction, with removal of structural reinforcing steel, and used on site as engineered fill for voids. All other demolition debris is removed from the site and disposed of at a local offsite construction landfill.

17. This estimate does not include credit for material scrap value.

18. **[Security-Related Information has been redacted and withheld from public disclosure per 10 CFR 2.390]**

19. **[Security-Related Information has been redacted and withheld from public disclosure per 10 CFR 2.390]**

20. **[Security-Related Information has been redacted and withheld from public disclosure per 10 CFR 2.390]**

21. **[Security-Related Information has been redacted and withheld from public disclosure per 10 CFR 2.390]**

22. Existing decontamination stations and liquid effluent systems are used during dismantling and decommissioning.

23. Work will be performed on eight-hour shifts, five days per week. No overtime hours have been included.

24. Cascade and Vaporization area decommissioning and decontamination activities occur in parallel.

25. Cascade area decommissioning and decontamination work is to be done with 2 shifts per day.

26. Assumed that 10% of overall floor area will be Class I for MARSSIMS survey.

27. Assumed that 5% of total cylinder pads will be Class II areas for MARSSIMS survey.

28. Assumed that 2-Acre Holding Lagoon will be Class II area for MARSSIMS survey and soil of lagoons will undergo soil sampling to verify as clean.

29. Assumed that GLE will purchase the approximately 200-acre facility of the Wilmington site from GE.

30. Annual insurance cost during decommissioning of $1,250,000.

31. Annual property tax cost during decommissioning of $22,500.

32. Annual NRC Inspection fee during decommissioning of $200,000.

33. Laboratory equipment costs for performing the decommissioning sampling analysis is included in the "D&D equipment" costs listed in the Table 12.0 – Equipment/Supply Costs.

34. Craft labor rates were taken from RS Means and professional labor rates provided by GEH and from EnergySolutions data.

35. Assumed "cleared" worker labor rate increase of approximately 22% over un-cleared worker rate.

36. The total estimated volume of UF6 tails requiring disposition, following 40 years of facility operations is 391,493,338 kg.

37. UF_6 tails are assumed shipped to Piketon, Ohio for processing. After processing, it is assumed that the original cylinder is used to ship material for final disposition. No additional purchase of cylinders will be required.

38. It is assumed that the decommissioning work is managed and performed by professional consulting engineering.

39. The size of the staff varies in each period in accordance with the requirements of the work activities.

40. Contamination is limited to localized low-levels of radioactivity incidental to routine activities. There is no subsurface or widespread contamination. Characterization surveys will be conducted prior to remediation, decontamination, and/or disposal.

APPENDIX D – DOE UF_6 TAILS DISPOSAL COST ESTIMATE

Department of Energy
Washington, DC 20585

March 17, 2008

Mr. Al Kennedy
Facility Licensing Manager
GE Hitachi Nuclear Energy
3901 Castle Hayne Road
Wilmington, NC 28402

Dear Mr. Kennedy:

This is in response to your November 30, 2007, letter requesting whether the Department of Energy (DOE) would accept for conversion and disposal the depleted uranium hexafluoride (DUF_6) product to be generated by GE-Hitachi Global Laser Enrichment (GLE) proposed laser-based enrichment facility, and if so, the anticipated costs of providing such services.

The Department would accept, upon request, such DUF_6 for conversion and disposal (or reuse) pursuant to authorities granted to the Department under the Atomic Energy Act. The Department's acceptance of such material would be contingent upon the negotiation of an agreement for conversion and disposal services that would include full cost recovery of the Department's expenses.

As requested, DOE prepared a cost estimate for providing DUF_6 conversion and disposal services to GLE. The cost estimate is based on GLE's projection that it would generate approximately 7,100 metric tons of DUF_6 annually for 40 years, beginning in 2010.

The Department estimates that the cost of converting and disposing of GLE's projected DUF_6 inventory would range from \$3.84 to \$5.72 per kilogram of DUF_6 in FY07 dollars. This estimated price reflects the following costs: design and construction (capital costs); DUF_6 conversion (Operating & Cylinder Management); transportation of conversion products to a disposal site (rail to a transload facility then truck shipments); disposal of the conversion products as Low Level Radioactive Waste; and decontamination and decommissioning of the conversion facility. For illustrative purposes, the Department has used transportation and disposal at the Nevada Test Site in the attached analysis. Final determinations of waste disposal are subject to regulatory changes and the Department's alternative site selections.

The following is a cost estimate range with a break-out of the four principal cost components:

	MIN	MAX
Capital Costs	$0.49	$0.52
Conversion (Operating & Cylinder Management)	$2.49	$4.35
Transportation & Disposal	$0.65	$0.65
Decontamination & Decommissioning	$0.20	$0.20
TOTAL	**$3.84**	**$5.72**

The Department's cost estimate assumes that the DUF_6 would be converted and disposed consistent with the terms and conditions of the Department's current contract for the construction and operation of the conversion facilities at the Portsmouth and Paducah Gaseous Diffusion Plants. The Department's cost estimate takes into account the conversion and disposal of GLE's projected inventory as well as the Department's current inventory of DUF_6. If the Department were to convert and dispose of additional inventories of DUF_6, then the Department anticipates that the estimated unit cost (set forth above) would likely decrease.

The Department's cost estimate is a long-term forecast that is subject to considerable uncertainties and change as the Department receives actual cost and performance data from the conversion process.

If you have any further questions, please contact Mr. Frank Marcinowski, Deputy Assistant Secretary for Regulatory Compliance, at (202) 586-0370.

