INTEGRATED SAFETY ANALYSIS

3.1 PURPOSE OF REVIEW

The purpose of this review is to establish that there is reasonable assurance that the applicant has performed an Integrated Safety Assessment (ISA) and submitted an ISA summary as required by 10 CFR 70.65(b) (as revised)[1]. The review should also establish that the facility is designed to meet the performance requirements contained in § 70.61.

3.2 RESPONSIBILITY FOR REVIEW

Primary: Integrated Safety Assessment (ISA) Specialist

Secondary: Licensing Project Manager

Supporting: Technical Area Specific Reviewers (Chemical Safety, Fire Safety, Radiological Protection, etc.)
Site Resident Inspector, if appropriate

3.3 AREAS OF REVIEW

Section 70.62, requires each licensee to perform an ISA to identify the following:

(i) Radiological hazards resulting from possessing or processing licensed material at its facility;

(ii) Chemical hazards of licensed material or hazardous chemicals produced from licensed material resulting from possessing or processing licensed material at its facility;

(iii) Facility hazards (e.g., chemical, fire, electrical and mechanical) which could affect the safety of licensed materials and thus present an increased radiological risk;

(iv) Potential accident sequences caused by process deviations or other events internal to the plant and credible external events, including natural phenomena;

(v) The consequence and the likelihood of occurrence of each potential accident sequence; identified in (iv) above, and the methods used to determine the consequences and likelihoods; and

(vi) Each item relied on for safety and the characteristics of its preventive, mitigative, or other safety function and the assumptions and conditions under which the item is relied upon to support compliance with the performance requirements of § 70.61..

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[1] Nuclear Regulatory Commission (U.S.), Washington, D.C. “Domestic Licening of Special Nuclear Material (10 CFR Part 70)”. *Federal Register:* Vol. 64, No. 146. pp.41338--41357. July 30, 1999.

To assure that this has been done properly and to facilitate the review process, an ISA summary is submitted in accordance with § 70.64(b). The ISA summary should provide the following information for review:

1. Supporting Design Basis Information

   This section should provide enough information to support an evaluation of the completeness and acceptability of the (1) hazard identification task, (2) potential accident sequences task, (3) consequences and likelihood of occurrence of the accidents identified, and (4) items relied on for safety (items (i) through (vi) referenced above).

   a. Process description: This section should include all of the processes necessary to support the ISA summary and should include the intended purpose of the process and its relationship to the rest of the facility and products of the facility.

   b. Site description: This section should address and emphasize those factors that could affect safety, such as geography, meteorology (e.g., high winds, flood potential), seismology, and demography.

   c. Facility description: This section should address and emphasize those features that could affect potential accidents and their consequences. Examples of such features are facility location, facility design information, and the location and arrangement of buildings on the facility site.

   d. Process Theory: This section should consist of a description of the theory of operation of each process analyzed as part of the ISA. Areas include basic process function and theory, major components–their function and operation, and process operating ranges and limits, including expected limits and upset conditions. Schematics and flow diagrams of the process or parts of the process may also need to be included.

   e. Process Design and Equipment: This section should consist of the applicant's references to process safety information (PSI) sufficient to support the process description and process theory sections of the ISA. This should include information on the hazardous materials, technology, and equipment used in each process. The compilation and maintenance of current and accurate PSI should be explained in the applicant’s description of its configuration management program.

   f. Drawings and Operating Procedures: This section should contain the applicant’s commitment to maintain an accurate reference list of detailed engineering drawings, procedures, schedules, checklists, etc. Information referenced in this section should be supporting information that will also form the basis for facility configuration management. There is expected to be overlap between this section and the preceding section, with much of the information referenced in the Process Design and Equipment section described above.

2. Process Hazards Analysis (PHA) Summary: This section should contain a brief discussion of the PHA method used for each individual process and the justification for its selection. For purposes of this review, the PHA summary begins with an identification of hazards that are identified in (i) through (iii) described above. Based on a systematic analysis of each plant process and the hazards identified, the ISA identifies a set of individual accident sequences that could result in consequences. The systematic analysis of the individual processes should include any interfaces with other processes and how specific accident sequences can impact those other processes. Information could be drawn from safety specific analyses (e.g., a fire hazard analysis) that look across specific processes. The accidents thus cause the threat of the hazards to become consequences of concern. The section is expected to contain a summary of the following:

    a. A description of the PHA methodology.

    b. Hazard identification.

    c. Accident sequences identification.

