Cornerstone Development

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Cornerstone Development

1.0 **Background**

In the staff requirements memorandum (SRM) for SECY-11-0140, "Enhancements to the Fuel Cycle Oversight Process" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML120050322), the U.S. Nuclear Regulatory Commission (NRC) directed its staff to continue their interaction with stakeholders to develop the optimal basis for the cornerstones, ultimately recommending the path that is most likely to help ensure safe operations. In addition, the Commission directed the staff to consider how the cornerstones would be understood in the context of fuel facility operation and less to whether they resemble those of the Reactor Oversight Process (ROP). Finally, the Commission stated that possibly a combination of hazard analysis- and operations-based cornerstones could prove to be the optimal approach to help ensure safe operations.

In response to the Commission's direction in the SRM for SECY-11-0140, a new working group of NRC staff from the Offices of Nuclear Material Safety and Safeguards, Nuclear Security and Incident Response, Nuclear Reactor Regulation, and Region II was established to develop the optimal basis for the cornerstones of the Revised Fuel Cycle Oversight Process (RFCOP).

2.0 **RFCOP Regulatory Framework**

The staff used a top-down hierarchical approach to develop the regulatory framework for the RFCOP. The RFCOP regulatory framework, shown in Figures 1 through 4[1], starts at the highest level with the NRC's mission. The NRC's mission is to license and regulate the Nation's civilian use of radioactive material to protect public health and safety, promote the common defense and security, and protect the environment.

The Commission established strategic goals to meet this mission in the NRC's Strategic Plan (NUREG-1614, Volume 6, "Strategic Plan: Fiscal Years 2014–2018," issued September 2014) (ADAMS Accession No. ML14246A439). The strategic goals of safety and security are to ensure the safe and secure use of radioactive materials. Each strategic goal has objectives and those objectives form the basis for the second level in the RFCOP regulatory framework or the strategic performance areas of Fuel Facility Safety and Safeguards. The relationship between the strategic performance areas and strategic objectives is described below. The NRC, through its oversight process, verifies that licensees meet their regulatory requirements and therefore satisfy the strategic objectives and the NRC's mission.

- Fuel Facility Safety: Prevent and mitigate accidents and ensure radiation safety.
- Safeguards: Ensure protection of nuclear facilities and radioactive materials, and classified and Safeguards Information.

In addition, NRC regulations require fuel cycle licensees to control the potential impacts on workers and the public from certain hazardous chemicals used at their facilities that are associated with processes involving radioactive materials. The memorandum of understanding

[1] The details of how the staff derived Figures 1 and 2 are contained in Enclosure 2 to SECY-11-0140 (ADAMS Accession No. ML111180712). The derivation of Figures 3 and 4 is discussed in this document.

(MOU) with the U.S. Occupational Safety and Health Administration (OSHA)[2] delineates the areas of responsibility of each agency regarding occupational safety and health.

The fundamental building blocks for the RFCOP are the cornerstones which are shown as the third level of the regulatory framework (Figures 2 through 4; for Figure 1 the cornerstones are shown in the fourth level). The cornerstones are those aspects of licensee performance that are important to the mission and therefore merit regulatory oversight. Acceptable licensee performance in these cornerstones (i.e., meeting the objectives) should help demonstrate that the NRC's mission is met.

In developing each cornerstone, the staff identified the objective, the key attributes of licensee performance necessary to achieve the objective, and the areas the NRC needs to inspect to ensure that the objectives of the cornerstones are met. For each inspectable area, the staff described the scope of the inspection activities and provided the basis.

3.0 **Consideration of Different Cornerstone Approaches**

In response to the SRM for SECY-10-0031, the staff developed the two cornerstone approaches and proposed them in SECY-11-0140 (ADAMS Accession No. ML111180705). These two cornerstone approaches were named "hazards analysis" and "operations." In response to the SRM for SECY-11-0140, the staff considered those two cornerstone approaches as well as, their combination. The main differences among the cornerstone approaches are related to the cornerstones of safety, except emergency preparedness. The emergency preparedness and safeguards-related cornerstones are expected to be the same regardless of the recommended cornerstone approach. In other words, the recommended cornerstone approach would contain cornerstones related to emergency preparedness, security, and material control and accounting (MC&A). The security and MC&A cornerstone would support the NRC's mission from a security perspective. The discussion in the subsequent paragraphs focuses on the staff's consideration of the different approaches for the cornerstones of safety (except emergency preparedness) and provides the basis for recommending a cornerstone approach (or a set of cornerstones that could be applied to the RFCOP). The cornerstones of safety would support the NRC's mission from a safety perspective.

3.1 Consideration of the Hazards Analysis-Based Cornerstones

The origin of the hazards analysis-based cornerstones was a comment from the Advisory Committee on Reactor Safeguards (ACRS) during a June 20, 2011, briefing to the ACRS Subcommittee on Radiation Protection and Nuclear Materials. In that briefing, the staff was discussing a cornerstone approach similar to the operations-based cornerstones and a member of that ACRS subcommittee suggested that it may be a good idea to try to mirror or have symmetry with the ROP (see pages 16 – 20 of ADAMS Accession No. ML11193A208). The other members of the ACRS subcommittee agreed with the comment and the staff, in response to the ACRS comment, developed the hazards analysis-based cornerstones. The ACRS documented their preference for the hazard analysis-based approach in the letter report dated October 17, 2011 (ADAMS Accession No. ML11284A143). The hazard analysis-based cornerstone approach is shown in Figure 1.

[2] Memorandum of Understanding between the U.S. Nuclear Regulatory Commission and the Occupational Safety and Health Administration, "Worker Protection at Facilities Licensed by the NRC," dated September 6, 2013 (ADAMS Accession No. ML11354A432).

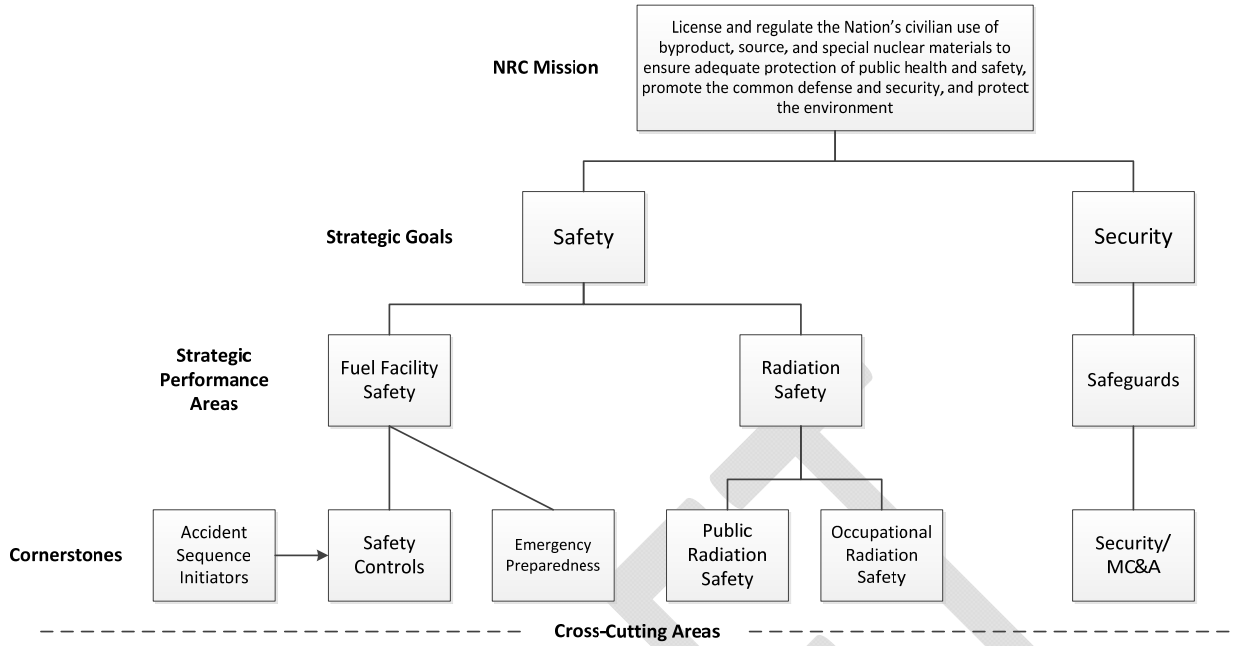


Figure 1, Hazard Analysis-Based Cornerstones (from SECY-11-0140)

The hazards analysis-based cornerstones are based on the way licensees typically developed their integrated safety analyses (ISAs). It should be noted that security and MC&A are not the focus of the ISA. Security and MC&A are addressed in other documents such as Physical Protection Plans and Fundamental Nuclear Material Control (FNMC) Plans. ISA is an ongoing process that mainly identifies accident sequences and the items relied on for safety (IROFS) to ensure compliance with Title 10 of the *Code Federal Regulations* (10 CFR) Section 70.61, "Performance Requirements." The results of the ISA process are documented in supporting documentation which are kept at the fuel facilities and are available for NRC inspection. A synopsis of the results is documented in the ISA Summary. The ISA Summary is a document that must be submitted with a license application and must contain the information specified in 10 CFR 70.65(b).

During the ISA process licensees consider the facility and external hazards that could become accident sequence initiators and identify the safety controls that would be used to prevent accident sequences or mitigate the consequences. This is also known as a process hazards analysis (PHA). Typically, licensees designate a subset of the safety controls identified in the PHAs as IROFS in order to comply with the performance requirements of 10 CFR 70.61. This results in the ISA summaries being an incomplete reflection of a fuel facility's true safety basis. Therefore, the staff determined that a cornerstone approach <u>based entirely on ISA summaries</u> is not the optimal approach to ensure safe operations at fuel cycle facilities. By basing the cornerstone approach entirely on ISA summaries, the staff may not consider in the inspection program an element of a risk-informed decision making process, that is, safety margin. This is because ISA summaries do not contain information related to safety margin.

The staff arrived at this determination by also considering the Commission's direction in the SRM for SECY-11-0140 related to give consideration to how the cornerstones would be understood in the context of fuel facility operation and less to whether they resemble those of the ROP.

On the topic of how the cornerstones would be understood in the context of fuel facility operation, industry stakeholders have stated that the hazard analysis-based cornerstones would negatively impact communication with stakeholders and thereby create misunderstanding and confusion by facility workers, their clients, and the public (ADAMS Accession No. ML112490224). For example[3], licensees train their workers in accordance with the safety programs they have today and, according to licensees, introducing terminology such as "accident sequence initiators" would create confusion on how safety would be maintained. In addition to their workers and members of the public nearby their facilities, licensees have another key stakeholder and that is their corporate partners. Typically, licensees work together with their corporate partners (e.g., international counterparts) to improve their safety programs. These corporate partners have different regulatory requirements. Licensees have stated that terminology in the operations-based cornerstones would allow them to work with their corporate partners even though the regulatory requirements are different and that introducing new terminology would add complexity to those interactions.

On the topic of giving less consideration to whether the cornerstones resemble those of the ROP, the staff notes that fuel cycle facilities are not nuclear power plants and their hazards are different. The initiating events, mitigating systems, barrier integrity, and emergency preparedness cornerstones are appropriate for the ROP because the main hazard at a nuclear power plant is the reactor core. As stated in Inspection Manual Chapter (IMC) 0308, "Reactor Oversight Process Basis Document" (ADAMS Accession No. ML14164A209), for the reactor safety area to fail to meet the goal of adequate protection of public health and safety, an initiating event would have to occur, followed by failures in one or more mitigating systems, and ultimately failure of multiple barriers. If not properly mitigated and multiple barriers are breached, a reactor accident could result which would compromise the public health and safety. At that stage, the emergency plan is implemented as the last defense-in-depth measure for public protection.

In contrast to reactors, the hazards at fuel cycle facilities include toxic chemicals, fissile materials with the potential for inadvertent criticality, and radioactive materials. Acute exposure to radioactive materials has, except for plutonium facilities, relatively minor consequences when compared to toxic chemicals or exposures occurring within 20 feet of a criticality accident. Thus, except for a few large chemical sources, most hazards do not pose a significant risk to members of the public. Also, NRC regulations require protection of facility workers based on the MOU with OSHA. In addition, there is great diversity in the processes, equipment, and physical and chemical forms of radioactive material and an intimate, hands-on contact between operators and radioactive material. Finally, the designs of some types of safety controls are different both from nuclear power plants and among processes within a fuel cycle facility. For example, exposure to radioactive material and toxic chemicals are typically controlled through careful and robust containment and appropriate ventilation, and criticality is often controlled by the use of safe geometry equipment and independent controls on mass and moderation.