Sincerely,

Inés R. Triay

Inés R. Triay
Principal Deputy Assistant Secretary
for Environmental Management

Enclosure

Analysis of the Department of Energy Cost to Disposition GE-Hitachi Nuclear Energy Depleted Uranium Hexafluoride

BACKGROUND

In 2002, the Department of Energy (DOE) awarded a contract to Uranium Disposition Services, LLC (UDS) to design and construct facilities, and perform initial operations to convert Depleted Uranium Hexafluoride (DUF_6) into a more stable chemical form for beneficial reuse or disposal. UDS is in the process of completing construction of the conversion facilities at Portsmouth, Ohio, and Paducah, Kentucky (Portsmouth and Paducah respectively). One of the Project's primary goals is to safely convert the Department's entire inventory within 25 years. By processing DUF_6 at the contract target production rate of 31,500K kg per year, UDS would eliminate Paducah's inventory in approximately 23.4 years, and Portsmouth's in about 18.2. Once the facilities are complete and the Authorization Authority has granted approval to begin conversion operations, UDS will begin to process DOE's inventory of DUF_6 generated as a result of previous enrichment operations and currently stored on-site.

DOE is aware that several different companies plan to seek authorization from the U.S. Nuclear Regulatory Commission (NRC) to build and operate uranium enrichment facilities in the United States. As a condition of applying for a license to operate the proposed enrichment facilities, the NRC requires the applicant to provide a Decommissioning Funding Plan (DFP) which must include an estimate of the cost of dispositioning DUF_6 generated as a byproduct of enrichment operations.

Per 42 USC 2297h-11, DOE is authorized to accept, upon request by an NRC-licensed generator, the resulting DUF_6 for disposal. In addition, by law, a company must "reimburse the Secretary for the disposal of the depleted uranium... in an amount equal to the Secretary's costs, including a pro rata share of any capital costs." Therefore, DOE must determine the appropriate price to charge for its acceptance of the DUF_6.

As a result of requests from several companies for disposal cost information, DOE has analyzed costs associated with accepting and processing additional material for disposition, and developed a cost per kilogram (kg) to compensate DOE for providing this service.

COST ANALYSIS CONDITIONS AND ASSUMPTIONS

It is assumed that DOE will continue to process existing and any new DUF_6 through its contract with UDS or its successor. It is also assumed that DOE will process the additional DUF_6 at the Portsmouth or Paducah sites. The Portsmouth and Paducah conversion facilities will be decontaminated and decommissioned (D&D) at the end of processing DOE's backlog and company provided DUF_6.

Elements comprising this cost estimate include:

- Capital costs associated with building the conversion facilities;
- Cylinder management and conversion operations;
- Plant Management and Administration;
- Management reserve;
- Fee earned by the contractor performing the conversion and disposal activities;

- DOE contingency;
- DOE direct support (integrated project team);
- Packaging (current cylinders used for storage);
- Transportation;
- Disposal; and,
- Decontamination and decommissioning

<u>SUMMARY FOR GE-HITACHI NUCLEAR ENERGY SYSTEMS (GLE)</u>
It is assumed that DOE will start to accept additional DUF_6 from GLE in 2010 at a rate of 7,100 metric tons annually until 2052. This analysis calculated processing an additional 284,000 metric tons of DUF_6 provided by GLE. See the Appendix for further assumptions regarding this analysis.

This analysis utilizes the UDS provided November 2007 Draft Operations Baseline and contract DE-AC05-02OR22717 for calculating a cost range ($/kg min – $/kg max) for processing DUF_6 material. In January 2008, UDS informed DOE that their construction baseline cost of $429.6M will not be met. UDS did not provide the exact amount of the deviation, but did provide a range of the increase ($56M-$76M). This increase has been incorporated into the capital cost calculation provided below. It is assumed that Operations costs and DOE Directs costs remain constant whether the minimum or maximum numbers of kilograms are produced annually. The resulting cost range is **$3.78/kg - $5.64/kg**. The resulting rates are in FY07 dollars; therefore, this rate should be appropriately escalated to the year in which additional DUF_6 is received.

This estimated price reflects the following costs: design and construction (capital costs); DUF_6 conversion (Operating & Cylinder Management); transportation of conversion products to a disposal site (NTS or Energy*Solutions*); disposal of the conversion products as Low Level Radioactive Waste; and decontamination and decommissioning (D&D) of the conversion facility.

Cost Element Analysis:

Capital Cost
Capital costs are costs associated with the design, construction and pre-operational aspects of preparing the conversion facilities for operation.

Table 1 provides a breakdown of cost elements included in defining the capital investment. These elements reflect both Portsmouth and Paducah costs. Utilizing both facilities costs allows for access to both processing facilities. The capital cost component is presented as a range (minimum - maximum) based on the projected cost increase provided by UDS in January 2008. The capital cost component is amortized over the entire volume of DOE and GLE material (984K metric tons).

Table 1. Capital Costs for DOE's DUF_6 Conversion Project

Cost Category	Minimum Cost ($M)	Maximum Cost ($M)
Design	$41	$41
Construction	$324	$324
Fee	$5	$5
DOE Contingency	$12	$12
DOE Directs (Integrated Project Team)	$28	$28
Pre-Ops OPC	$5	$5
Pre-Ops fee	$1	$1
Pre-Ops DOE Directs	$13.6	$13.6
Estimated Cost Increase (1/2008)	$56	$76
Total	**$485.6**	**$505.6**

Capital cost amortized over the life of conversion operations (DOE & GLE material) - $485.6M ÷ 984K metric tons (700K metric tons DOE inventory + 284K metric tons GLE inventory) = **$.49/kg**.
Capital cost amortized over the life of conversion operations (DOE & GLE material) - $505.6M ÷ 984K metric tons (700K metric tons DOE inventory + 284K metric tons GLE inventory) = **$.51/kg**

Operations Cost
DOE will extend the operating period at the Portsmouth and Paducah plants to process DOE backlog and additional DUF_6 accepted material. DOE estimates the plants will operate for ~43 years starting in 2009 with the existing and additional DUF_6 treated concurrently. It is assumed that D&D occurs in 2052.