3. Safety Analysis Summary: This section should focus on hazard management. Given the PHA, the safety analysis allows for an integrated safety assessment including safety specific disciplines and across disciplines. The results should be compared to the performance requirements of § 70.61 and used to identify the controls relied on for safe operation of the facility. Specifically, this section should contain some form of the following:

    a. A summary of the unmitigated and mitigated consequences of each postulated accident to facility workers or the public.

    b. Comparisons of the consequences of each postulated accident to the performance requirements of § 70.61.

    c. Assignment of accident sequences to likelihood categories and comparison to performance requirements of § 70.61.

    d. Identification of items relied on for safety including engineered and administrative controls involved in each accident sequence.

4. ISA Management Summary: This section should contain information on the ISA team and the ISA process at the facility. Specifically this section should contain the following:

    a. A description of the ISA team.

    b. A summary of the procedures for conducting and maintaining the ISA and a reference to the actual detailed procedures.

    c. A protocol for informing the NRC of ISA summary updates.

3.4 ACCEPTANCE CRITERIA

3.4.1 Regulatory Requirements

Sections 70.65(b) and 70.61 specifically relate to the requirement to perform an ISA and submit the ISA summary to the NRC.

3.4.2 Regulatory Guidance

Guidance applicable to performing an ISA and documenting the results is given in NUREG-1513, "Integrated Safety Analysis Guidance Document," 1995. Guidance in regard to accident analysis may be found in the “Nuclear Fuel Cycle Facility Accident Analysis Handbook,” NUREG/CR-6410, 1998.

3.4.3 Regulatory Acceptance Criteria

The NRC reviewers should find the applicant’s submittal regarding the ISA summary provides reasonable assurance that the regulatory review criteria, below, are adequately addressed and satisfied. Some of the information may be referenced from other sections of the application, or incorporated by reference provided that these references are clear and specific.

3.4.3.1 Supporting Design Basis Information

The information provided in this section is acceptable if it allows for the reviewers to evaluate the completeness and acceptability of the ISA summary including (1) hazard identification task, (2) potential accident sequences task, (3) consequences and likelihood of occurrence of the accidents identified, and (4) items relied on for safety (items (i) through (vi) referenced above). If information was incorporated by reference and is needed to support the reviewer’s evaluation with respect to the applicant demonstrating the ability to meet the performance criteria, then the reviewer should request through the project manager that the information be submitted.

1. Process Description: The description should be considered acceptable if it contains the following:

    a. A description of all of the processes that have applicability to plant operations that are contained in the ISA.

    b. The purpose of each process and its relationship to the overall facility process.

    c. An identification of the components that are integral to plant operations, description, or process. This information should include the general arrangement, function, and operation of these components in the process. It should include process schematics showing the components and instrumentation as well as chemical flow sheets showing the anticipated ranges of compositions of the various process streams. Such

information should be provided to the extent necessary to describe the process in regard to performance requirements.

2. Site Description: The description should be considered acceptable if it contains:

   a. A description of the site geography, including its location relative to prominent natural and man-made features such as mountains, rivers, airports, population centers, possibly hazardous commercial and manufacturing facilities, etc., adequate to permit evaluation of the ISA summary.

   b. Population information based on recent census data to show population distribution as a function of distance from the facility adequate to permit evaluation of the ISA summary.

   c. Characterization of natural phenomena (e.g., tornadoes, hurricanes, high winds, and earthquakes) and other external events sufficient to assess their likelihood of occurrence and to assess their impact on plant safety. The discussion identifies the design basis events for the facility and indicates which events are considered incredible and the basis for that determination. The assessment also indicates which events could occur without adversely impacting safety.

   d. Designation of controlled site boundary.