Even though the staff determined that the hazards analysis-based cornerstones are not the optimal approach to ensure safe operations, they provided a useful insight of what an appropriate cornerstone approach should strive to accomplish and that is to prevent and

[3] The discussion in this paragraph is based on remarks made by an industry representative during the September 23, 2011, briefing to the ACRS subcommittee on Radiation Protection and Nuclear Materials (ADAMS Accession ML11320A090 see pages 91-94 and 102-105).

mitigate accidents. Successful demonstration that accidents are prevented and can be mitigated provides reasonable assurance that the safety side of the NRC's mission is met.

3.2 Consideration of the Operations-Based Cornerstones

The operations-based cornerstones are based on the way licensees typically organize their safety and security programs. The safety programs address the hazards at fuel cycle facilities and typically include environmental protection, radiation safety, chemical safety, fire protection, and nuclear criticality safety. These hazards are regulated under 10 CFR Part 20, "Standards for Protection against Radiation," 10 CFR Part 40, "Domestic Licensing of Source Material," and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material." Licensees are required by 10 CFR Parts 40 and 70 to develop safety analyses to support their operations. For 10 CFR Part 70 licensees this includes the development of an ISA. The one operating uranium conversion plant developed an ISA to support licensing under 10 CFR Part 40. ISAs must jointly consider all relevant hazards including radiological, nuclear criticality, chemical, and fire. For the security programs, the protection of radioactive material and sensitive information are regulated under 10 CFR Part 73, "Physical Protection of Plants and Materials," 10 CFR Part 74, "Material Control and Accounting of Special Nuclear Material," and 10 CFR Part 95, "Facility Security Clearance and Safeguarding of National Security Information and Restricted Data." The operations-based cornerstone approach is shown in Figure 2.

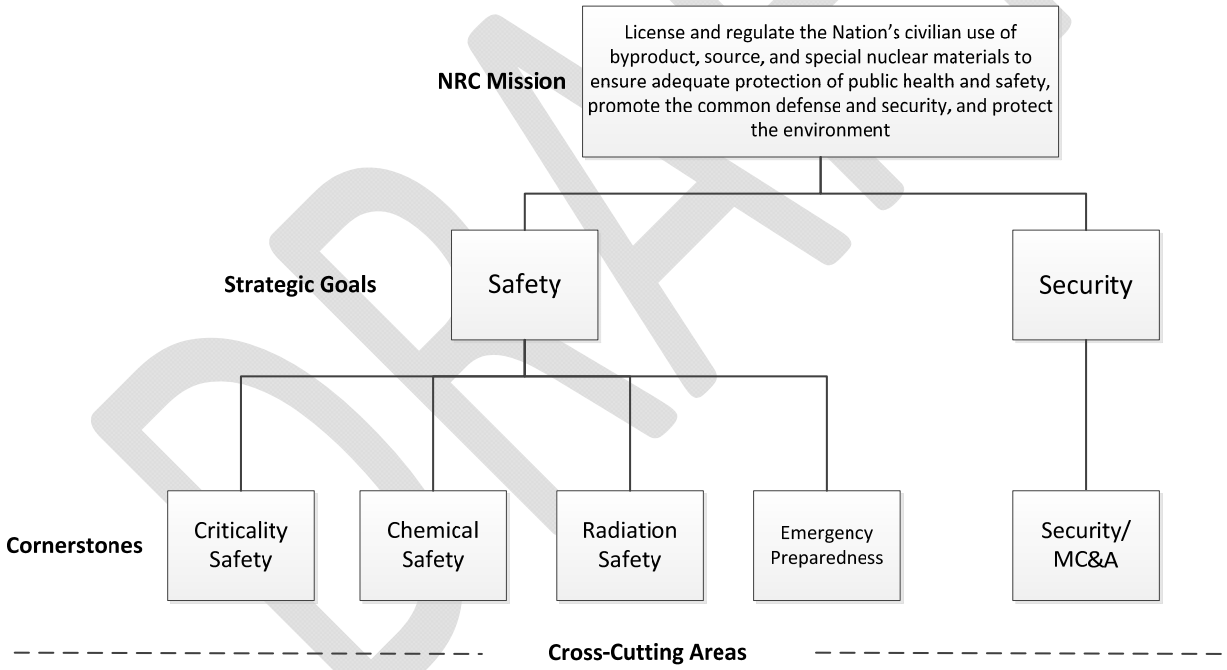


Figure 2, Operations-Based Cornerstones (from SECY-11-0140)

During the development of the operations-based cornerstones in 2011, the staff considered including a "Fire Protection" cornerstone because of its importance to ensure safe operations. However, the performance requirements of 10 CFR 70.61 do not have consequences in terms of fire events. Instead, they have consequences in terms of radiological dose, exposure to chemicals (those within the NRC's jurisdiction), and nuclear criticality (70.61(d)). Therefore, the staff included fire protection as an inspectable area within the cornerstones of criticality safety, chemical safety, and radiation safety.

In the licensing review of fuel cycle facilities, the staff reviews a portion of all processes and relies on programmatic commitments related to safety and security in order to make a finding that there is reasonable assurance of adequate safety and security. During inspection the staff verifies in a risk-informed and performance-based manner that licensees adequately implement their safety and security programs. Based on the diversity of fuel cycle facilities and how they are licensed and inspected, the staff determined that the operations-based cornerstones provide an appropriate approach to verify that the NRC's mission is met. The staff also notes that the operations-based cornerstones provide an approach that is similar to the staff's current inspection program and there is consensus that it ensures safe and secure operations. The current inspection program uses insights from the ISA Summaries to select the inspection samples and this would be expected to continue.

3.3 Consideration of a "Combined" Cornerstone Approach

The staff considered a combined cornerstone approach due to the Commission's direction in the SRM for SECY-11-0140. The combination of the two approaches that staff considered, hazards analysis-based and operations-based, is shown in Figure 3. The combined cornerstone approach has the following cornerstones: "Integrated Safety Analysis," "Criticality Safety," "Operational Safety" (which includes chemical safety and fire protection), "Radiation Safety," "Emergency Preparedness," "Security," and "Material Control and Accounting." In the Fuel Facility Safety strategic performance area, the cornerstones would have worked together by verifying the correct performance of the ISA process (i.e., the "Integrated Safety Analysis" cornerstone) and verifying the correct implementation of the safety controls and safety control support programs (e.g., management measures) in criticality, operational, and radiation safety.

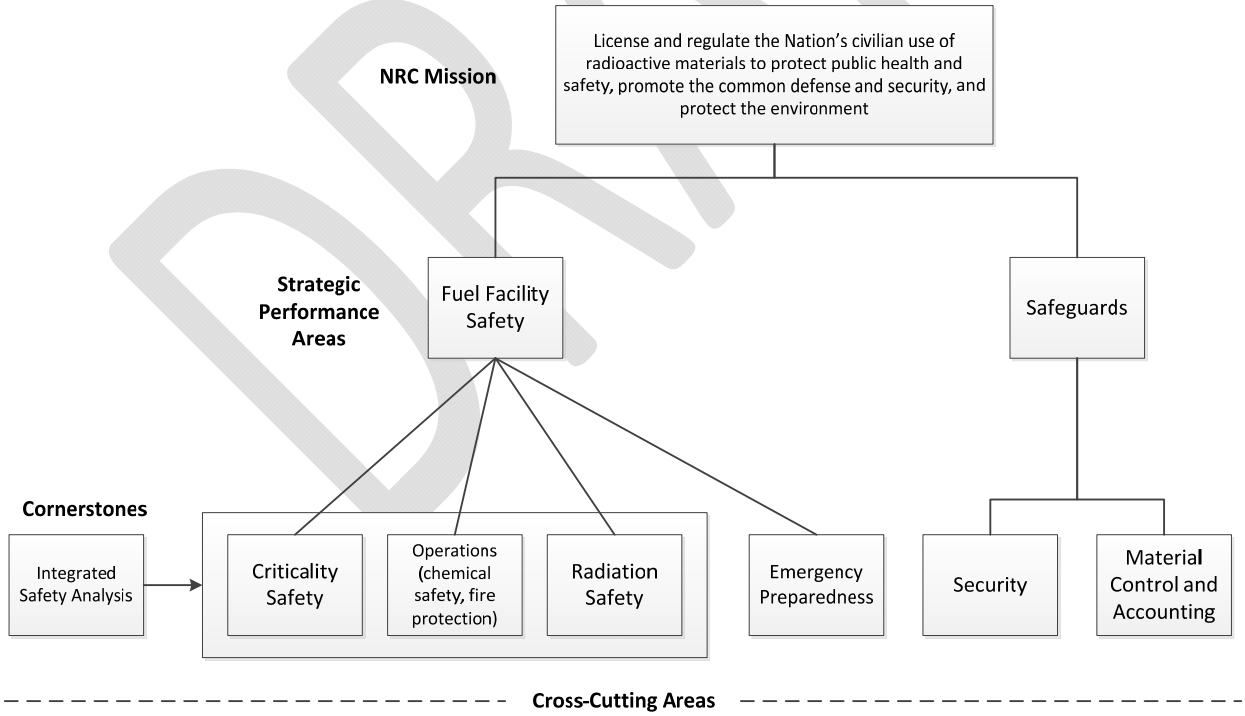


Figure 3, Combined Cornerstone Approach Considered by the Staff

The staff determined that the combined approach was not the optimal approach because of the "Integrated Safety Analysis" cornerstone since confirming the correct performance of the ISA process would not provide useful data to assess a licensee's performance. This is because confirming the correct performance of the ISA process is done during the licensing process where the staff reviews and approves the methodology licensees used to perform the ISA process. However, as mentioned in the consideration of the operations-based cornerstones, it is recognized that the selection of inspection samples uses insights from the licensees' ISA summaries. In certain situations where NRC inspectors suspect that a licensee improperly screened out an event from the ISA summary due to the event being considered as either not credible or of low consequence, inspectors attempt to verify that the licensee's assumptions and/or bounding cases were properly included in the licensee's determination that the event is not credible or of low consequence.

4.0 **Staff's Recommendation**

After deliberation and discussions with internal and external stakeholders, the staff recommends an approach very similar to the "operations-based" cornerstones. The description of the staff's recommendation is provided in Section 4.1. The rationale of the staff's recommendation is discussed in Section 4.2 and the result of the development of the cornerstones is provided in Section 4.3.

4.1 Description of Staff's Recommendation

The staff's recommendation is shown in Figure 4 and includes the following cornerstones: "Criticality Safety," "Operational Safety," "Occupational Radiation Safety," "Public Radiation Safety," "Emergency Preparedness," "Security," and "Material Control and Accounting."