Table 2 summarizes estimated annual operations costs. This analysis is based on costs provided by UDS in their November 2007 Operations Baseline update. This draft Ops Baseline captures the first phase (Initial Operations) of the Project. For the purposes of this cost analysis, it will be assumed that both Portsmouth and Paducah will operate for 33 months. It is assumed that the same amount of Production costs, PM&I, Management Reserve and DOE Direct support will be required whether producing the minimum or maximum number of kgs. While the first six months of initial operations are considered ramp-up months (operating at a reduced 50% operating capacity), the minimum and maximum numbers of kilograms used to calculate cost per kg were derived from Table 4. *Number of Kilograms Processed – Incentive Table* in the current contract, Mod A002. Minimum and maximum numbers of kgs were utilized to help provide a cost range.

Table 2. Operations Costs

Cost Category	Cost ($M) (Min Ops Cost/kg)	Cost ($M) (Max Ops Cost/kg)
Portsmouth & Paducah Operations	$168.44	$168.44
PM&I	$18.39	$18.39
Management Reserve	$17.2	$17.2
Fee	$22.64	$11.52
DOE Contingency	$0	$30.36
DOE Directs (Integrated Project Team)	$3.85	$3.85
Total	**$230.52**	**$249.76**
Number of kgs produced in contract period	**57,420,000**	**92,614,870**

Minimum Operations cost per kg - $230.52M ÷ 92.61M kg = **$2.49/kg.**
Maximum Operations cost per kg - $252.52M ÷ 57.420M kg = **$4.35/kg.**

1. Ops and Cylinder Management costs are taken from page 3, Table 1-1 of UDS's November 2007 Ops Baseline submittal. Ports & Pad Ops cost - $240.36M - $18.39M (PM&I) = $221.97M - $53.53M (Transportation and Disposal costs) = $168.44M.
2. PM&I cost is taken from page 3, Table 1-1 of UDS's November 2007 Ops Baseline submittal = $18.39M.
3. Management Reserve costs are taken from page 3, Table 1-1 of UDS's November 2007 Ops Baseline submittal = $17.2M.
4. Max Fee is a percentage of contract's original 60 months operations period maximum fee available - $41.165M ÷ 60 months (original contract ops period) = $686.08K/month x 33 months operations = $22.64M.
5. Minimum Fee is a percentage of contract's original 60 months operations period minimum fee available - $20.944 ÷ 60 months (original contract ops period) = $349.07/month x 33 months operations = $11.52M.
6. DOE Contingency is factored at $0 Contingency expended in the Minimum Ops Cost calculation, and a percentage of contract's original 60 months operations period maximum Contingency available - $55.2M ÷ 60 months (original ops period) = .92M/mo x 33 months operations = $30.36M.

Phase 1 of the contract with UDS defines minimum and maximum annual throughput of 22,000,000kg and 35,300,000kg, respectively. Based on minimum throughput, the minimum amount of material that could be processed by the end of UDS's current contract is 57,420Kkg. (104,400,000kg (min # of kgs processed in Table 4. *Number of Kilograms Processed – Incentive Table*) ÷ 60 months operations = 1,740,000kg/month x 33 months available operations = 57,420,000kg to be processed during the remaining contract period.)
Based on maximum throughput, the maximum amount of material that could be processed by the end of UDS's current contract is 92,615Kkg. (168,390,667kg (max # of kgs processed in Table 4. *Number of Kilograms Processed – Incentive Table*) ÷ 60 months operations = 2,806,511kg/month x 33 months available operations = 92,614,867kg to be processed during the remaining contract period.)

Transportation and Disposal Costs
Transportation and disposal costs are based on the updated November 2007 Operations Baseline submittal, the transportation and disposal costs are defined in Table 3.

Component costs for transportation are comprised of two project control accounts; *Waste Management & Transportation, and Waste Transportation.* Component costs for disposal are comprised of two control accounts; *Waste Sampling, and Waste Disposal.* The November submittal provides cost estimates for transportation and disposal based on target throughput. However, this cost estimate uses maximum throughput in an effort to bound the Department's liability.

Transportation and Disposal costs per kg remain constant even though the total cost increases significantly ($60.25M vice $37.35M) when processing the maximum number of kgs allowed in the contract.

Table 3. Transportation and Disposal Costs

Cost Category	Cost ($M) (Min Ops Cost/kg)	Cost ($M) (Max Ops Cost/kg)
Transportation	$45.57	$28.25
Disposal	$14.68	$9.1
Total	$60.25	$37.35

Minimum Ops Cost/kg for Transportation and Disposal - $60.25M ÷ 92.615Kkg = **$.65/kg**.
Maximum Ops Cost/kg for Transportation and Disposal - $37.35 ÷ 57.42Kkg = **$.65/kg**

1. The UDS Operations Baseline cost estimate defined transportation costs at target production levels (31,500K kg/yr or 82,290K kg during the initial operations period) as $40.48M and disposal costs as $13.04M. However, to provide a range, the minimum and maximum amounts allowed in the contract to be produced by UDS are used (minimum – 31,500K kg/yr or 57,420K kg during the initial operations period; maximum – 35,300K kg/yr or 92.615M kg during the initial operations period). If UDS, or subsequent contractor, generates maximum throughput per year, the project would incur additional transportation and disposal costs. (Transportation - $40.487M ÷ 82.29M kg (target production rate) = $.492/kg x 57.42M kg processed min = $28.25M; Disposal - $13.04 ÷ 82.29M kg processed target = $.1584/kg x 57.42M kg processed min = $9.1M). (Transportation - $40.487M ÷ 82.29M kg (target production rate) = $.49/kg x 92.615M kg processed max = $45.57M; Disposal - $13.04 ÷ 82.29M kg processed target = $.15.84/kg x 92.615M kg processed max = $14.68M).