3. Facility Description: The description should be considered acceptable if it contains;

   a. The facility location and the distance from any boundaries established for regulatory compliance, including the distance to the nearest resident and distance to boundaries in the prevailing wind directions. The distances to all publicly accessible locations, if any, within the site boundary shall be included.

   b. A description of all of the buildings that house the processes discussed above.

   c. Design information regarding the ability of the facility to withstand the effects of credible external events, when those failures may impact the performance criteria.

   d. The location and arrangement of buildings on the facility site.

4. Process Theory: The discussion of process theory should be considered acceptable if it includes or references elsewhere in the application:

   a. Basic process function and theory, including a general discussion of the basic theory of operation of each described process.

   b. Process operating ranges and limits, including the operating ranges and limits for all measured variables (e.g., temperatures, pressures, flows, and compositions) used in engineered or administrative controls to ensure safe operation of the process. A set of postulated abnormal operating conditions, where applicable, should be identified.

The process operating limits and ranges are considered acceptable if they provide reasonable assurance of process safety and are consistent with those assumed in the hazards analysis.

c. Schematics indicating safety interrelationships of parts of the process. In particular, either schematics or descriptions indicating the inventory, location, and geometry of special nuclear materials, moderators, and other materials in the process should be sufficient to permit an understanding of the adequacy of controls on mass, geometry, moderation, reflection, and other criticality parameters.

5. Process Design and Equipment: This section of the ISA summary should be considered acceptable if the following process safety information[2] is provided or referenced (external to the application) and that a commitment is provided to maintain the information current and accurate:

   a. Hazardous material information including toxicity information, permissible exposure limits, physical data, reactivity data, corrosivity data, and thermal and chemical stability data.

   b. Process technology information including block flow diagram or simplified process flow diagram, process chemistry, maximum intended inventory, and safe upper and lower limits for such items as temperatures, pressures, flows, and compositions.

   c. Process and safety equipment assurance measures, including codes and standards used for mechanical, civil, chemical, electrical, and instrumentation and control systems.

   d. Process and safety equipment information including materials of construction, piping and instrumentation diagrams (P&IDs), electrical classification, material and energy balances, functional logic diagrams, requirement and design specifications, software code, and electrical/electronic schematics.

   e. The compilation and maintenance of current and accurate PSI should be explained in the applicant's description of its configuration management program.

6. Drawings and Operating Procedures: This section should be considered acceptable if the final collection of material available at the site as referenced by this section is sufficient to establish the design basis for system configuration management for each system and process discussed under process description. As referenced material is needed in the safety evaluation, then through the licensing project manager, the specific references should be requested to be submitted to the NRC.

3.4.3.2 Process Hazards Analysis Summary

[2] This information is consistent with that of the process safety information contained in 29 CFR 1910.119, "Process Safety Management of Highly Hazardous Chemicals."

1. The description of the PHA methodology selected should be considered acceptable if it is consistent with the guidance provided in NUREG-1513. For methods used by the applicant but not addressed in NUREG-1513, the applicant should provide justification and references for their use.

   The PHA ordinarily should be considered acceptable if it provides the following:

   a. The PHA summary addresses potential process specific hazards identified in (i) through (iii) in SRP Section 3.3, above. The applicant should identify and justify any hazards eliminated from further consideration.

   b. The PHA summary provides reasonable assurance that the applicant identifies all process specific significant accident sequences (including the controls used to prevent or mitigate the accidents) that could result in radiological and nuclear criticality consequences. Chemical consequences which could result from processing licensed material or adversely affect radiological safety should also be included.

   c. The PHA summary takes into account the interactions of identified hazards and proposed controls, including interactions between systems and processes, to ensure that the overall level of risk at the facility is minimized.

   d. The PHA summary addresses all modes of operation including startup, normal operation, shutdown, and maintenance.

   e. The PHA summary addresses hazards resulting from process deviations (e.g., high temperature, high pressure), initiating events internal to the facility (e.g., fires or explosions), and credible external events (e.g., floods, high winds, earthquakes, and airplane crashes). The PHA summary should address aspects of the entire event sequence. The applicant should provide justification for its determination that certain events are incredible and, therefore, not subject to analysis in the ISA (this could be more categorical in nature rather then for every event).

   f. The PHA summary adequately describes the effects and failures of non-safety systems and components on safety systems and components.

   g. The PHA summary adequately addresses initiation of, or contribution to, accident sequences by human error.

   h. The PHA summary adequately addresses common mode failures and system interactions in evaluating systems that are to be protected by double contingency.