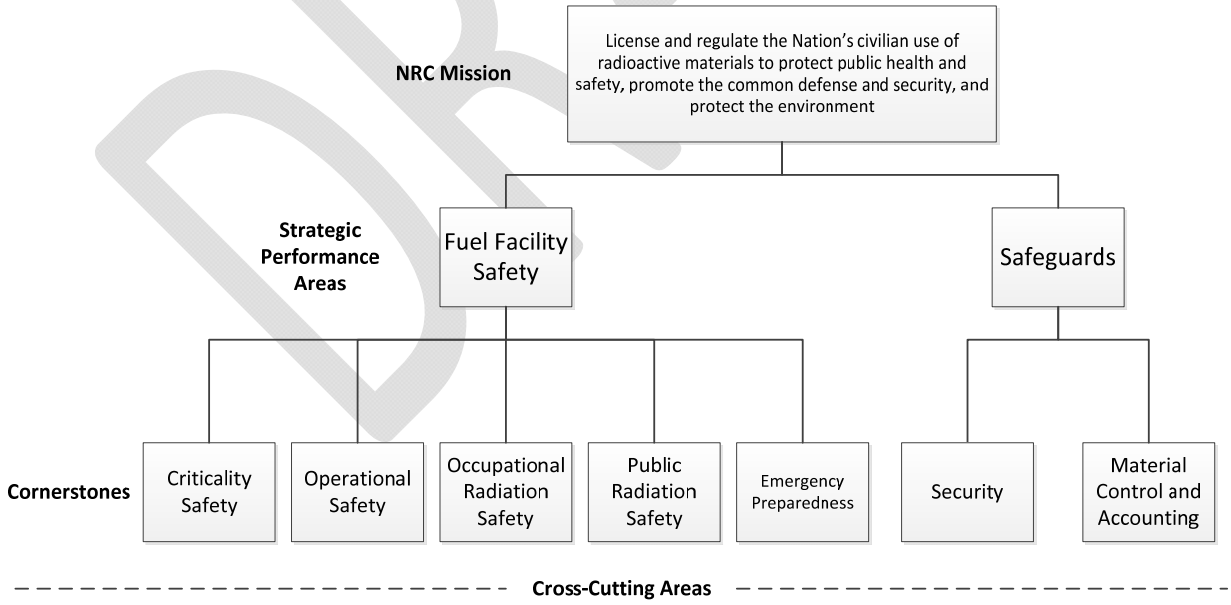


Figure 4, RFCOP Regulatory Framework Using Recommended Cornerstones

The similarities and differences between the staff's recommendation and the operations-based cornerstones can be seen by comparing and contrasting Figures 2 and 4. The similarities and

differences are explained below. The staff's recommendation is very similar to operations-based cornerstones because it includes cornerstones related to Criticality Safety and Emergency Preparedness, and the differences are not significant. Specifically, the fire protection inspections would be incorporated into the Operational Safety cornerstone instead of being in the Criticality Safety, Chemical Safety, and Radiation Safety cornerstones. Also, the staff's recommendation separates the Radiation Safety cornerstone in the operations-based approach into two cornerstones, Occupational Radiation Safety and Public Radiation Safety, to enhance communication with stakeholders. Similarly, the staff's recommendation separates the Security/MC&A cornerstone in the operations-based approach in two cornerstones, Security and MC&A, to enhance communication with stakeholders and for implementation purposes.

The staff developed its recommendation by considering the cornerstone approaches discussed in Sections 3.1 through 3.3 and what is important to meet the NRC's mission. Specifically, the staff considered from a risk-informed and performance-based perspective the important aspects of licensee performance that merit regulatory oversight. These important aspects of licensee performance are the cornerstones.

The cornerstones of safety were informed by the appropriate regulatory requirements (i.e., 10 CFR Parts 20, 40, and 70) and NUREG-1520, "Standard Review Plan for the Review of the License Application for a Fuel Cycle Facility" (ADAMS Accession No. ML101390110). NUREG-1520 describes the review of the safety programs that licensees develop in order to ensure safe operations at fuel cycle facilities. The review of the safety programs is described in Chapters 3, "ISA and ISA Summary;" 4, "Radiation Protection;" 5, "Nuclear Criticality Safety;" 6, "Chemical Process Safety;" 7, "Fire Safety;" 8, "Emergency Management;" 9, "Environmental Protection;" and 11, "Management Measures."

The "Criticality Safety" cornerstone is related to Chapter 5. The "Operational Safety" cornerstone covers chemical safety and fire safety; therefore, it is related to Chapters 6 and 7. The "Public Radiation Safety" and "Occupational Radiation Safety" cornerstones are related to Chapters 4 and 9. The "Emergency Preparedness" cornerstone is related to Chapter 8. Finally, Chapters 3 and 11 of NUREG-1520 provide the framework for complying with the requirements of Subpart H to 10 CFR Part 70, "Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material." Therefore, they are related to the cornerstones that have an interface with the ISA summary and management measures. Table 1 summarizes the relationship between the cornerstones of safety and the identified chapters of NUREG-1520.

Table 1, Relationship between Cornerstones of Safety and NUREG-1520 Chapters

Cornerstones	NUREG-1520 Chapters
Criticality Safety	5, "Nuclear Criticality Safety" 3, "ISA and ISA Summary" 11, "Management Measures"
Operational Safety	6, "Chemical Process Safety 7, "Fire Safety" 3, "ISA and ISA Summary" 11, "Management Measures"
Occupational and Public Radiation Safety	4, "Radiation Protection" 9, "Environmental Protection" 3, "ISA and ISA Summary" 11, "Management Measures"
Emergency Preparedness	8, "Emergency Management"

The safeguards-related cornerstones were informed by the appropriate regulatory requirements (i.e., 10 CFR Parts 73, 74, and 95) and guidance documents. The cornerstones under the safeguards strategic performance area would be applied commensurate with the type of facility (i.e., Category I, Category II, Category III fuel fabrication facility, and Category III enrichment facility). Table 2 provides the relationship between the safeguards-related cornerstones and selected guidance documents.

Table 2, Relationship between Safeguards-Related Cornerstones and Guidance Documents

Cornerstones	Guidance Document
Security	Regulator Guide (RG) 5.52, "Standard Format and Content of a Licensee Physical Protection Plan for Strategic Special Nuclear Material at Fixed Sites (Other than Nuclear Power Plants)" RG 5.59, "Standard Format and Content for a Licensee Physical Security Plan for the Protection of Special Nuclear Material of Moderate or Low Strategic Significance"
Material Control and Accounting	NUREG-1280, "Standard Format and Content Acceptance Criteria for the [MC&A] Reform Amendment" NUREG-1065, "Acceptable Standard Format and Content for the [FNMC] Plan Required for Low-Enriched Uranium Facilities" NUREG/CR-5734, "Recommendations to the NRC on Acceptable Standard Format and Content for the FNMC Plan Required for Low-Enriched Uranium Enrichment Facilities"

4.2 Rationale of Staff's Recommendation

The staff recommends this cornerstone approach because having an inspection program that verifies the adequate implementation of these important aspects of licensee performance in a risk-informed and performance-based manner would ensure safe and secure operations. The recommended cornerstone approach would also provide flexibility to implement effective oversight of licensee activities to such a diverse group of facilities. Also, the recommended cornerstone approach aligns with how licensees typically organize their safety and security programs and it is ultimately their responsibility, with NRC oversight, to ensure that those programs provide safe and secure operations. Since the recommended cornerstone approach

aligns with how licensees typically organize their safety and security programs, it would be understood in the context of fuel facility operation. Therefore, the staff's recommendation would address the Commission's direction in the SRM for SECY-11-0140. Further, as concluded by ACRS in their letter report related to the "Comparison of Integrated Safety Analysis and Probabilistic Risk Assessment for Fuel Cycle Facilities" (ADAMS Accession No. ML110460328), ISAs, in combination with practices required by current regulations, are adequate for the protection of the health and safety of workers and the public, and for licensing fuel cycle facilities. The staff's recommendation would continue to use insights from the ISA summaries and the practices required by current regulations include the verification that safety and security programs are being adequately implemented. For these reasons, the staff determined that its recommendation is the optimal basis for the cornerstones of the RFCOP.

The staff recognized for licensees that to ensure safe operations at fuel cycle facilities, accidents need to be prevented and in the event that an accident occurs, the consequences need to be mitigated. Accidents can be prevented (i.e., minimize the occurrence) and mitigated through the use of safety controls. The consequence of accidents can be mitigated through appropriate emergency response actions. Therefore, the staff included accident prevention and mitigation as the objectives of the cornerstones and a specific cornerstone on emergency preparedness whose objective is to ensure that emergency response actions are adequate. In addition, safety controls used to prevent or mitigate accident sequences must be available and reliable to perform their function when needed. This is ensured by safety control support programs such as the management measures which are required by 10 CFR 70.62(d).

To confirm the appropriateness of the staff's recommendation, the staff reviewed the International Atomic Energy Agency's (IAEA) "Guidance for the Application of an Assessment Methodology for Innovative Nuclear Energy Systems" (Section 3.4 of Volume 9 of IAEA-TECDOC-1575, Rev. 1), dated November 2008. The staff found that the cornerstones of safety are consistent with the fundamental safety functions for nuclear fuel cycle facilities of maintaining subcriticality, controlling chemistry, confining radioactive materials and shielding sources of radiation.

4.3 Results of Cornerstone Development

The cornerstones define the baseline inspection program under the RFCOP. Each cornerstone has several key attributes. Under each key attribute, there are one or more inspectable areas. For each inspectable area, the staff developed the scope and provided the basis. These inspectable areas were selected using a risk-informed and performance-based approach. They are risk-informed because the staff considered insights from the ISAs, operating experience, vulnerability assessments (security), and regulatory requirements. They are performance-based because the staff would inspect how licensees implement their safety and security programs (instead of inspecting the programs themselves).

The objectives of the cornerstones are provided below. Appendices A through G present the results of the development of each cornerstone.

Criticality Safety — The objective of this cornerstone is to protect against the consequences of a nuclear criticality accident, preferably by prevention of the accident. This is commonly done by verifying that the licensee evaluates the normal and credible abnormal conditions of processes involving special nuclear material and establishes and maintains robust controls to ensure the material remains subcritical by an appropriate margin of safety. It includes verifying licensee preparedness to protect worker and public health and safety should an inadvertent criticality

occur by monitoring for, and preparing to respond to, a criticality accident.

Operational Safety — The objective of this cornerstone is to verify the availability and reliability of items relied on for safety (IROFS) and other safety controls, such as chemical safety controls and fire safety controls to protect worker and public health and safety. This objective includes ensuring adequate process safety analyses of these IROFS and other safety controls to prevent, limit the frequency of, or mitigate accident sequences that could lead to intermediate or high consequence accidents, particularly for process chemicals under NRC jurisdiction per the MOU with OSHA.

Occupational Radiation Safety — The objective of this cornerstone is to verify adequate protection of worker health and safety from exposure to radiation from radioactive materials used in civilian nuclear fuel processing. Licensees can maintain worker protection by meeting the applicable regulatory limits including "as low as is reasonably achievable" (ALARA).

Public Radiation Safety – The objective of this cornerstone is to verify adequate protection of public health and safety from exposure to radiation from radioactive material utilized in civilian nuclear fuel processing. Public exposure would result from radioactive materials released into the public domain as a result of civilian nuclear fuel processing operations. These releases include routine gaseous and liquid radioactive effluent discharges, the inadvertent release of solid contaminated materials, and the offsite transport of radioactive materials and wastes. Licensees can maintain public protection by meeting the applicable regulatory limits including ALARA.

Emergency Preparedness — The objective of this cornerstone is to verify that the licensee is capable of implementing adequate measures to protect public health and safety in the event of a radiological or chemical emergency (for those chemicals under NRC jurisdiction).

Security — The objectives of this cornerstone are to (1) verify that the licensee's safeguards systems and programs for both fixed site facility and transportation shipments promote the common defense and security by protecting against: (a) acts of radiological sabotage; (b) loss, theft, and diversion of special nuclear material (SNM); and (c) unauthorized disclosure of classified and sensitive unclassified information; and (2) verify that the licensee's physical protection systems minimize the possibility for unauthorized removal of SNM and facilitate the location and recovery of missing SNM.

MC&A — The objectives of this cornerstone are to (1) verify that the licensee's MC&A program promotes the common defense and security by detecting and protecting against loss, theft, diversion, or misuse of SNM, and facilitating the location and recovery of missing SNM; and (2) verify that the licensee adequately detects unauthorized production and unauthorized levels of enrichment of SNM at enrichment facilities.

5.0 **Cross-Cutting Areas**

The staff's recommended cornerstone approach (see Figure 4) shows the cross-cutting areas. The staff reviewed how the cross-cutting areas are used in the ROP for potential applicability in the RFCOP.

In the ROP, the cross-cutting areas are fundamental performance characteristics that extend across all cornerstones. These areas are human performance, problem identification and

resolution, and safety conscious work environment. Each cross-cutting area has several cross-cutting aspects. A cross-cutting aspect is a performance characteristic of an inspection finding that is the most significant causal factor of the performance deficiency as described in IMC 0612, "Power Reactor Inspection Reports" (ADAMS Accession No. ML12244A483). These cross-cutting aspects are listed in IMC 0310, "Aspects within the Cross-Cutting Areas" (ADAMS Accession No. ML13351A028). The staff assigns cross-cutting aspects to inspection findings and evaluates them in accordance with IMC 0305, "Operating Reactor Assessment Program" (ADAMS Accession No. ML13178A032).

