

FCSS Interim Staff Guidance-09, Revision 0

Initiating Event Frequency

Prepared by
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards

Issue

This guidance addresses the measures needed to assure the validity and maintenance of initiating event frequencies (IEFs) used to demonstrate compliance with the performance requirements for Title 10 of the Code of Federal Regulations (10 CFR) 70.61.

Introduction

The purpose of this Interim Staff Guidance (ISG) is to clarify the use of IEFs for demonstrating compliance with the performance requirements of 10 CFR 70.61. NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," and NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," provide methods for reviewing integrated safety analyses (ISAs), employing a semi-quantitative risk index method. While one of these methods is used below to illustrate the use of IEFs, applicants and licensees may use other methods which would produce similar results. There is no particular method explicitly mandated, and sequences that are risk significant or marginally acceptable are candidates for more detailed evaluation by the applicant or licensee and reviewer.

Discussion

Each licensee or applicant is required to perform an ISA to identify all credible high-consequence and intermediate-consequence events. The risk of each such credible event is to be limited through the use of appropriate engineered and/or administrative controls to meet the performance requirements of 10 CFR 70.61. Such a control is referred to as an item relied on for safety (IROFS). In turn, a safety program must be established and maintained to assure that each IROFS is available and reliable to perform its intended function when needed. The safety program may be graded such that management measures applied are graded commensurate with the reduction of risk attributable to that item. In addition, a configuration management system must be established pursuant to § 70.72 to evaluate changes and to assure, in part, that the IROFS are not removed without at least equivalent replacement of the safety function.

The risk of each credible event is determined by cross-referencing the severity of the consequence of the unmitigated accident sequence with the likelihood of occurrence in a risk matrix with risk index values. The likelihood of occurrence risk index values can be determined by considering the criteria in NUREG-1520, Tables A-9 through A-11. Accident sequences result from initiating events which are followed by the failure of one or more IROFS. Initiating events can be (1) an external event such as a hurricane or earthquake, (2) a facility event external to the process being analyzed (e.g., fires, explosions, failures of other equipment, flooding from facility water sources), (3) deviations from normal operations of the process (credible abnormal events), or (4) failures of an IROFS in the process. (Note: Additional guidance regarding initiating probabilities from natural phenomena hazards are addressed in

draft ISG-08, "Natural Phenomena Hazards."

An initiating event does not have to be an IROFS failure. An item only becomes an IROFS if it is credited in the ISA for mitigation or prevention per the definition in § 70.4. If an item, whose failure initiates an event, has strictly an operational function, it does not have to be an IROFS. This applies to external events and can apply to internal events. If the item whose failure initiates an event, has solely a safety function that is credited in the ISA, then it should be an IROFS. If the item has both an operational and a safety function, the safety function should make it an IROFS (for its ISA credited safety features only).

IEFs can play a significant role in determining whether the performance requirements of § 70.61 are met for a particular accident sequence. Whether an initiating event is due to an IROFS or a non-IROFS failure, licensees should take appropriate action to assure that any change to the basis for assigning an IEF value to that event is evaluated on a continuing basis to ensure continued compliance with the performance requirements. For example, a non-IROFS continued compliance with the performance requirements. For example, a non-IROFS component may not be subject to the same quality assurance (QA) program controls and other management measures that an IROFS would receive (i.e., surveillance, testing, procurement, etc.). However, appropriate management controls should be considered, in a graded manner, to provide assurance that performance requirements are met over time. The ability to identify a non-IROFS component failure, similar to that for IROFS, may be needed to provide feedback on failure rates and IEFs to the ISA process. Changes to the IEF values may result from changes to a component's design, procurement, operation, or maintenance history, as well as new or increased external plant hazards, and should be considered in a graded approach.

Regulatory Basis

- 10 CFR 70.61, Performance Requirements
- 10 CFR 70.62, Safety Program and Integrated Safety Analysis
- 10 CFR 70.65, Additional Content of Applications
- 10 CFR 70.72, Facility Changes and Change Process

Applicability

This guidance is for use in those cases where an applicant or licensee chooses to use an IROFS or non IROFS failure IEF for risk determination.

Technical Review Guidance

1. IEF and Identification of an IROFS

Example

A licensee uses a heater/blower unit to heat a UF₆ cylinder in a hot box to liquify the contents prior to sample. The unmitigated accident sequence involves the failure of the controller for the heater/blower resulting in overheating the cylinder. This results in the cylinder becoming overpressurized and rupturing, releasing the UF₆ to the surrounding process area. Such a release is analyzed to exceed the performance requirements of § 70.61. The licensee has two basic choices: (1) assume the initiating event probability

equals 1 and provide an appropriate level of mitigation or prevention solely through one or more IROFS, or (2) assign a value to the initiating event (blower/heater controller failure) and provide one or more preventive or mitigative IROFS to bring the accident sequence risk within the performance requirements.