2. The summary of the hazard identification results should be considered acceptable if it provides:

   a. A list of materials and chemicals (radioactive, fissile, flammable, and toxic) that could result in hazardous situations affecting safe operation of the facility. The list includes

maximum intended inventory amounts and the location of the hazardous materials at the site.

b. A hazards interaction table showing potential interactions either between materials/chemicals, including radiolysis, that could possibly result in hazardous situations affecting safe operation of the facility.

c. A list of facility hazards (e.g., chemical, fire, electrical and mechanical) which could affect the safety of licensed materials.

3. The summary of potential accident sequences should be considered acceptable if it includes:

a. The accident sequences whose unmitigated consequences exceed the performance criteria contained in § 70.61.

b. The controls or barriers that must fail in order for the accident to occur.

3.4.3.3 Safety Analysis

1. A summary of the unmitigated and mitigated consequences of each postulated accident to facility workers or the public should be acceptable if it contains the following:

a. Evidence that discipline-specific safety (i.e., radiation, criticality, fire and chemical safety) hazards, accident scenarios, and controls are represented in the summary. The summary has considered all credible cross-discipline interactions that could result in initiation or intensification of an accident such as loss of criticality control caused by water from fire suppression activities.

b. Comparisons of the consequences of each postulated accident to the performance criteria of § 70.61.

c. Assignment of accident sequences to likelihood categories and comparison to the performance criteria of § 70.61.

d. Identification of engineered controls used in the determination of mitigated consequences.

e. A listing of accidents evaluated as incredible events. Adequate justification for their evaluation as incredible should be provided. Reviewers are cautioned against excessive focus on the adequacy of justifications for incredible events that can be qualitatively shown to be so unlikely as to not merit consideration. In addition, events that are unlikely to have adverse impacts on the system need not be considered if similar events that pose greater hazards have already been considered.

2. Evaluation of consequences of accidents should be considered acceptable if:

a. The narrative demonstrates that valid consequence evaluation methods have been used, as described in the appropriate safety chapters of the license application (e.g., Nuclear Criticality Safety, Chemical Safety);

b. The narrative contains a description of accidents for which consequences have been evaluated along with the quantitative results in a form that can be directly compared to the performance criteria of § 70.61; and

c. The summary of accident sequences gives either the calculated consequence values or a traceable reference to the quantitative evaluation that is the basis for the assignment of the accident sequence to the correct consequence category of the performance criteria of § 70.61.

3. To demonstrate sufficiently low likelihood for each accident sequence for compliance with the performance criteria of § 70.61, it is necessary, as a minimum, that the items relied on for safety supported by applicable measures to assure their reliability, meet the following qualitative criteria:

   a. For an accident sequence that results in a nuclear criticality accident, adherence to double contingency should be demonstrated. Adherence to double contingency requires that at least two unlikely, independent, and concurrent changes in process conditions are necessary before a criticality accident can occur. If double contingency is not feasible, then the controls should exhibit sufficient redundancy and diversity to make criticality comparably unlikely.

   b. For an accident sequence that results in "high consequences," other than nuclear criticality, as defined in § 70.61, the likelihood should be comparable to that achieved by double contingency. Normally, multiple independent events are required to achieve such a likelihood. However, in principle, it can be achieved if the sequence requires a single event which is confidently known to be highly unlikely. Alternatively, or in addition, controls may be used to mitigate the consequences of the accident rather than to prevent its occurrence.

   c. For an accident sequence that results in consequences, "intermediate" as defined in § 70.61, at least one single unlikely event must occur before the unmitigated consequences of the accident occur. A mitigative control applied to a sequence must reduce the consequences below the limits defining the lower bound of the category in order to be credited in determining compliance with § 70.61

4. A list of items relied on for safety required to satisfy the performance criteria of § 70.61 should be considered acceptable if:

   a. It includes all items relied on for safety in the identified accident sequences; and

   b. The description of the items relied on for safety, clearly articulating the specific safety features, their assurance measures, and the associated safety limits and margins are adequate to permit a determination of compliance with § 70.61,

c. Information concerning the assignment of assurance measures to safety controls is adequate to show compliance with § 70.61. (If a system of graded assurance measures is used, the grade applied to each control should be determinable from information provided.)