The cross-cutting areas would be considered when the staff develops the performance assessment process for the RFCOP. This is consistent with the RFCOP Project Plan.

6.0 **References**

1. "A Comparison of Integrated Safety Analysis and Probabilistic Risk Assessment," Revision 1, dated February 2011 (ADAMS Accession No. ML110610195).

7.0 **RFCOP Cornerstones Working Group Members**

- Jonathan DeJesus, Office of Nuclear Material Safety and Safeguards
- Christopher Tripp, Office of Nuclear Material Safety and Safeguards
- Mary Thomas, Region II
- Gregory Chapman, Office of Nuclear Material Safety and Safeguards
- Richard Gibson, Region II
- F. Scot Sullivan, Office of Nuclear Security and Incident Response
- Rebecca Richardson, Office of Nuclear Security and Incident Response
- Glenn Tuttle, Office of Nuclear Material Safety and Safeguards
- Suzanne Ani, Office of Nuclear Material Safety and Safeguards
- James Isom, Office Nuclear Reactor Regulation

Appendix A, Criticality Safety Cornerstone

Objective

The objective of this cornerstone is to protect against the consequences of a nuclear criticality accident, preferably by prevention of the accident. This is commonly done by verifying that the licensee evaluates the normal and credible abnormal conditions of processes involving special nuclear material and establishes and maintains robust controls to ensure the material remains subcritical by an appropriate margin of safety. It includes verifying licensee preparedness to protect worker and public health and safety should an inadvertent criticality occur by monitoring for, and preparing to respond to, a criticality accident.

Key Attributes and Inspectable Areas

Experience from the history of criticality accidents, significant operational events, and enforcement actions shows that having a robust nuclear criticality safety (NCS) program is essential to ensure safe operation of a nuclear fuel cycle facility. Therefore, the key attributes were developed from the essential functions performed by the NCS program to ensure safety. These are described in the NRC's licensing guidance, particularly the main program areas discussed in Chapter 5 of NUREG-1520, "Nuclear Criticality Safety." In addition, great consideration was given to those factors identified as root and contributing causes in surveys of lessons learned from those historical accident and significant events, grouping those factors which have historically led to the majority of such occurrences together under the headings of key attributes. The key attributes thus constitute a holistic and integrated overview of the essential functions of the NCS program, which are: establishing sufficient controls to ensure subcriticality, providing oversight to ensure those controls are maintained, and restoring those controls or otherwise protecting workers and the public from consequences should those controls be degraded or failed.

Figure A-1 shows those attributes of licensee performance that affect criticality safety. These key attributes and the inspectable areas are described below.

1. Criticality Analysis

   Establishing controls and limits in NCS evaluations to prevent criticality.

   a. Identifying credible abnormal conditions

   Scope: Inspection activities in this area include reviewing licensee analyses and calculations to determine whether they have identified the most reactive conditions resulting from credible events and process deviations, based on established controls. Also, include reviewing application of criteria for determining which abnormal conditions are considered credible.

   Basis: This area is inspected because identification of abnormal conditions is mentioned in the objective and is part of meeting the performance requirement of 10 CFR 70.61(d). History shows that failure to consider process deviations, or failure to consider them credible, has often led to accidents and other significant events.

b. Demonstrating subcriticality for normal and credible abnormal conditions

Scope: Inspection activities in this area include reviewing licensee analyses and calculations to determine whether they have adequately demonstrated subcriticality for the worst credible conditions, whether they provide for sufficient margin of subcriticality as approved in the license, and whether the calculations are based on validated methods.

Basis: This area is inspected because ensuring subcriticality under normal and credible abnormal conditions is mentioned in the objective and is part of meeting the performance requirement of 10 CFR 70.61(d).

c. Demonstrating compliance with double contingency principle

Scope: Inspection activities in this area include reviewing licensee demonstrations of double contingency, including the aspects of independence, concurrence, and unlikelihood. This necessarily entails the consideration of common-mode failure, provisions for prompt detection and correction, and adherence to the preferred design hierarchy and application of management measures appropriate to the type of control.

Basis: This area is inspected because compliance with the double contingency principle is required for those licensees covered by the baseline design criteria in 10 CFR 70.64(a)(9). This is also required by all existing licenses in their license, and is fundamental to the industry standard practice of criticality safety (for example, through ANS-8.1) as the preferred way of ensuring subcriticality under normal and credible abnormal conditions.

d. Specifying controlled parameters, controls, and limits

Scope: Inspection activities in this area focus on determining whether controlled parameters, controls, and limits listed in licensee criticality safety evaluations are sufficient to limit parameters to subcritical values. Also, inspection activities include determining whether the specification of the controls will be adequate to meet their intended safety function (e.g., whether the important attributes of engineered controls are specified, whether all necessary components of control systems are identified, whether procedures are clear and readily performable), and whether there is sufficient operating margin in limits and setpoints to provide high confidence that the applicable safety limits will not be exceeded.

Basis: This area is inspected because criticality prevention is achieved by establishing controls to limit process parameters to their subcritical values, to ensure subcriticality under normal and credible abnormal conditions.

2. Criticality Implementation

Adequate implementation in the field of the controls established in the facility's flowdown documents ensures that criticality accidents are prevented. Controls are used to establish safety limits on controlled parameters to prevent criticality and to ensure subcriticality under normal and credible abnormal conditions.

a. Flowdown of engineered and administrative controls

Scope: Inspection activities in this area include reviewing safety basis documents such as specifications, drawings, diagrams, system descriptions, procedures, postings, and job-specific training to determine whether controls are consistent with the current safety basis as described in criticality safety evaluations. Also, inspection activities include examining facilities and processes to determine whether they are consistent with the approved safety basis.

Basis: This area is inspected because engineered controls must be procured, installed, and verified to ensure they have specified attributes to perform their intended safety functions. They must also be identified as such in equipment drawings, piping and instrumentation diagrams, and system description documents to ensure they are maintained under configuration control and are not inadvertently changed so as to compromise safety. Administrative controls must be flowed appropriately into procedures, postings/operator aids, and training. The proper implementation of controls is necessary to ensure they will be available and reliable to prevent criticality.

b. Establishing quality assurance and management measures

Scope: Inspection activities in this area include reviewing the specified quality assurance and management measures of criticality controls to determine whether they will be sufficient to establish and maintain the controls to an acceptable level of reliability to meet the performance requirements and double contingency principle.

Basis: This area is inspected because controls must be maintained so as to be available and reliable to perform their safety functions, to prevent criticality at an acceptable level of risk. Ensuring that criticality is made highly unlikely, and that process deviations will be sufficiently unlikely to meet the double contingency principle entails maintenance, surveillance, functional testing, etc., for engineered controls and procedures, postings, audits, and training for administrative controls.

c. Interface with integrated safety analysis

Scope: Inspection activities in this area include evaluating consistency between the criticality analyses and ISA, and proper application of the approved ISA methodology to criticality hazards.

Basis: This area is inspected because criticality analysis forms a significant portion of the basis for ISA. The criticality controls relied on to ensure subcriticality under normal and credible abnormal conditions must be designated as IROFS consistent with 10 CFR 70.61(e). Consistency between the safety basis as described in the criticality analysis and the supplemental demonstration of risk in ISA is necessary to have an accurate understanding of and regulatory oversight over the risk of criticality.

3. Criticality Operational Oversight

Maintaining controls through ongoing oversight of facility operations ensures that once controls are established, they are maintained to prevent criticality on an ongoing basis.

a. Preventive and corrective maintenance

Scope: Inspection activities in this area focus on determining whether controls are maintained as specified to ensure they will be available and reliable to perform their intended safety functions, and to restore them to working order when found failed or degraded. Also, inspection activities include review start-up and post-maintenance verification prior to placing new or changed operations in service.

Basis: Once management measures have been established, it is necessary to check that they're actually performed and performed properly. This is necessary to support the objective of preventing criticality.

b. Functional testing and surveillance

Scope: Inspection activities in this area focus on determining whether surveillance is sufficient to ensure compliance with the performance requirements and double contingency principle. Inspection activities also include the review of the scope and periodicity of functional testing to determine whether all aspects of control systems needed to perform their intended safety functions are verified to be working properly.

Basis: This area is inspected because correct performance of management measures is necessary to support the objective of preventing criticality by establishing and maintaining sufficiently robust controls.

c. Configuration and change control

Scope: Inspection activities in this area focus on determining whether new operations, change requests, and work packages are appropriately reviewed and approved. Inspectors would review change requests that impact criticality safety to determine whether they have the proper review and that the impact on criticality safety is properly assessed. This applies to both permanent plant modifications and temporary changes, and includes equipment, process, and procedural modifications. Determine whether facility safety basis documents are controlled and maintained current.

Basis: This area is inspected because criticality prevention on an ongoing basis requires ensuring that robust controls are established and maintained throughout the lifetime of the operation.

d. Process monitoring, sampling, and nondestructive assay

Scope: Inspection activities in this area include the review of the licensee's oversight over process conditions to ensure that process deviations that can lead to criticality are promptly detected and corrected as needed to meet the performance requirements and the double contingency principle. Inspection activities also include the review of procedures and sampling records to evaluate whether any single failure of administrative controls can result in criticality (such as by transferring concentrated solutions from favorable to unfavorable geometry). Inspectors would also review nondestructive assay methods and records to determine whether they are adequate to detect the unwanted accumulation of an unsafe mass of material where such could lead to criticality.

Basis: This area is inspected because the double contingency principle requires the prompt detection and correction of process deviations to ensure low likelihood of concurrent failures. In areas which may be inaccessible and where large accumulations of fissionable material are possible, special care must be taken to detect such accumulations nondestructively. In addition, sampling is needed where concentrated solutions may be transferred from favorable to unfavorable geometry. Past experience shows that dual sampling prior to transfers and nondestructive assay tend to be problematic areas that have led to accidents and significant events.

e. Fissile material operator training

Scope: Inspection activities in this area include the review of training provided to operators to determine whether they understand controls and hazards in their work areas, factors affecting criticality, potential consequence of criticality, their responsibilities during an emergency, and plant safety policies such as stop-work authority, condition reporting, and procedural compliance. Inspection activities also include determining whether operators are appropriately trained on job-specific tasks and procedures prior to performing work. Inspectors would review refresher training and operator aids to maintain awareness of criticality hazards and controls. Inspectors would also discuss the above with operators to determine whether they adequately understand the provided training.

Basis: This area is inspected because hands-on operation involving fissionable materials is widespread in fuel facilities, and past experience shows that human error plays a major role in the occurrence of accidents and significant events. Training of operators to correctly perform administrative controls and recognize and appropriately respond to criticality hazards is essential to meeting the objective of preventing criticality using robust (administrative) controls.

4. Criticality Programmatic Oversight

Maintaining an effective criticality safety program is essential in ensuring that criticality is adequately prevented on an ongoing basis.

a. Walkthroughs, inspections, and program audits

Scope: Inspection activities in this area focus on determining whether criticality safety staff walk through and inspect plant areas containing fissionable materials on the specified periodicity, and evaluate the scope, breadth, and thoroughness of those reviews. Inspectors would accompany criticality staff on their inspections whenever possible and independently observe facility operations and assess their compliance with established controls and limits. Inspection activities would also determine whether criticality staff is familiar with operations and maintains close working relations with operations, evaluate the results of any external program audits, and determine whether findings are appropriately handled.

Basis: This area is inspected because the NCS Program as described in the license application is the primary entity responsible for ensuring criticality is prevented to an acceptable level. The observation of plant operations for procedural compliance and

material condition is of primary importance in preventing a degradation of the facility safety basis that could erode the ability to prevent criticality to an acceptable level.

b. Review of new operations and proposed changes

Scope: Inspection activities in this area include evaluating the scope and thoroughness of new and revised analysis, and determining whether it is performed in accordance with industry standard practices, program procedures, and license requirements. Inspection activities would also determine whether criticality analysis is performed by knowledgeable and qualified individuals and whether it is subject to peer-review and management approval.