Decontamination and Decommissioning (D&D)
D&D activities will take place following completion of conversion operations (estimated to be in 2052). D&D of the DUF_6 facilities is estimated to cost $200M.

Cost Category	Cost ($M) (Min Ops Cost/kg)	Cost ($M) (Max Ops Cost/kg)
D&D	$200M	$200M
Total	**$200M**	**$200M**

Minimum D&D Cost/kg for Transportation and Disposal - $200M ÷ 984Mkg = **$.20/kg**.
Maximum D&D Cost/kg for Transportation and Disposal - $200M ÷ 984Mkg = **$.20/kg**

TOTAL COST

For purposes of this cost estimate, it will cost GLE between **$3.78/kg** and **$5.64 per kg** (FY07 dollars) for DOE to process this additional DUF_6. The costs are summarized in Table 4. The Department's cost estimate assumes that the DUF_6 will be converted and disposed of consistent with the terms and conditions of the Department's current contract for construction and operation of the conversion facilities.

Table 4. Cost to DOE of *Processing Additional DUF_6*

FULL OPERATIONS MIN COST/kg; INCLUDING GLE MATERIAL

Principal Components	***Cost ($ in M)***	***Cost/kg - incl. GLE DUF_6***
Capital – *Design*	$41.00	$0.04
Capital - *Construction*	$324.00	$0.33
Design and Construction Fee	$5.00	$0.01
DOE Contingency	$12.00	$0.01
DOE Directs - Design & Construction	$28.00	$0.03
Pre-Ops OPC	$5.00	$0.01
Pre-Ops Fee	$1.00	$0.00
Pre-Ops DOE Directs	$13.60	$0.01
Proposed Cost Increase	$56	$0.06
Capital Subtotal	**$485.60**	**$0.50**
Ops/Cylinder Management (incl. Reserve)	$204.03	$2.20
Fee	$22.64	$0.24
DOE Contingency	$0.00	$0.00
DOE Directs	$3.85	$0.04
Ops/Cylinder Management Subtotal	**$230.52**	**$2.49**
Transportation	$45.57	$0.49
Disposal	$14.68	$0.16
Transportation & Disposal Subtotal	**$60.25**	**$0.65**
D&D	$200.00	$0.20
D&D Subtotal	**$200.00**	**$0.20**
TOTAL	**$920.37**	**$3.84**

FULL OPERATIONS MAX COST/kg; INCLUDING GLE MATERIAL

Principal Components	***Ratio ($ in M)***	***Cost/kg - incl. GLE DUF_6***
Capital - *Design*	$41.00	$0.04
Capital - *Construction*	$324.00	$0.33
Design and Construction Fee	$5.00	$0.01
DOE Contingency	$12.00	$0.01
DOE Directs - Design & Construction	$28.00	$0.03
Pre-Ops OPC	$5.00	$0.01
Pre-Ops Fee	$1.00	$0.00
Pre-Ops DOE Directs	$13.60	$0.01
Proposed Cost Increase	$76	$0.08
Capital Subtotal	**$429.60**	**$0.52**
Ops/Cylinder Management (incl. Reserve)	$204.03	$3.55
Fee	$11.52	$0.20
DOE Contingency	$30.36	$0.53
DOE Directs	$3.85	$0.07
Ops/Cylinder Management Subtotal	**$249.76**	**$4.35**
Transportation	$28.25	$0.49
Disposal	$9.10	$0.16
Transportation & Disposal Subtotal	**$37.35**	**$0.65**
D&D	$200.00	$0.20
D&D Subtotal	**$200.00**	**$0.20**
TOTAL	**$916.71**	**$5.72**

Note: Totals may not equal the sum of individual numbers due to rounding.

Assumptions for Analysis

- DOE accepts 7,100 metric tons of DUF_6 (equivalent to ~ 4,800 metric tons of uranium) annually for 40 years starting in 2012 (284,000 metric tons total).
- DOE processes the additional DUF_6 under its current contract with UDS, or a successor firm, under current terms and conditions.
- Assumes processing efficiencies are attainable to enable UDS, or a successor firm, to complete processing additional GE DUF_6 by 2052.
- The contract with UDS, or a successor firm, will require modification to allow for increased maximum conversion throughput necessary to process GE DUF_6 by 2052.
- The cost estimate does **not** include the cost to transport the DUF_6 to the processing site(s) (Paducah or Portsmouth). This transportation cost will be the responsibility of the enrichment company requesting conversion.
- Capital costs are amortized over both the DOE inventory and the enrichment company's inventory combined (~700,000 metric tons + 284,000 metric tons = 984,000 metric tons total).
- Equipment replacement costs are not included in this estimate (conversion unit replacement costs are estimated at ~$300K/unit).
- There are two conversion units per line of operations.
- Converted depleted uranium oxide is classified as class A waste and qualifies for disposal at either NTS or EnergySolutions without any additional processing.
- Escalation for out-year pricing is not included.
- Transportation method is rail to a transload facility then trucked to NTS for disposal.
- Assumes GE provides UDS, or a successor firm, DOT compliant cylinders for use as packaging converted oxide for transportation to disposal facility.
- Disposal at NTS. Alternate transportation and disposal at EnergySolutions would result in higher disposal cost, but lower transportation cost. For estimation purposes, the cost difference would have minimal impact on the cost per kg estimate. No decision has been made as to disposal at either NTS or Energy Solutions.
- Costs are shown in FY07 dollars unless otherwise specified.
- Cost includes contractor management reserve and min/max fee range.
- The existing DOE inventory of DUF_6 and the additional GE DUF_6 are processed concurrently.
- Decontamination and decommissioning cost of the conversion facilities is $200M.
- D&D occurs following completion of processing additional DUF_6 (2038).
- Paducah operates four conversion lines and Portsmouth operates three conversion lines.
- Minimum amount of DUF_6 to be processed per Table 4. *Number of Kilograms Processed – Incentive Table* in the current contract with UDS is 8,640,625 + 20,571,875 + 22,000,000 + 22,000,000 + 22,000,000 + 9,187,500 = **104,400,000kg.**
- Maximum amount of DUF_6 to be processed per Table 4. *Number of Kilograms Processed – Incentive Table* in the current contract with UDS is 14,826,317 + 32,956,017 + 35,300,000 + 35,300,000 + 35,300,000 + 14,708,333 = **168,390,667kg.**
- Assumes labor rate/needs are constant from processing DOE to GE inventory.
- Assumes use of all Management Reserve.
- Assumes UDS operates until August 2011.