3.4.3.4 ISA Management

Management controls should be considered acceptable if the following criteria are met:

1. The ISA team should have a team leader who is knowledgeable in the ISA methodology chosen for the hazard and accident evaluations. In addition, the team leader should be able to demonstrate a basic understanding of all process operations and hazards under evaluation, but should not be the cognizant engineer or expert for that process.

    a. At least one member of the ISA team should have specific and detailed experience in each process under evaluation.

    b. A variety of process operating and engineering design experience should be represented across the team. Radiation safety, nuclear criticality safety, fire protection, and chemical safety disciplines should also be represented.

    c. A manager provides overall administrative and technical direction for the ISA.

2. The description of the facility procedures for conducting and maintaining the ISA should be considered acceptable if it includes:

    a. Management policies.

    b. Organizational responsibilities.

    c. Administrative controls, and procedures governing the performance, review, and approval of the initial ISA and any revisions to the ISA.

    d. A commitment to maintain the ISA to reflect changes using a team with similar qualifications to the team that originally prepared the ISA for the system under review.

    e. A commitment to maintain the ISA under an adequate configuration management function.

    f. Identifies updates to the table on controls necessary to ensure safety, as well as seek prior approval for any changes that raise unreviewed safety questions or increase the level of risk.

    g. Administrative controls ensure the independence of reviewing organizations and individual reviewers.

h. Procedures to control records and supporting documentation concerning the ISA.

3. The protocol for informing the NRC of ISA summary updates should be acceptable if it is consistent with the requirements in § 70.72.

3.5 REVIEW PROCEDURES

3.5.1 Acceptance Review

The primary reviewer should evaluate the application to determine whether it addresses the "Areas of Review" discussed in Section 3.3, above. If significant deficiencies are identified, the applicant should be requested to submit additional material before the start of the safety evaluation.

3.5.2 Safety Evaluation

After determining that the application is acceptable for review in accordance with Section 3.5.1, above, the primary reviewer will perform a safety evaluation against the acceptance criteria described in Section 3.4. If during the course of the safety evaluation, the primary reviewer determines the need for additional information, the primary reviewer coordinates a request for additional information with the licensing project manager.

The secondary reviewer (licensing project manager) should assure that the team of supporting reviewers is appropriate for the processes, systems, and events considered. The secondary reviewer should also review the sections of ISA Management.

Because the ISA summary forms the basis for many of the individual discipline specific safety programs (i.e., radiation, criticality, chemical, and fire safety), the supporting reviewers should assure that there is evidence that discipline specific inputs have been incorporated into the Safety Analysis section of the ISA summary. The reviewer should assure that the ISA also addresses events, such as fire or earthquake, that could affect more than one process. The reviewer should also evaluate areas of possible safety conflict, an example being fire suppression systems and nuclear criticality safety. Furthermore, the supporting reviewers should assure that the identified hazards, accident scenarios, consequences and controls contained in the ISA summary are consistent with the appropriate SRP Sections (i.e., fire, chemical, criticality safety) throughout the application.

When the safety evaluation is complete, the primary staff reviewer, with assistance from the other reviewers, should prepare the Integrated Safety Analysis input for the SER as described in Section 3.6.

3.6 EVALUATION FINDINGS

The primary reviewer should write an SER section addressing each topic reviewed under this SRP chapter and explain why the NRC staff has reasonable assurance that the ISA summary

submitted is acceptable. License conditions may be proposed to impose requirements where the application is deficient. The SER should include a summary statement of what was evaluated and the basis for the reviewers' conclusions.