Basis: This area is inspected because criticality analysis for new or revised operations must be performed and reviewed appropriately to ensure that criticality continues to be prevented at an acceptable level.

c. Training and qualification of NCS staff

Scope: Inspection activities in this area include the review of the training and qualification of criticality staff to determine whether they meet license requirements and are knowledgeable in the technical aspects of criticality safety, are familiar with facility operations, and are cognizant of the regulatory requirements.

Basis: This area is inspected because qualified and competent staff are essential to having confidence that the NCS Program is adequate to meet the objective of preventing criticality to an acceptable level. Given the primary importance of the NCS Program to preventing criticality, the staff implementing that program must be of the highest caliber.

6. Criticality Incident Response and Corrective Action

Responding to events and infractions, thereby restoring adequate preventive measures when they are degraded or compromised ensures that they do not lead to criticality. In the event of criticality, protecting workers and the public from its consequences by prompt and effective response and recovery is essential in meeting the cornerstone objective.

a. Criticality alarm placement, testing, and maintenance

Scope: Inspection activities in this area include the review of the design and deployment of the criticality alarm system, including assessing the basis for detector locations and alarm setpoints, alarm logic, vulnerability to environmental conditions (e.g., lightning, earthquakes), calibration, testing, maintenance, and audibility of the detectors and alarms.

Basis: This area is inspected because ensuring the prompt detection of criticality is necessary to ensure timely evacuation and response and recovery actions are initiated. This is necessary to meet the objective of protecting worker health and safety from the consequences of accidental criticality.

b. Emergency planning, exercises, and drills

Scope: Inspection activities in this area include the review of emergency plans to determine whether they include allowances for criticality hazards and accidents, including evacuation, personnel accountability, medical attention, and reentry and recovery during a possible long-term excursion. Plans should involve both onsite and offsite personnel who perform response activities and any restrictions on the use of firefighting agents (e.g., water in moderation-controlled areas). Inspection activities would assess the conduct of drills and exercises to determine whether they are sufficient to adequately test these emergency response functions.

Basis: This area is inspected because prompt evacuation is necessary to meet the objective of minimizing the consequences from accidental criticality. Evacuation routes must be designed to minimize the potential for injuries from other hazards or unnecessarily exposing individuals to the radiation from criticality. Prompt medical attention of exposed individuals is also essential to minimizing fatalities. Offsite responders to events such as fires must also be knowledgeable about facility hazards. Performance at an acceptable level requires frequent training and exercises.

c. Problem reporting, incident investigation, and corrective action

Scope: Inspection activities in this area focus on determining whether facility operators report defective conditions promptly and adhere to plant safety policies (e.g., stop work and procedural compliance). Inspectors would determine whether significant events are appropriately investigated and whether the licensee performs adequate root cause and extent of condition reviews. Inspectors would also determine whether there is a trend of degrading performance or a preponderance of repeated or similar infractions. Inspections activities would evaluate whether corrective actions are prompt, effective to prevent recurrence, and sufficiently broad in scope to address both immediate as-found and potential safety implications and assess whether corrective actions are tracked to completion and completed in a time frame commensurate with their safety significance.

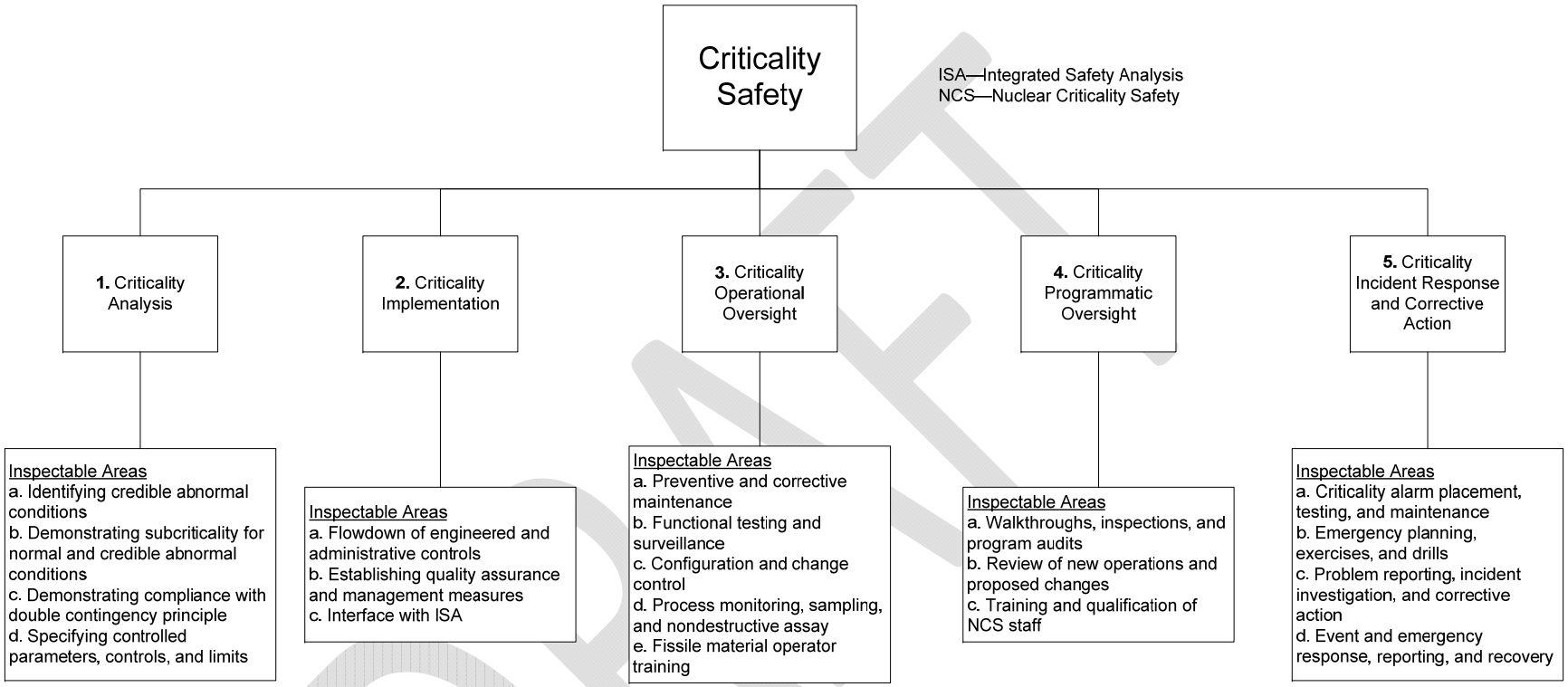
Basis: This area is inspected because, as recognized by the double contingency principle, process deviations and infractions will occur. As no single occurrence must lead to an accident, such occurrences afford valuable opportunities to eliminate possible precursors before they can lead to an accident. Restoration of the baseline safety basis promptly and effectively is crucial to ensuring compliance with both the performance requirements and the double contingency principle is maintained so as to prevent criticality at an acceptable level.

d. Event and emergency response, reporting, and recovery

Scope: Inspection activities in this area assess the licensee's procedures for responding to events, reporting to the NRC and other Agencies, and recovering from a criticality accident. Inspectors would also assess whether criticality staff are readily available to provide support at all times, whether they are promptly notified in an emergency, and whether the licensee makes prompt and correct reportability decisions. Inspection activities would evaluate whether recovery procedures include provisions for intervention and safe reentry.

Basis: This area is inspected because criticality accidents have the potential to persist for hours or longer, which could result in additional doses to workers and the public. Past experience shows that accident conditions can be reinitiated by ill-advised recovery actions. Advice from criticality staff is important in balancing the various risks during an accident and protecting responders from unnecessary radiation. This is an important part of meeting the objective of protecting workers and the public from the consequences of accidental criticality.

Figure A-1, Criticality Safety Cornerstone Key Attributes



Appendix B, Operational Safety Cornerstone

Objective

The objective of this cornerstone is to verify the availability and reliability of items relied on for safety (IROFS) and other safety controls, such as chemical safety controls and fire safety controls to protect worker and public health and safety. This objective includes ensuring adequate process safety analyses of these IROFS and other safety controls to prevent, limit the frequency of, or mitigate accident sequences that could lead to intermediate or high consequence accidents, particularly for process chemicals under NRC jurisdiction per the MOU with OSHA.

Key Attributes and Inspectable Areas

Figure B-1 shows the attributes of licensee performance that affect operational safety. These key attributes and the inspectable areas are described below.

1. Design

Proper initial design and subsequent design are essential to ensuring the availability and reliability of operational safety controls and IROFS. This includes assurance of assumptions regarding accident sequence initiators. The integrated safety analysis (ISA) documentation should reflect the hazard identification and controls that meet regulatory requirements.

a. Review of ISA Summary

Scope: Inspection activities in this area include review of the ISA summary and ISA, safety analyses, process hazards analyses, and fire hazards analyses; as-built conditions; modifications; testing; and normal and emergency operation of risk-significant systems. This would be an in-depth review of a selected risk-significant systems and support systems.

Basis: This area is inspected to assure that the licensee has designed the structures, systems, and components to meet the performance requirements of 70.61 or appropriate safety analyses required by license condition.

b. Review of Accident Sequence Initiators and Accident Sequences

Scope: Inspection activities in this area focus on selected systems processing licensed material that present an operational safety hazard to determine whether the accident sequence initiators and accident sequences evaluated as part of the ISA, ISA development, or safety analysis were effectively identified. Inspectors review the licensee's analyses of selected systems and activities (included in the ISA or safety analysis, or excluded from the ISA or safety analysis because the licensee determined that the accident sequence was non-credible). As part of this evaluation, inspectors should observe the installed equipment and licensee staff activities to operate the equipment. If inspectors are unable to observe equipment operation during the

inspection, inspectors should conduct walkthroughs with plant staff to evaluate equipment operation.

Basis: This area is inspected to assure that the licensee has considered all potential accident sequences and respective initiators for the process systems at their facility in accordance with 70.62(c)(1)(iv) or appropriate safety analyses required by license condition.

c. Staff Performance and Procedure Quality

Scope: Inspections activities in this area focus on whether the licensee's ISA or safety analysis appropriately considered the complexity of actions required by licensee staff, provided adequate guidance in procedures, and appropriately considered, in accident sequence initiator determination, the potential staff performance deficiencies that might result from deficient procedures.

Basis: This area is inspected to determine whether expectations of staff were taken into consideration when developing accident response actions in accordance with 70.22(i)(3)(vii and x) or 40.31(j)(3)(vii and x).

d. Facility and Equipment Performance

Scope: Inspections focus on whether the licensee's ISA or safety analysis appropriately considered potential facility or equipment failure modes and frequencies. Inspectors observe equipment operation to identify potential failure modes and resultant accident sequence initiators and compare them to those analyzed in the ISA or safety analysis.

Basis: This area is inspected to determine whether all equipment failure modes were considered when developing the ISA in accordance with 70.62(c) or appropriate safety analyses required by license condition.

e. Frequency of Accident Sequence Initiators that Result in IROFS or Other Safety Controls

Scope: Inspectors first identify the accident sequence initiators that could result in operational safety hazards (from the ISA or other safety analysis) to selected accident sequences that resulted in the licensee establishing IROFS and other safety controls. Inspectors evaluate these actual frequencies to determine whether the actual frequencies of the initiators are consistent with the frequency assumptions in the ISA or other safety analysis. Inspectors then review the licensee's evaluation of the causes of the failures that resulted in the accident sequence initiator. If the licensee has not evaluated the cause of the initiator, inspections should determine the causes (such as staff performance, procedure quality, design, facility and equipment performance, or configuration control) and then determine the effectiveness of the licensee's actions to prevent or control the occurrence of the initiator.

Basis: This area is inspected to assure that the licensee has identified the frequency of accident sequence initiators that result in IROFS in accordance with 70.62(c) or other safety controls in accordance with appropriate safety analyses required by license condition.

f. Accident Sequence Initiators that Do Not Result in IROFS or Other Safety Controls

Scope: Inspectors first identify the accident sequence initiators that present an operational safety hazard (from the ISA or other safety analysis) to selected accident sequences that, because of low likelihood, do not require that licensees establish IROFS and other safety controls. Inspectors evaluate these actual frequencies to determine whether the actual frequencies of the initiators are consistent with the frequency assumptions in the ISA or other safety analysis. If the actual frequencies are higher than the frequency assumptions in the ISA or other safety analysis, inspectors review the licensee's actions as a result of the increased frequencies, such as establishing IROFS because of the increased likelihood of the accident sequence.