APPENDIX E – REVISED DOE UF_6 TAILS DISPOSAL COST ESTIMATE

Department of Energy
Washington, DC 20585

APR 23 2009

Mr. Al Kennedy
Facility Licensing Manager
GE Hitachi Nuclear Energy
3901 Castle Hayne Road
Wilmington, NC 28402

Dear Mr. Kennedy:

This is in response to your March 18, 2009, letter requesting whether the Department of Energy (DOE) would accept for conversion and disposal the depleted uranium hexafluoride (DUF_6) product to be generated by GE-Hitachi Global Laser Enrichment (GLE) proposed laser-based enrichment facility, and if so, the anticipated costs of providing such services.

DOE would accept, upon request, such DUF_6 for conversion and disposal (or reuse) pursuant to authorities granted to DOE under the Atomic Energy Act. DOE's acceptance of such material would be contingent upon the negotiation of an agreement for conversion and disposal services that would include full cost recovery of the DOE's expenses.

As requested, DOE prepared a cost estimate for providing DUF_6 conversion and disposal services to GLE. The cost estimate is based on GLE's projection that it would generate approximately 10,500 metric tons of DUF_6 annually for forty years.

DOE estimates that the cost of converting and disposing of GLE's projected DUF_6 inventory would range from $3.76 to $5.64 per kilogram of DUF_6. This estimated price reflects the following costs: design and construction (capital costs); DUF_6 conversion (Operating & Cylinder Management); transportation of conversion products to a disposal site (rail to a transload facility then truck shipments); disposal of the conversion products as Low Level Radioactive Waste (at Nevada Test Site per the Baseline); and decontamination and decommissioning of the conversion facility. Additionally, this cost estimate includes estimated minimum/maximum capital cost increases provided by the design and construction contractor (Uranium Disposition Services) in January 2008.

The following is a break-out minimum and maximum cost estimate of the four principal cost components:

	MIN	MAX
Capital Costs	$0.44	$0.46
Conversion (Operating & Cylinder Management)	$2.49	$4.35
Transportation & Disposal	$0.65	$0.65
Decontamination & Decommissioning	$0.18	$0.18
TOTAL	**$3.76**	**$5.64**

DOE's cost estimate assumes that the DUF_6 would be converted and disposed of consistent with the terms and conditions of DOE's current contract for the construction and operation of the conversion facilities at the Portsmouth and Paducah Gaseous Diffusion Plants. DOE's cost estimate takes into account the conversion and disposal of GLE's projected inventory as well as DOE's current inventory of DUF_6. If DOE were to convert and dispose of additional inventories of DUF_6, DOE anticipates that the estimated unit cost (set forth above) would likely decrease.

DOE's cost estimate is a long-term forecast that is subject to considerable uncertainties. The cost estimate is subject as assumptions and circumstances change and as DOE receives actual cost and performance data from the conversion process.

If you have any further questions, please contact me at (202) 586-0370 or Ross Bradley, Office of Regulatory Compliance, at (301) 903-7646.

Sincerely,

Frank Marcinowski
Deputy Assistant Secretary for
Regulatory Compliance

Enclosure

Analysis of the Department of Energy's Cost to Disposition GE Hitachi Nuclear Energy Depleted Uranium Hexafluoride

BACKGROUND

In 2002, the Department of Energy (DOE) awarded a contract to Uranium Disposition Services, LLC (UDS) to design and construct facilities, and perform initial operations to convert Depleted Uranium Hexafluoride (DUF_6) into a more stable chemical form for beneficial reuse or disposal. UDS is in the process of completing construction of the conversion facilities at Portsmouth, Ohio, and Paducah, Kentucky (Portsmouth and Paducah respectively). One of the Project's primary goals is to safely convert the DOE's entire inventory within 25 years. By processing DUF_6 at the contract target production rate of 31,500K kilogram (kg) per year, UDS would eliminate Paducah's inventory in approximately 23.4 years, and Portsmouth's in about 18.2 years. Once the facilities are complete and the Authorization Authority has granted approval to begin conversion operations, UDS will begin to process DOE's inventory of DUF_6 generated as a result of previous enrichment operations and currently stored on-site.

The DOE is aware that several different companies plan to seek authorization from the U.S. Nuclear Regulatory Commission (NRC) to build and operate uranium enrichment facilities in the United States. As a condition of applying for a license to operate the proposed enrichment facilities, the NRC requires the applicant to provide a Decommissioning Funding Plan (DFP) which must include an estimate of the cost of dispositioning DUF_6 generated as a byproduct of enrichment operations.