The staff can document the evaluation as follows:

> *The staff has evaluated* ... [Insert a summary statement of what was evaluated and why the reviewer finds the submittal acceptable.] *The applicant has performed an Integrated Safety Analysis (ISA) to identify and evaluate those hazards and potential accidents that could result in unintended exposure of persons to radiation or radioactive materials associated with licensed materials, and to establish safety controls to ensure facility operation within the bounds of the ISA. The NRC staff has reviewed those postulated accidents resulting from the facility hazards that may be anticipated to occur (or are considered unlikely or highly unlikely). To ensure that the performance requirements of § 70. 61 are met, the applicant has established both administrative and engineered safety controls. The staff has reviewed these safety controls and finds them acceptable based on the staff's evaluation of a summary of the applicant's ISA and other supporting information.*
>
> *The staff concludes that the identification and evaluation of the hazards and accidents as part of the ISA and the establishment of controls to maintain safe facility operation from their consequences satisfy the performance requirements of § 70. 61.*

3.7 DEFINITIONS

These definitions have specialized meanings to be applied only in the context of using this SRP chapter.

Accident Sequence

In general, an unintended sequence of events or process failures that would result in adverse consequences. In the context of this SRP, an unintended sequence of events that results in environmental contamination, a radiation exposure, a release of radioactive material, an inadvertent nuclear criticality, or an exposure to hazardous chemicals, provided the chemicals are composed of, or the accident results from the processing of, licensed radioactive material; or if the accident has the potential to jeopardize the safety of regulated activities. The term “accident” may be used interchangeably with accident sequence.

Assurance Measures

An inclusive term for any measures applied to items relied on for safety to ensure their ability to reliably and effectively perform their safety function. Such measures include design procedures, human-system interface analysis, construction procedures, functional testing, inspections, calibration, surveillance monitoring and testing, maintenance, training, configuration management, quality assurance, records management, and audits.

Operating procedures that are relied on for safe operation are considered administrative safety controls, not assurance measures. However, the policy of requiring written operating procedures for the purposes of safety would be one element of an acceptable configuration management program.

Certain assurance measures are of a generic nature in that they apply to the whole system of safety controls, not to any one control in particular. These include incident investigation, safety organization, management independence and authority, and policies or procedures specifying how safety management functions are to be carried out.

Baseline Design Criteria

A set of criteria that identify safety considerations that applicants must address in the design of new facilities or in the design of new processes at existing facilities, in accordance with § 70.64. Applicants are expected to address these baseline design criteria in establishing minimum requirements for all items relied upon for safety.

Consequence

Any result of interest or concern caused by an event or sequence of events. In this context, adverse consequences refers to the adverse health or safety effects on workers or the public. Consequences are specified in § 70.61, in the context of meeting performance requirements.

> Unmitigated Consequences are the consequences that result from an accident sequence when mitigative control fails or does not exist.

Control

A system, device, or procedure intended to regulate a device or process. Controls may be engineered controls or administrative (procedural) controls. Controls may be preventive or mitigative. A process control may not be "an item relied on for safety" if safety controls exist that will perform their function despite frequent or continuous failure of the process control.

Administrative Control: The provisions relating to organization and management, procedures, record keeping, reviews, audits, and reporting necessary to ensure operation of the plant in a safe manner.

Engineered Control: An active or passive structure, system, or component that prevents or mitigates the consequences of accidents from licensed material that could cause significant consequences.

Mitigative Control: A control intended to reduce the consequences of an accident sequence, not to prevent it entirely. When a mitigative control works as intended, the results of the sequence are called the mitigated consequences.

Preventive Control: A control intended to prevent an accident entirely, i.e., to prevent any of the types of radiological or chemical consequences.

Process Control: A control that is not considered a Safety Control.

Safety Control: A system, device, or procedure intended to regulate a device or process so as to maintain a safe state. Effectively synonymous with "item relied on for safety." In the context of this SRP, use of the unmodified term "control" normally means safety control. The function of safety controls is to satisfy the performance requirements contained in § 70.61.

Event

An occurrence; a change of conditions from a prior state.