Basis: This area is inspected to assure that the licensee has identified the frequency of accident sequence initiators that do not result in IROFS in accordance with 70.62(c) or other safety controls in accordance with appropriate safety analyses required by license condition.

2. Procedure Quality

To ensure proper functioning of operational safety controls and IROFS, the procedures regarding operational safety controls and IROFS use, maintenance, and testing must be correct. Maintenance and testing procedures influence the reliability of operational safety controls and IROFS to respond when needed. Standard operating procedures and abnormal operating procedures are essential to ensuring operational safety controls and IROFS, which are frequently contained in these procedures, are implemented as required by regulations and the license. Unclear procedures or procedural steps that are out of sequence could result in staff errors that lead to the failure of operational safety controls or IROFS.

a. Procedure Quality and Use

Scope: Inspection activities in this area focus on the clarity of plant procedures with regard to operational safety controls or IROFS. Inspection activities include observation of plant staff performance during operations and during walkthroughs by inspectors. Inspectors evaluate any deficient performance to determine if it results from inadequate, deficient, or unclear procedures. While reviewing the use of procedures, inspectors also evaluate whether the procedure and activities observed result in compliance with regulations and license requirements. In addition, inspectors review selected changes to procedures to determine whether the procedures provide adequate guidance to plant staff to meet NRC requirements.

Basis: This area is inspected to determine whether required actions identified in the ISA Summary or safety analyses have been correctly transcribed into written operating procedures and are available to operators. This area is also inspected to evaluate whether procedures adequately address various operational aspects, including startup, temporary operation, and shutdown as required by license condition or licensee policy/procedure and to verify that observed deviations from procedures and unforeseen process changes affecting nuclear criticality, chemical, radiological, and fire safety are reported to management, are documented, and are investigated promptly. Procedures are one of the management measures listed in the definition of same in 70.4, and are

required as part of a license application by 70.22(a)(8). For Part 40 licensees, procedures are required by 40.32(c).

3. Staff Performance and Training

Staff performance and training in day-to-day activities, prior to any initiating event, influences the performance of process safety controls and IROFS through the conduct of operational, maintenance, and test activities. Staff actions are also important for equipment to respond to initiating events. Staff performance is critical to reducing the frequency of certain accident sequences and mitigating the resultant consequences. Staff actions can be operational safety controls or IROFS. Examples of staff actions that are important to the performance of operational safety controls or IROFS would include staff action in response to alarms for elevated hydrogen fluoride concentrations in air, for uranium hexafluoride (UF_6) in air, or for the weight of a UF_6 cylinder. Staff performance during initial and re-qualification provide an indication of expected staff performance.

a. Performance

Scope: Inspection activities in this area observe staff performance to determine if they are adhering to applicable safety procedures, particularly with regard to the adequacy of precautions taken for radiological, chemical, toxicological, fire protection, and control of nuclear material. Inspectors would observe and talk with operators to determine whether operators know and understand process conditions, safety limits on controlled parameters and safety controls, and whether they have the skill to follow the procedures. Inspectors would also be alert to any conditions that are unsafe, and note whether or not they are being performed in accordance with approved procedures, regulatory requirements, or license commitments.

Basis: This area is inspected to determine whether operators and technicians are adequately implementing safety controls in accordance with 70.22(a)(8) or 40.32(c).

b. Training

Scope: Inspection activities in this area include the review of training in the area of operational safety. Inspection activities in this area focus on the effectiveness of the licensee's program for conducting initial training, qualification, and requalification training for plant staff through observation of plant staff performance during operations and during walkthroughs by inspectors. Inspectors evaluate any deficient performance to determine if it results from deficient training and qualification.

Basis: This area is inspected to evaluate whether training is compliance with license requirements. Training is listed as one of the management measures in the definition in 10 CFR 70.4.

4. Equipment Performance

Adequate availability and reliability of facilities and equipment that function as operational safety controls and IROFS are crucial to preventing and mitigating the consequences of events that could lead to a chemical release. Maintenance,

surveillance, and fire protection ensure equipment functions when needed. In addition, external events such as flooding, cold or hot weather, and loss of offsite power can lead to risk of loss of operational safety controls or IROFS. Protective systems, such as freeze protection, and backup power can reduce the impact of external events on the plant.

a. Maintenance

Scope: Inspection activities in this area focus on determining whether the licensee is assuring adequate performance of operational safety controls or IROFS by implementing this management measure appropriately, including reviewing the failure evaluations of selected IROFS to determine causes as required by 10 CFR 70.62(a). Inspectors observe maintenance activities for operational safety controls or IROFS to evaluate work practices, including post-maintenance testing.

Basis: This area is inspected to determine whether maintenance activities for IROFS and other safety controls are adequate to assure that IROFS and controls are available and reliable to perform their safety function when needed, and to comply with the performance requirements or appropriate license conditions. Maintenance is one of the management measures listed in the definition in 70.4.

b. Surveillance

Scope: Inspection activities in this area focus on determining whether surveillance of operational safety controls or IROFS assures that they are capable of performing their intended safety functions. This includes evaluating the licensee's surveillance to determine readiness for protecting operational safety controls or IROFS from external factors such as earthquakes, tornados, hurricanes, high winds, high temperatures, cold or hot weather, and other adverse weather-related conditions. Inspectors determine whether operational safety controls or IROFS would perform within the design assumptions. Inspectors review surveillance test results for adequacy in meeting the requirements, observe ongoing testing to evaluate staff performance, and ensure that test acceptance criteria are in agreement with operational safety controls or IROFS specifications.

Basis: This area is inspected to determine whether surveillance activities for IROFS and other safety controls are adequate to assure that IROFS and controls are available and reliable to perform their safety function when needed, and to comply with the performance requirements or appropriate license conditions. Surveillance, although not specifically mentioned in the definition in 70.4, is a management measure as discussed in the standard review plan.

c. Fire Protection

Scope: Inspection activities in this area evaluate protection against fires within and external to the facility. The inspection is conducted in two phases. Phase 1 consists of annual assessment of conditions related to ignition sources, control of combustible materials, and fire protection systems and equipment. (For licensees with resident inspectors, Phase 1 is conducted at the frequency specified in resident inspection procedures.) Phase 2 is a periodic inspection that is a more in-depth review of fire

protection of operational safety controls or IROFS and other fire protection required by the license.

Basis: This area is inspected to determine whether fire protection systems and equipment and administrative controls are available and reliable for the fire accident sequences delineated in safety analyses or the ISA required, in part, by 70.62(c)(1)(iv).

d. Flood Protection

Scope: Inspection activities in this area focus on a licensee's readiness to protect operational safety controls or IROFS from potential internal and external flooding. These inspection activities would include walkdowns of key plant areas to determine whether flood protection features are adequately implemented, review of procedures including verification of key operator actions credited for coping with flood, and evaluation of compensatory measures during impending conditions of flooding or heavy rains. The inspection would also focus on determining whether the licensee's flooding mitigation plans and equipment are consistent with the licensee's ISA or safety analysis.

Basis: This area is inspected to assure that the licensee has identified, implemented, and maintained flood protection controls that are consistent with protecting the plant from external events required by 70.62(c)(1)(iv) or the appropriate safety analyses required by license condition.

e. Cold or Hot Weather Protection

Scope: Inspection activities in this area focus on a licensee's readiness to protect operational safety controls or IROFS from potential impacts from cold or hot weather. These inspection activities would include walkdowns of key plant areas to determine whether cold or hot weather protection features are adequately implemented, review of procedures including verification of key plant staff actions credited for coping with cold or hot weather, and evaluation of compensatory measures during impending conditions of cold or hot weather. The inspection also focuses on determining whether the licensee's cold or hot weather protection plans and equipment are consistent with the licensee's ISA or safety analysis.

Basis: This area is inspected to assure that the licensee has identified, implemented, and maintained cold/hot weather protection controls that are consistent with protecting the plant from external events required by 70.62(c)(1)(iv) or appropriate safety analyses required by license condition.

f. Offsite and Onsite Power Reliability

Scope: Inspection activities in this area focus on a licensee's actions to ensure the reliability of offsite power during adverse weather conditions such as freezing rain or high winds. In addition, inspection activities cover a licensee's actions to ensure the availability and reliability of onsite backup power such as batteries and emergency diesel generators.

Basis: This area is inspected to assure that the licensee has identified, implemented, and maintained power reliability protection controls that are consistent with protecting

the plant from external events required by 70.62(c)(1)(iv) or appropriate safety analyses required by license condition.

5. Configuration Control

Maintaining configuration control of operational safety controls or IROFS is essential to ensure they are available and reliable when needed. Thus there is no compromise of the ability to prevent or mitigate the consequences of a release.

a. Permanent Plant Modifications

Scope: Inspection activities in this area include the review of design, installation, configuration control, and post-modification testing for risk-significant permanent modifications potentially affecting operational safety controls or IROFS. Inspection activities include an in-depth review of changes to the initial licensed design, the ISA and ISA summary or safety analysis, management measures, and normal and emergency operating procedures.

Basis: This area is inspected to assure that the licensee's evaluations of the modifications meet the requirements of 10 CFR 70.72, "Facility Changes and Change Process," or the appropriate license condition.

b. Temporary Plant Modifications

Scope: Inspection activities in this area include a review of design, installation, configuration control, and post-modification testing for selected potentially risk-significant temporary modifications that impact operational safety controls or IROFS.

Basis: This area is inspected to assure that the licensee's evaluations of the modifications meet the requirements of 10 CFR 70.72 or the appropriate license condition.

c. Equipment Alignment

Scope: Inspection activities in this area determine whether equipment is properly aligned and whether there are discrepancies that impact the operational safety controls or IROFS. Equipment alignment includes visual observation of actual valve, switch, or breaker positions, if possible; if not, it includes visual observation of system control panels. The inspectors conduct periodic system or control panel walkdowns to determine whether operational safety controls or IROFS are properly aligned.

Basis: This area is inspected to determine whether equipment is in the correct alignment for operation to support 70.61(e) (or the appropriate license condition) and that it is left in the correct alignment after a modification has been implemented in accordance with 70.72 or the appropriate license condition.

6. Corrective Action Program

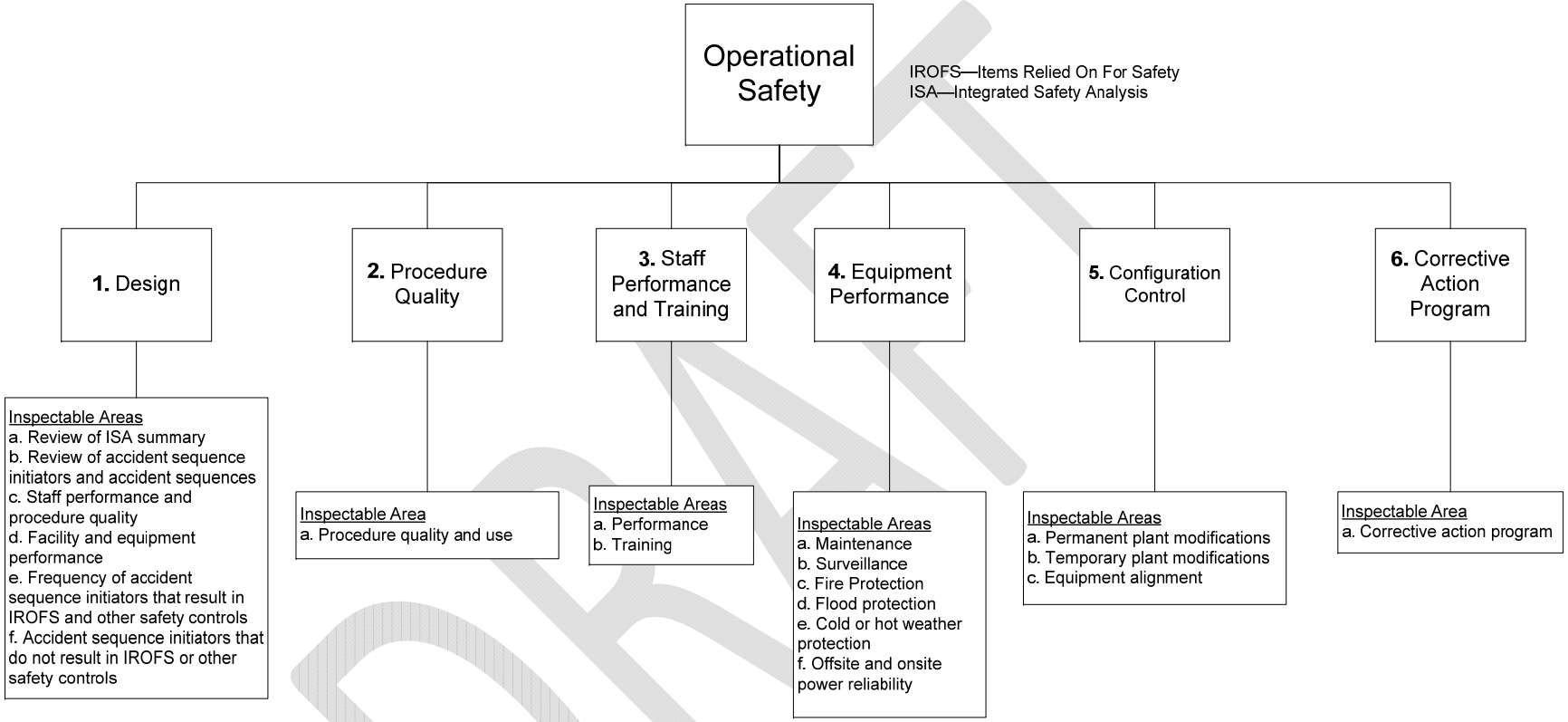
The licensee's CAP is expected to identify and correct problems or indications of problems in the above key attributes that could lead to degraded operational safety controls or IROFS. The CAP should identify early indications of problems before they have actual safety impacts.