Per Section 3113 of 42 USC 2297H, DOE is authorized to accept, upon request by an NRC-licensed generator, the resulting DUF_6 for disposal. In addition, by law, a company must "reimburse the Secretary for the disposal of the depleted uranium... in an amount equal to the Secretary's costs, including a pro rata share of any capital costs." Therefore, DOE must determine the appropriate price to charge for its acceptance of the DUF_6.

As a result of requests from several companies for disposal cost information, DOE has analyzed costs associated with accepting and processing additional material for disposition, and developed a cost per kg to compensate DOE for providing this service.

COST ANALYSIS CONDITIONS AND ASSUMPTIONS

It is assumed that DOE will continue to process existing and any new DUF_6 through its contract with UDS or its successor. It is also assumed that DOE will process the additional DUF_6 at the Portsmouth or Paducah sites. The Portsmouth and Paducah conversion facilities will be decontaminated and decommissioned (D&D) at the end of processing DOE's backlog and company provided DUF_6.

Elements comprising this cost estimate include:

- Capital costs associated with building the conversion facilities;
- Cylinder management and conversion operations;
- Plant Management and Administration;
- Management reserve;
- Fee earned by the contractor performing the conversion and disposal activities;
- DOE contingency;
- DOE direct support (integrated project team);
- Packaging (current cylinders used for storage);
- Transportation;
- Disposal; and
- D&D.

SUMMARY FOR GE HITACHI NUCLEAR ENERGY SYSTEMS (GE)

It is assumed that DOE will start to accept additional DUF_6 from GE in 2010 at a rate of 10,500 metric tons annually until 2050. This analysis calculated processing an additional 391,500 metric tons of DUF_6 provided by GE. See the Appendix for further assumptions regarding this analysis.

This analysis utilizes the UDS provided November 2007 Draft Operations Baseline and contract DE-AC05-02OR22717 for calculating a cost range ($/kg min – $/kg max) for processing DUF_6 material. In January 2008, UDS informed DOE that their construction baseline cost of $429.6M will not be met. UDS did not provide the exact amount of the deviation, but did provide a range of the increase ($56M-$76M). This increase has been incorporated into the capital cost calculation provided below. It is assumed that Operations costs and DOE Directs costs remain constant whether the minimum or maximum numbers of kilograms are produced annually. The resulting cost range is **$3.76/kg - $5.64/kg**. The resulting rates are in FY 2007 dollars; therefore, this rate should be appropriately escalated to the year in which additional DUF_6 is received.

This estimated price reflects the following costs: design and construction (capital costs); DUF_6 conversion (Operating & Cylinder Management); transportation of conversion products to a disposal site (NTS or Energy*Solutions*); disposal of the conversion products as Low Level Radioactive Waste; and D&D of the conversion facility.

Cost Element Analysis:

Capital Cost

Capital costs are costs associated with the design, construction and pre-operational aspects of preparing the conversion facilities for operation.

Table 1 provides a breakdown of cost elements included in defining the capital investment. These elements reflect both Portsmouth and Paducah costs. Utilizing both facilities costs allows for access to both processing facilities. The capital cost component is presented as a range (minimum - maximum) based on the projected cost increase provided by UDS in January 2008. The capital cost component is amortized over the entire volume of DOE and GE material (1,091.5K metric tons).

Table 1. Capital Costs for DOE's DUF_6 Conversion Project

Cost Category	Minimum Cost ($M)	Maximum Cost ($M)
Design	$41	$41
Construction	$324	$324
Fee	$5	$5
DOE Contingency	$12	$12
DOE Directs (Integrated Project Team)	$28	$28
Pre-Ops OPC	$5	$5
Pre-Ops fee	$1	$1
Pre-Ops DOE Directs	$13.6	$13.6
Estimated Cost Increase (1/2008)	$56	$76
Total	**$485.6**	**$505.6**

Capital cost amortized over the life of conversion operations (DOE & GE material) - $485.6M ÷ 1,091.5K metric tons (700K metric tons DOE inventory + 391.5K metric tons GE inventory) = **$.44/kg.**
Capital cost amortized over the life of conversion operations (DOE & GE material) - $505.6M ÷ 1,091.5K metric tons (700K metric tons DOE inventory + 391.5K metric tons GE inventory) = **$.46/kg**

Operations Cost

DOE will extend the operating period at the Portsmouth and Paducah plants to process DOE backlog and additional DUF_6 accepted material. DOE estimates the plants will operate for ~41 years starting in 2009 with the existing and additional DUF_6 treated concurrently. It is assumed that D&D occurs in 2050.

Table 2 summarizes estimated annual operations costs. This analysis is based on costs provided by UDS in their November 2007 Operations Baseline update. This draft Ops Baseline captures the first phase (Initial Operations) of the Project. For the purposes of this cost analysis, it will be assumed that both Portsmouth and Paducah will operate for 33 months. It is assumed that the same amount of Production costs, Project Management and Integration (PM&I), Management Reserve and DOE Direct support will be required whether producing the minimum or maximum number of kgs. While the first six months of initial operations are considered ramp-up months (operating at a reduced 50 percent operating capacity), the minimum and maximum numbers of kg used to calculate cost per kg were derived from *Table 4 Number of Kilograms Processed – Incentive Table* in the current contract, Mod A002. Minimum and maximum numbers of kgs were utilized to help provide a cost range.