If the licensee chooses (2) above and assigns an appropriate value to the IEF, the indices of NUREG-1520, Table A-9, Failure Frequency Index Number, may be used. The controller for the heater/blower unit would be assigned an appropriate Frequency Index Number. The licensee would then analyze the accident sequence and determine whether additional IROFS are necessary to meet the performance requirements. There are now two variables that feed into the risk determination: one or more IROFS controller for the heater/blower unit in a manner that changes the licensee's previous determination of compliance with the performance requirements must be evaluated per § 70.72(a).

2. IEF Index Use

Indices may be used to determine the overall likelihood of an accident sequence. NUREG-1520, Table A-9, Failure Frequency Index Numbers, identifies frequency index numbers based on specified evidence. The evidence used by applicants and licensees should be supportable and documented in the ISA summary as required by § 70.65(b)(4). The evidence cited in the ISA documentation should not be limited to anecdotal accounts and must demonstrate compliance with the descriptive definitions of unlikely, highly unlikely, and credible as required by § 70.65(b)(9). The rigor and specificity of the documented evidence should be commensurate with the item's importance to safety, and the data should support the frequency chosen (e.g., data from 30 years of plant operating experience based on a single component typically could not be expected to support a 10 E-2 failure probability).

An item's failure rate should be determined from actual data for that specific component or safety function in the current system design under the current environmental conditions. When specific failure data is limited or not available, the applicant or licensee may use more "generic" data with appropriate substantiation. However, when less specific failure data is available, appropriate conservatism should be exercised in assigning frequency indices. The footnote to Table A-9 that states "indices less than (more negative than) minus 1 should not be assigned to IROFS unless the configuration management, auditing, and other management measures are of high quality, because without those measures, the IROFS may be changed or not maintained," should also be applied to non-IROFS IEFs. In this case, appropriate management controls should be provided to assure that any changes to the evidence supporting IEF indices will be identified and promptly evaluated to ensure that the performance requirements of § 70.61 are met. A graded approach may be used in applying management controls based on the IEF values; however, how this will be done should be identified in the ISA summary.

Possible changes to IEFs, failure rates, and the assumptions they are based on should be periodically evaluated by the licensee to assure that any change to an IEF has been accounted for in the ISA process. Over time an IEF may change because of component aging or deterioration. Maintenance and performance experience should be fed back

into the IEF evaluation. IEF changes could involve, for example, the introduction of new effects or hazards from nearby processes or new materials, changes in design, maintenance or operation activities, etc. The applicant or licensee should establish management measures, which may be graded, to periodically confirm that there have been no changes to the ISA assumptions. For example, an applicant or licensee may choose to verify that there have been no changes to hazards from maintenance activities during a certain period of time based on an appropriate documented technical review or audit under the QA program.

Whatever strategy the applicant or licensee chooses to employ should have an outcome of timely identification and periodic evaluation of failure rates followed by a prompt evaluation of the failure rate change on the ISA assumptions. This can be accomplished in accordance with the corrective maintenance program and/or the QA problem identification and corrective action system.

Indices particularly relied upon (i.e., less than minus 1) for overall likelihood will be reviewed during the ISA review process.

3. External IEFs

Possible changes to non-natural phenomena external events should be periodically evaluated by the licensee to assure that any change to an IEF has been accounted for in the ISA process. Such changes could involve, for example, the introduction of new hazards from an adjoining industrial site, changes in adjoining transportation activities, etc. The applicant or licensee should establish management measures which may be graded to periodically confirm that there have been no changes to the ISA assumptions. For example, an applicant or licensee may choose to verify that there have been no changes to outside hazards based on a 2 to 3-year review under the QA program.

4. Assurance

The safety program required by § 70.62(a) should have provisions for implementing the appropriate management controls to maintain the validity of the IEFs. Consideration should also be given to commitments in the QA program or a specific license condition.

References

U.S. Code of Federal Regulations, *Title 10, Energy*, Part 70, "Domestic Licensing of Special Nuclear Material."

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

NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility." NRC: Washington, D.C. August 2000.

Approved: _____/RA/_____ Date: June 9, 2005___
Robert C. Pierson, Director
Division of Fuel Cycle Safety
and Safeguards, NMSS