Credible Event: An initiating (or secondary) event with a likelihood of occurrence greater than one in a million in any year. Any accident sequence identified in the ISA as initiated by a credible event must have its consequences assessed, and controls applied so as to satisfy the performance requirements contained in § 70.61. When determining whether an event (or its likelihood category) is credible, uncertainty in the estimate of likelihood of the event as well as the estimate itself, should be considered. This will help to assure that events or accident sequences are not improperly categorized because of estimation method or choice of data or assumptions.

External Event: An event for which the likelihood cannot be altered by changes to the regulated facility or its operation. This would include all natural phenomena events plus airplane crashes, explosions, toxic releases, fires, etc., occurring near or on the plant site.

Incredible Event: An initiating (or secondary) event that is so unlikely that it alone makes the sequence sufficiently improbable (i.e., likelihood less than or equal to 1 in a million per year) that it need not be addressed further, even for consideration of the maximum credible consequences. For such sequences, there is no need to add controls to prevent occurrence of consequences of concern. In evaluating compliance with § 70.61, using the ISA, justification should be provided that such events are, in fact, of sufficiently low frequency.

Initiating Event: The first event in an accident sequence. In a well-defined accident sequence, an initiating event is normally the first deviation of the system from its intended behavior (a failure), or the occurrence of an abnormal condition beyond the system's design basis. Subsequent events in the sequence are referred to as secondary events.

Internal Event: An event for which changes to the regulated facility or its operation can affect the likelihood of occurrence. This would include all deviations from normal process operating conditions and abnormal events in other plant processes that would, if controls fail, contribute to causing an accident with consequences of concern.

Natural Phenomena Events: Earthquakes, floods, tornadoes, tsunamis, hurricanes, and other events that occur in the natural environment and could adversely affect safety. Natural phenomena events, depending on their likelihood of occurrence, may be credible or incredible.

Items Relied on for Safety

Structures, systems, equipment, components, and activities of personnel that are relied on to prevent or mitigate accidents to satisfy the performance requirements contained in 10 § 70.61. These items include design features and controls, both engineered and administrative, that are relied on to protect the worker, the public, and the environment in all phases of operation, including during normal operation, transients, and accidents in progress (mitigation).

Design features and controls relied on for safety include those that:

1. Confine or contain SNM for safety reasons;

2. Control a process to maintain the chemical form, concentration, geometry, or other property of SNM-bearing material to assure safety;

3. Provide the capability to place or maintain a process containing SNM in a safe shutdown condition;

4. Are operating procedures relied on for safety, or other actions of personnel required for safety;

5. Are items or human actions that, if not functioning properly, could cause the failure of another item relied on for safety;

6. Are items or human actions that, if not functioning properly, could substantially degrade the reliability of another item relied on for safety.

Certain process controls and features may be excluded from being considered items relied on for safety, even though they functionally provide a margin of safety, provided no credit is taken for this safety functionality in assessing the adequacy of the safety performance of the process for compliance with § 70.61.

Uncontrolled Outcome

The sequence of events and consequences that result if no controls or barriers are available to prevent or mitigate an accident sequence. Thus the consequences of an uncontrolled outcome are, by definition, unmitigated. These consequences may also be referred to as uncontrolled consequences.

Unlikely

For the facility unlikely is an implied assessment of a frequency of occurrence (or exceedence) of less than 10^{-2} but greater than 10^{-5} per year. For the facility highly unlikely is an implied assessment of a frequency of occurrence (or exceedence) of less than 10^{-5} per year.

3.8 REFERENCES

1. American Institute of Chemical Engineers (AIChE). “Guidelines for Hazard Evaluation Procedures, Second Edition with Worked Examples.” AIChE: New York. September 1992.

2. Nuclear Regulatory Commission (U.S.), Washington, D.C. “Domestic Licensing of Special Nuclear Material (10 CFR Part 70).” *Federal Register:* Vol. 64, No. 146. pp. 41338--41357. July 30, 1999.

3. Nuclear Regulatory Commission (U.S.) (NRC). NUREG-1513, “Integrated Safety Analysis Guidance Document.” NRC: Washington, D.C. 1995.

4. Nuclear Regulatory Commission (U.S.) (NRC). NUREG/CR-6410, “Nuclear Fuel Cycle Accident Analysis Handbook.”, NRC: Washington, D.C. 1998.