Table 2. Operations Costs

Cost Category	Cost ($M) (Min Ops Cost/kg)	Cost ($M) (Max Ops Cost/kg)
Portsmouth & Paducah Operations	$168.44	$168.44
PM&I	$18.39	$18.39
Management Reserve	$17.2	$17.2
Fee	$22.64	$11.52
DOE Contingency	$0	$30.36
DOE Directs (Integrated Project Team)	$3.85	$3.85
Total	**$230.52**	**$249.76**
Number of kgs produced in contract period	**92,614,870**	**57,420,000**

Minimum Operations cost per kg - $230.52M ÷ 92.61M kg = **$2.49/kg.**
Maximum Operations cost per kg - $252.52M ÷ 57.420M kg = **$4.35/kg.**

1. Ops and Cylinder Management costs are taken from page 3, Table 1-1 of UDS's November 2007 Ops Baseline submittal. Ports & Pad Ops cost - $240.36M - $18.39M (PM&I) = $221.97M - $53.53M (Transportation and Disposal costs) = $168.44M.
2. PM&I cost is taken from page 3, Table 1-1 of UDS's November 2007 Ops Baseline submittal = $18.39M.
3. Management Reserve costs are taken from page 3, Table 1-1 of UDS's November 2007 Ops Baseline submittal = $17.2M.
4. Max Fee is a percentage of contract's original 60 months operations period maximum fee available - $41.165M ÷ 60 months (original contract ops period) = $686.08K/month x 33 months operations = $22.64M.
5. Minimum Fee is a percentage of contract's original 60 months operations period minimum fee available - $20.944 ÷ 60 months (original contract ops period) = $349.07/month x 33 months operations = $11.52M.
6. DOE Contingency is factored at $0 Contingency expended in the Minimum Ops Cost calculation, and a percentage of contract's original 60 months operations period maximum Contingency available - $55.2M ÷ 60 months (original ops period) = .92M/mo x 33 months operations = $30.36M.

Phase 1 of the contract with UDS defines minimum and maximum annual throughput of 22,000,000kg and 35,300,000kg, respectively. Based on minimum throughput, the minimum amount of material that could be processed by the end of UDS's current contract is 57,420Kkg. (104,400,000kg (min # of kgs processed in *Table 4. Number of Kilograms Processed – Incentive Table*) ÷ 60 months operations = 1,740,000kg/month x 33 months available operations = 57,420,000kg to be processed during the remaining contract period.)

Based on maximum throughput, the maximum amount of material that could be processed by the end of UDS's current contract is 92,615kg (168,390,667kg (max # of kgs processed in *Table 4. Number of Kilograms Processed – Incentive Table*) ÷ 60 months operations = 2,806,511kg/month x 33 months available operations = 92,614,867kg to be processed during the remaining contract period.)

Transportation and Disposal Costs

Transportation and disposal costs have changed considerably since DOE's initial cost per kg analysis was performed. The preferred alternative in the baseline has changed from rail shipment to EnergySolutions (formerly Envirocare of Utah) to rail shipments to a transload facility and truck shipments to the Nevada Test Site (NTS) for disposal. Several factors caused this change. The two biggest factors are DOE direct funding NTS operations and utilizing a transload facility to help reduce the original straight truck shipment transportation option. Based on the updated November 2007 Operations Baseline submittal, the transportation and disposal costs are defined in Table 3.

Component costs for transportation are comprised of two project control accounts; *Waste Management & Transportation, and Waste Transportation.* Component costs for disposal are comprised of two control accounts; *Waste Sampling, and Waste Disposal.* The November submittal provides cost estimates for transportation and disposal based on target throughput. However, this cost estimate uses maximum throughput in an effort to bound DOE's liability.

Transportation and Disposal costs per kg remain constant even though the total cost increases significantly ($60.25M vice $37.35M) when processing the maximum number of kgs allowed in the contract.

Table 3. Transportation and Disposal Costs

Cost Category	Cost ($M) (Min Ops Cost/kg)	Cost ($M) (Max Ops Cost/kg)
Transportation	$45.57	$28.25
Disposal	$14.68	$9.1
Total	$60.25	$37.35

Minimum Ops Cost/kg for Transportation and Disposal - $60.25M ÷ 92.615Kkg = **$.65/kg.**
Maximum Ops Cost/kg for Transportation and Disposal - $37.35 ÷ 57.42Kkg = **$.65/kg**

1. The UDS Operations Baseline cost estimate defined transportation costs at target production levels (31,500K kg/yr or 82,290K kg during the initial operations period) as $40.48M and disposal costs as $13.04M. However, to provide a range, the minimum and maximum amounts allowed in the contract to be produced by UDS are used (minimum – 31,500K kg/yr or 57,420K kg during the initial operations period; maximum – 35,300K kg/yr or 92.615M kg during the initial operations period). If UDS, or subsequent contractor, generates maximum throughput per year, the project would incur additional transportation and disposal costs. (Transportation - $40.487M ÷ 82.29M kg (target production rate) = $.492/kg x 57.42M kg processed min = $28.25M; Disposal - $13.04 ÷ 82.29M kg processed target = $.1584/kg x 57.42M kg processed min = $9.1M). (Transportation - $40.487M ÷ 82.29M kg (target production rate) = $.49/kg x 92.615M kg processed max = $45.57M; Disposal - $13.04 ÷ 82.29M kg processed target = $.15.84/kg x 92.615M kg processed max = $14.68M).

Decontamination and Decommissioning (D&D)

D&D activities will take place following completion of conversion operations (estimated to be in 2050). D&D of the DUF_6 facilities is estimated to cost $200M.

Cost Category	**Cost ($M) (Min Ops Cost/kg)**	**Cost ($M) (Max Ops Cost/kg)**
D&D	$200M	$200M
Total	**$200M**	**$200M**

Minimum D&D Cost/kg for Transportation and Disposal - $200M ÷ 1091.5Mkg = **$.18/kg.**
Maximum D&D Cost/kg for Transportation and Disposal - $200M ÷ 1091.5Mkg = **$.18/kg**

TOTAL COST

For purposes of this cost estimate, it will cost GE between **$3.84/kg** and **$5.72/kg** (FY07 dollars) for DOE to process this additional DUF_6. The costs are summarized in Table 4. The Department's cost estimate assumes that the DUF_6 will be converted and disposed of consistent with the terms and conditions of the Department's current contract for construction and operation of the conversion facilities.