a. Corrective Action Program

Scope: Inspection activities in this area include reviews of selected operational safety items in the licensee's CAP to determine whether the items were adequately identified and corrected. This inspection is to complement the periodic inspection of the CAP program that evaluates implementation of the overall CAP program. This process is a management measure for licensees under 10 CFR Part 70.

Basis: This area is inspected to determine whether the licensee is self-identifying and self-correcting problems in accordance with the corrective action program license condition.

Figure B-1, Operational Safety Cornerstone Key Attributes



Appendix C, Occupational Radiation Safety Cornerstone

Objective

The objective of this cornerstone is to verify adequate protection of worker health and safety from exposure to radiation from radioactive materials used in civilian nuclear fuel processing. Licensees can maintain worker protection by meeting the applicable regulatory limits including "as low as is reasonably achievable" (ALARA).

Key Attributes and Inspectable Areas

Figure C-1 shows the attributes of licensee performance that affect occupational radiation safety. These key attributes and the inspectable areas are described below.

1. Plant Facilities, Equipment, and Instrumentation

   Plant facilities/equipment and instrumentation are used to assess and assure that radiological exposures meet regulatory requirements and are ALARA.

   a. Control of Radiologically Significant Work Environments

   Scope: Inspections in this area will verify that the licensee has implemented effective Radiation Protection (RP) controls to prevent an uncontrolled exposure in an airborne, high radiation area (HRA) or very high radiation area (VHRA) that could potentially exceed regulatory limits. RP controls include: identification and control of the hazard, administrative controls (radiation work permits (RWPs), planning, procedures, postings), physical barrier integrity or engineered controls (e.g., ropes, locked doors, respiratory protection equipment, ventilated process enclosures and gloveboxes, shielding, and ventilation systems), radiological surveys and monitoring (e.g., RP technician coverage, personnel alarming dosimeter, or localized contamination monitoring), and radiation worker training.

   Basis: Inspection in this area supports the plant facilities attribute of the Occupational Radiation Safety cornerstone.

   This area is inspected to assure that the licensee implements and maintains the physical and administrative controls defined in Subparts G, H, I, and J of 10 CFR Part 20, IROFS identified in the facility ISA to prevent or mitigate radiological consequences, and licensee procedures for RWPs, airborne areas, HRAs and VHRAs, and worker adherence to these controls.

   Radiological risk (i.e., exposure) to a worker must be within the occupational exposure limits defined in 10 CFR Part 20 and ALARA to minimize the potential for health effects. Collectively, the access controls provide a "defense-in-depth" against a significant exposure.

b. Radiation Monitoring Instrumentation

Scope: Inspection of this area should ensure that criticality monitors, area radiation monitors, and continuous air monitors are reliable and accurate in areas where activities could result in transient HRAs, VHRAs or airborne areas. This inspection will also include, instrumentation used for routine air sampling and analysis, air monitoring equipment such as pressure gauges used to assess loading of filters and oxygen level meters in inert gloveboxes, contamination monitoring, portable instrumentation used to assess radiologically significant areas or activities including process holdup, and bioassay equipment (such as whole body counters or laboratory analytical equipment).

Basis: This area is inspected to assure that instrumentation is calibrated and maintained (including verifying alarm setpoints) as required by 10 CFR Part 20 and a licensee's procedures. If equipment is designated as IROFS, then inspection should verify that appropriate management measures are in place and up to date.

Radiological risk (i.e., exposure) to a worker should be maintained within the occupational exposure limits defined in 10 CFR Part 20 and ALARA to minimize the potential for health effects. These monitors identify changing radiological conditions to workers such that actions to prevent an overexposure can be taken. Industry has experienced several events where these monitors were the primary indication that radiological conditions had significantly changed as a result of planned or unplanned activities

2. Programs and Processes

Those programs and processes which establish radiological controls and practices to assure radiological exposures meet regulatory requirements and are ALARA.

a. ALARA Planning and Controls

Scope: Inspections in this area will verify that the licensee maintains occupational exposure as low as reasonably achievable (ALARA) by properly planning and controlling radiologically significant work activities. Controls, as stated here, refer to those physical (e.g., locked doors, ropes, shielding, engineering controls) and administrative (e.g., surveys, planning, procedures, training, monitoring) that, in the aggregate, serve to mitigate exposure.

The focus is whether reasonable goals were established for radiologically significant work which consider previous licensee performance and industry experience, and whether the licensee's subsequent performance met those goals. Emphasis should be placed on those jobs having a high individual and/or collective dose, being performed in an area of higher radiological risk or are of concern because of industry or license experience (such as maintenance work on contaminated systems). This may include observing selected activities to verify the assumptions underlying these goals and that the appropriate controls were implemented. The inspection should also review licensee assessments of the ALARA program to determine whether adequate administrative controls, management oversight, and exposure controls (including source term reduction) were taken. Specific attention should be given to Planned Special Exposures and exposures to Declared Pregnant Workers, because of the inherent risk and public

interest.

Basis: This area is inspected to assure that the licensee meets the requirements of Subpart B to 10 CFR Part 20, which requires that a Radiation Protection program, including procedures and engineering controls, be instituted to maintain occupational dose ALARA. As discussed in the Statement of Considerations to the 1991 rule change (FR Vol. 56, No. 98, page 23367), compliance with this requirement is judged on whether the licensee has incorporated measures to track and, if practical, to reduce exposures and not whether exposures represent an absolute minimum.

Radiological risk (i.e., exposure) to a worker should be maintained within the occupational exposure limits defined in 10 CFR Part 20 and ALARA to minimize the potential for health effects. Effective ALARA planning will ensure that adequate physical and administrative controls are in place to mitigate exposure during radiologically significant work. Industry's experience includes frequent events where problems in this area have resulted in unanticipated exposure or a loss of control of the work activity. Specific attention should be given to Planned Special Exposures, exposures to Declared Pregnant Workers, and to activities that challenge the maintenance of occupational exposure control and ALARA, such as emergent work activities and radiological events.

b. Identification and Resolution of Problems/Issues

Scope: Inspections in this area will verify that the licensee has an effective problem identification and resolution (corrective action) program. Problem identification and resolution refers to: (1) the deficiency reporting process; (2) licensee self-assessments; and (3) Quality Assurance audits. Additionally, some departments may have their own problem identification and resolution program. The focus of the inspection is on the licensee's effectiveness in identifying, resolving and preventing risk significant problems.

Basis: Inspection in this area supports all of the cornerstones.

This area is inspected, in accordance with the CAP license condition, to ensure that the licensee effectively assesses performance to identify and correct situations that could impact the cornerstone objective.

An effective problem identification and resolution program is the primary means of reducing risk by correcting deficiencies involving people (i.e., training, knowledge and skills), processes (i.e., procedures and programs), and equipment (i.e., design and maintenance) before they manifest in a significant event affecting the health and safety of workers or the public. Industry experience indicates that licensees having an effective program for identifying and resolving problems also have a reduced frequency of events.

The inspector shall select a set of outputs from a selected program for review. For each cornerstone of interest, a sample set comprising licensee assessments and deficiency reports will be selected for review. The selection will be made using information contained in, and insights gained from, site-specific ISA results, industry experience, and NRC inspection findings. Where site specific toxic hazards and industrial hygiene problems have been identified, the resolution of these types of issues should be included in a review of corrective actions.

For selected programs, additional issues may be identified by periodic observations of

specific activities such pre-job briefings, training, emergency preparedness, or security and fire protection drills and exercises. Some issues may also be identified by reviewing engineering and maintenance work request data bases. Collectively, these issues shall also be reviewed for inclusion in the sample set. When reviewing the sample set, consider whether individuals involved in the problem identification and resolution process effectively identify, resolve and correct risk-significant problems. Additionally determine if risk insights were used to allocate licensee resources for investigating and correcting identified deficiencies.

Inspection should verify that: (1) the licensee's assessments of problems and issues were of sufficient scope to address the key attributes of the cornerstone; (2) the risk significance of the findings was properly assessed; (3) root cause analyses and corrective actions were timely and adequate to prevent recurrence; (4) industry and NRC generic issues were considered; and (5) required reports to the Commission were made.

Periodically during the inspection, discuss issues with the residents or other inspection team members, if applicable, to identify common issues that cross other cornerstones. For example, procedural adherence problems in the Occupational Radiation Safety, Emergency Preparedness, Operational Safety, and Criticality Safety cornerstones. Review the common finding as stated above and determine if the licensee was aware of the common issues.

Additional sampling of the licensee's corrective action program feedback loop is required if: (1) recurrent issues or highly risk significant findings were identified; or (2) adequate corrective actions were not taken in response to reduced safety performance.

3. Human Performance

Because all activities impacting radiation safety have a partial basis in personnel actions, human performance should be evaluated to ensure that human errors are considered and minimized for those activities with exposure potential.

a. Radiation Worker Performance

Scope: Inspection activities in this area consists of observing radiation worker (including Radiation Protection (RP) technicians) performance to verify that they are aware of and use appropriate radiological controls (such as properly controlling radioactive material and using respiratory protection equipment) when performing work involving radiological hazards.

The focus is on whether licensee identified radiation worker performance events were appropriately corrected, were not recurrent and were being trended to identify underlying performance issues (such as poor training). This includes observations of work during plant walk downs, performed as part of other inspectable areas (such as ALARA Planning and Controls and Radioactive Material Processing and Transportation), to verify that workers (including technicians) understand and use appropriate controls to maintain exposures within regulatory limits and ALARA, and to prevent an unauthorized release of radioactive material to the environment.