Table 4. Cost to DOE of *Processing Additional* DUF_6

FULL OPERATIONS MIN COST/kg; INCLUDING GE MATERIAL

Principal Components	***Cost ($ in M)***	***Cost/kg - incl. GE*** DUF_6
Capital - *Design*	$41.00	$0.04
Capital - *Construction*	$324.00	$0.30
Design and Construction Fee	$5.00	$0.01
DOE Contingency	$12.00	$0.01
DOE Directs - Design & Construction	$28.00	$0.03
Pre-Ops OPC	$5.00	$0.01
Pre-Ops Fee	$1.00	$0.00
Pre-Ops DOE Directs	$13.60	$0.01
Proposed Cost Increase	$56	$0.05
Capital Subtotal	**$485.60**	**$0.44**
Ops/Cylinder Management (incl. Reserve)	$204.03	$2.20
Fee	$22.64	$0.24
DOE Contingency	$0.00	$0.00
DOE Directs	$3.85	$0.04
Ops/Cylinder Management Subtotal	**$230.52**	**$2.49**
Transportation	$45.57	$0.49
Disposal	$14.68	$0.16
Transportation & Disposal Subtotal	**$60.25**	**$0.65**
D&D	$200.00	$0.18
D&D Subtotal	**$200.00**	**$0.18**
TOTAL	**$920.37**	**$3.76**

FULL OPERATIONS MAX COST/kg; INCLUDING GE MATERIAL

Principal Components	***Ratio ($ in M)***	***Cost/kg - Incl. GE DUF_6***
Capital - *Design*	$41.00	$0.04
Capital - *Construction*	$324.00	$0.30
Design and Construction Fee	$5.00	$0.01
DOE Contingency	$12.00	$0.01
DOE Directs - Design & Construction	$28.00	$0.03
Pre-Ops OPC	$5.00	$0.01
Pre-Ops Fee	$1.00	$0.00
Pre-Ops DOE Directs	$13.60	$0.01
Proposed Cost Increase	$76	$0.07
Capital Subtotal	**$429.60**	**$0.46**
Ops/Cylinder Management (incl. Reserve)	$204.03	$3.55
Fee	$11.52	$0.20
DOE Contingency	$30.36	$0.53
DOE Directs	$3.85	$0.07
Ops/Cylinder Management Subtotal	**$249.76**	**$4.35**
Transportation	$28.25	$0.49
Disposal	$9.10	$0.16
Transportation & Disposal Subtotal	**$37.35**	**$0.65**
D&D	$200.00	$0.18
D&D Subtotal	**$200.00**	**$0.18**
TOTAL	**$916.71**	**$5.64**

Note: Totals may not equal the sum of individual numbers due to rounding.

Assumptions for Analysis

- DOE accepts 10,500 metric tons of DUF_6 annually for 40 years starting in 2010 (391,500 metric tons total).
- DOE processes the additional DUF_6 under its current contract with UDS, or a successor firm, under current terms and conditions.
- Assumes processing efficiencies are attainable to enable UDS, or a successor firm, to complete processing additional GE DUF_6 by 2050.
- The contract with UDS, or a successor firm, will require modification to allow for increased maximum conversion throughput necessary to process GE DUF_6 by 2050.
- The cost estimate does **not** include the cost to transport the DUF_6 to the processing site(s) (Paducah or Portsmouth). This transportation cost will be the responsibility of the enrichment company requesting conversion.
- Capital costs are amortized over both the DOE inventory and the enrichment company's inventory combined (~700,000 metric tons + 391,500 metric tons = 1,091,500 metric tons total).
- Equipment replacement costs are not included in this estimate (conversion unit replacement costs are estimated at ~$300K/unit).
- There are two conversion units per line of operations.
- Converted depleted uranium oxide is classified as class A waste and qualifies for disposal at either NTS or EnergySolutions without any additional processing.
- Escalation for out-year pricing is not included.
- Transportation method is rail to a transload facility then trucked to NTS for disposal.
- Assumes GE provides UDS, or a successor firm, DOT compliant cylinders for use as packaging converted oxide for transportation to disposal facility.
- Disposal at NTS. Alternate transportation and disposal at EnergySolutions would result in higher disposal cost, but lower transportation cost. For estimation purposes, the cost difference would have minimal impact on the cost per kg estimate.
- Costs are shown in FY07 dollars unless otherwise specified.
- Cost includes contractor management reserve and min/max fee range.
- The existing DOE inventory of DUF_6 and the additional GE DUF_6 are processed concurrently.
- Decontamination and decommissioning cost of the conversion facilities is $200M.
- D&D occurs following completion of processing additional DUF_6 (2050).
- Paducah operates four conversion lines and Portsmouth operates three conversion lines.
- Minimum amount of DUF_6 to be processed per Table 4. *Number of Kilograms Processed – Incentive Table* in the current contract with UDS is 8,640,625 + 20,571,875 + 22,000,000 + 22,000,000 + 22,000,000 + 9,187,500 = **104,400,000kg.**
- Maximum amount of DUF_6 to be processed per Table 4. *Number of Kilograms Processed – Incentive Table* in the current contract with UDS is 14,826,317 + 32,956,017 + 35,300,000 + 35,300,000 + 35,300,000 + 14,708,333 = **168,390,667kg.**
- Assumes labor rate/needs are constant from processing DOE to GE inventory.
- Assumes use of all Management Reserve.
- Assumes UDS operates until August 2011.

APPENDIX F

[This Appendix contains Proprietary and Security-Related Information and is withheld from public disclosure per 10 CFR 2.390.]