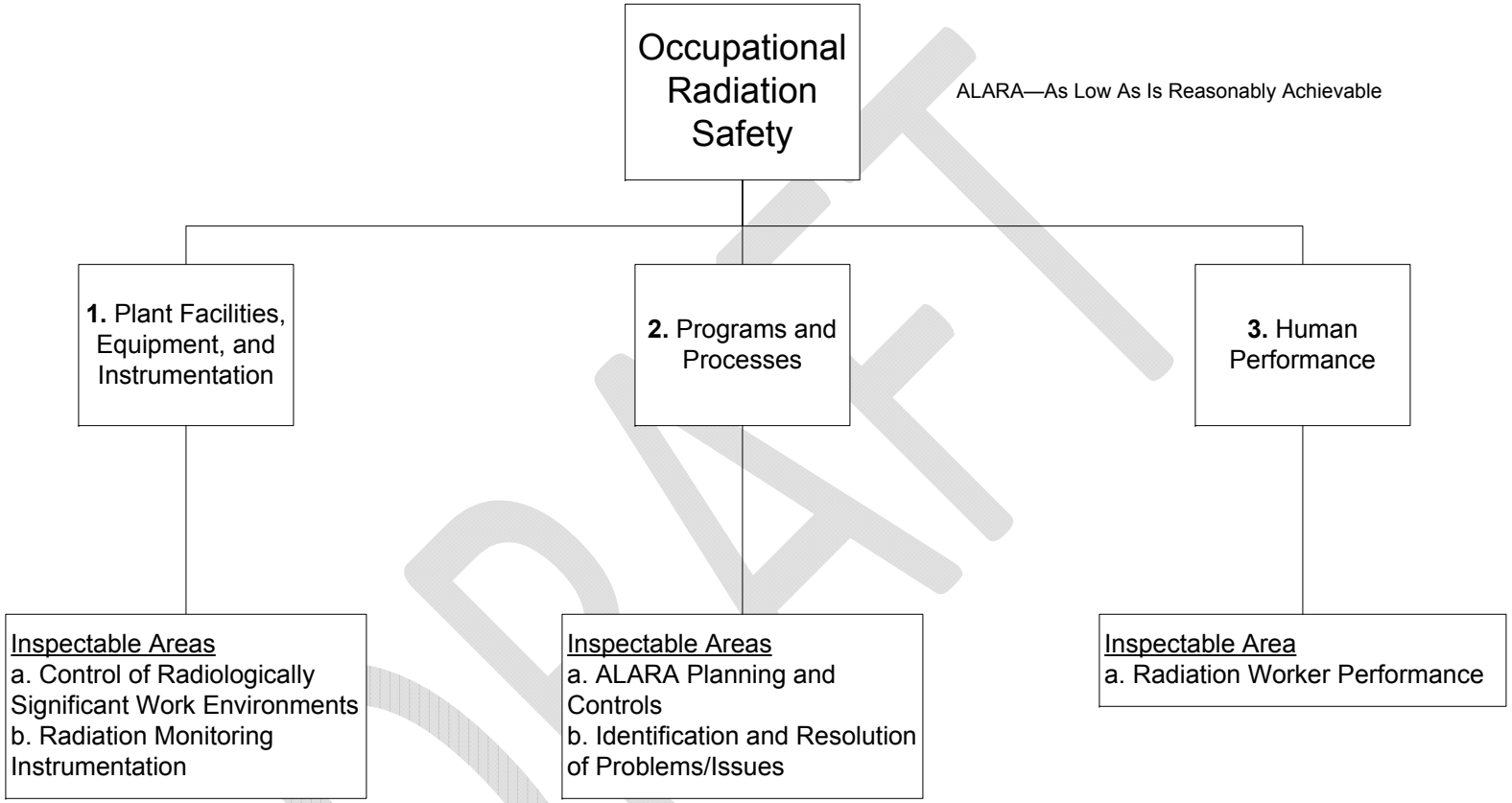
Basis: Inspection in this area supports the Occupational and Public Radiation Safety

cornerstones.

This area is inspected to verify that workers understand the radiological hazards associated with nuclear fuel cycle facility operation, effectively identify and control these hazards, identify and resolve adverse trends or deficiencies, and maintain proper oversight of work. The associated risk is the potential for a significant, unplanned exposure resulting either directly or in part by the failure of a worker to perform a required task owing to poor knowledge or training.

Recurrent problems in this area have been identified by the industry as a root or contributing cause in many exposure events and in some events involving the unplanned release of radioactive material to the environment. This is of special concern during maintenance activities, when radiologically significant work is often performed by contract staff having varying levels of experience.

Figure C-1, Occupational Radiation Safety Cornerstone Key Attributes



Appendix D, Public Radiation Safety Cornerstone

Objective

The objective of this cornerstone is to verify adequate protection of public health and safety from exposure to radiation from radioactive material used in civilian nuclear fuel processing. Public exposure would result from radioactive materials released into the public domain as a result of civilian nuclear fuel processing operations. These releases include routine gaseous and liquid radioactive effluent discharges, the inadvertent release of solid contaminated materials, and the offsite transport of radioactive materials and wastes. Licensees can maintain public protection by meeting the applicable regulatory limits including "as low as is reasonably achievable" (ALARA).

Key Attributes and Inspectable Areas

Figure D-1 shows the attributes of licensee performance that affect public radiation safety. These key attributes and the inspectable areas are described below.

1. Plant Facilities, Equipment, and Instrumentation

   The release of effluents and waste is heavily dependent on the process methods to minimize waste, waste treatment methods, and the instruments used to assess radioactive materials in the applicable media.

   a. Airborne and Liquid Effluent Treatment Systems

   Scope: Inspection activities in this area will verify that airborne and liquid radioactive effluent treatment systems are maintained such that radiological releases are properly mitigated, monitored and assessed. The focus is to ensure that radiological effluent releases are controlled in accordance with license conditions and regulatory limits, that system modifications are properly performed, and that radiological effluent and meteorological monitors are accurate and reliable. Overall system operation (including administrative controls) will be assessed by reviewing licensee problem and resolution assessments, the semi-annual radiological release reports, the reported annual dose from airborne releases, and any compiled information evaluating emissions trends for ALARA.

   The baseline program consists of performing in-office reviews of the semi-annual radiological release reports to verify that the program is being implemented as described in the licensee's procedures. Additional areas of review (on-site) include calibration of the gaseous and liquid radiological effluent monitors, including any modifications to the system, the calibration and operation of the site meteorological monitoring system, if applicable, and modifications to the radioactive waste treatment system. The baseline inspection also includes a walk down of the airborne and liquid radioactive processing and monitoring systems to observe routine activities and to verify that previously identified deficiencies are being corrected.

Basis: Inspection in this area supports the plant facilities/equipment and instrumentation and program/process attributes of the Public Radiation Safety cornerstone. This areas is inspected to verify that airborne and liquid radioactive effluent processing systems are maintained as required by license commitments.

The dose from radioactive effluents is required to be maintained within the limits of 10 CFR Part 20 and 40 CFR Part 190, as well as being As Low As is Reasonably Achievable (ALARA) to minimize the potential for health effects. Proper operation of the radioactive effluent treatment system and release point monitors will ensure an adequate defense-in-depth against an unmonitored, unanticipated release of radioactivity to the environment.

The NRC has determined that an independent assessment of licensee performance in this area is necessary to ensure that adequate protection of the public health and safety is maintained.

2. Programs and Processes

Programs and processes are established to ensure regulatory and license compliance with regards to transportation activities, environmental monitoring, and waste treatment.

a. Radioactive Material Processing and Transportation

Scope: Inspection activities of this area will verify that appropriate controls are instituted for the processing and transportation of radioactive material to a licensed disposal facility or other licensed recipient. The focus of the inspection is to review the administrative and physical controls for the processing and transportation of radioactive material (i.e., Class A, B, C, and greater than class C shipments) to ensure that radiation exposure to radiation workers and members of the public are within regulatory limits. The inspection also includes a walkdown of the radioactive waste processing systems to verify that the systems are in good material condition. During the inspection, a review and observation is performed on a sample of selected shipping activities having risk-significance (such as Type B, C, or greater than class C shipments), including reviewing associated transportation records, to provide independent validation of the transportation program. Emphasis is also given to the 10 CFR Part 61 waste characterization and stability requirements (III.A.3 and III.C.5 of Appendix G to 10 CFR Part 20). The inspection uses licensee documentation and assessments for the review of lesser shipping activities (i.e., Type A), administrative controls, worker training and qualifications, and to verify that changes to the U.S. Department of Transportation (DOT) or NRC transportation requirements were addressed. All transportation events reported to the Commission or to the licensee from a State

Basis: This area is inspected to verify that the radioactive material processing and transportation program comply with the requirements of 10 CFR Parts 20 and 71 and DOT regulations 49 CFR Parts 170-189. Radioactive material intended for disposal must also comply with 10 CFR 61.55 - 61.57 waste classification and stability requirements.

The regulations contain specific physical and administrative controls that provide a defense-in-depth approach for the safe processing and transport of radioactive material,

including situations involving the breach of a loaded transport package. Although there is a low frequency of industry events, the actual or potential consequence (i.e., significant exposures or release of radioactive material) can be high. The NRC has determined that an independent assessment of performance in this area is necessary to ensure that adequate protection of public health and safety is maintained.

b. Radiological Environmental Monitoring Program

Scope: Inspection activities in this area will ensure that the Radiological Environmental Monitoring Program (REMP) reasonably measures the effects of radioactive releases to the environment and sufficiently validates the integrity of the airborne and liquid effluent release program. The focus is on adverse trends or recurrent problems identified through licensee assessments or the semi-annual effluent reports and periodic observations of worker and equipment performance.

The baseline inspection should consist of an in-office review of any radiological environmental monitoring reports and licensee assessments to verify that the REMP was implemented as required by license commitments and procedures. Specific emphasis should be placed on verifying that environmental sampling is representative of the release pathways and that missed samples and/or inoperable sampling/analyses equipment are being properly addressed. A subsequent on-site walk down to observe sampler stations, environmental sampling and analyses techniques, and to review the calibration and maintenance of the counting room instrumentation should also be performed. The inspection should also consider the quality of procedures, quality assurance results of sample analysis, tracking of samples and other minor administrative processes.

Basis: Inspection in this area supports the plant facilities/equipment and instrumentation, and program/process attributes of the Public Radiation Safety cornerstone.

This area is inspected to verify that the REMP is implemented consistent with the licensee's commitments and procedures to validate that the effluent release program meets the ALARA principle. The REMP supplements the effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are as predicted by the effluent measurements and modeling of effluent pathways. As such, it serves as assurance that the associated dose from radioactive releases is within regulatory limits. Industry experience has shown that the REMP is often the primary method of assessing the potential risk from unplanned or unmonitored radioactive releases.

Because REMP results have served to allay public concerns regarding the actual health effects due to radioactive releases, the NRC has determined that an independent assessment of performance in this area is necessary to ensure that adequate protection of the public health and safety is maintained.

c. Identification and Resolution of Problem/Issues

Scope: Inspections in this area will verify that the licensee has an effective problem identification and resolution (corrective action) program. Problem identification and resolution refers to: (1) the deficiency reporting process; (2) licensee self-assessments;

and (3) Quality Assurance audits. Additionally, some departments may have their own problem identification and resolution program. The focus of the inspection is on the licensee's effectiveness in identifying, resolving and preventing risk significant problems.

Basis: Inspection in this area supports all of the cornerstones.

This area is inspected, in accordance with the CAP license condition, to ensure that the licensee effectively assesses performance to identify and correct situations that could impact the cornerstone objective.

An effective problem identification and resolution program is the primary means of reducing risk by correcting deficiencies involving people (i.e., training, knowledge and skills), processes (i.e., procedures and programs), and equipment (i.e., design and maintenance) before they manifest in a significant event affecting the health and safety of workers or the public. Industry experience indicates that licensees having an effective program for identifying and resolving problems also have a reduced frequency of events.

The inspector shall select a set of outputs from a selected program for review. For each cornerstone of interest, a sample set comprising licensee assessments and deficiency reports will be selected for review. The selection will be made using information contained in, and insights gained from, site-specific ISA results, industry experience, and NRC inspection findings. Where site specific toxic hazards and industrial hygiene problems have been identified, the resolution of these types of issues should be included in a review of corrective actions.

For selected programs, additional issues may be identified by periodic observations of specific activities such pre-job briefings, training, emergency preparedness, or security and fire protection drills and exercises. Some issues may also be identified by reviewing engineering and maintenance work request data bases. Collectively, these issues shall also be reviewed for inclusion in the sample set. When reviewing the sample set, consider whether individuals involved in the problem identification and resolution process effectively identify, resolve and correct risk-significant problems. Additionally determine if risk insights were used to allocate licensee resources for investigating and correcting identified deficiencies.

Inspection should verify that: (1) the licensee's assessments of problems and issues were of sufficient scope to address the key attributes of the cornerstone; (2) the risk significance of the findings was properly assessed; (3) root cause analyses and corrective actions were timely and adequate to prevent recurrence; (4) industry and NRC generic issues were considered; and (5) required reports to the Commission were made.

Periodically during the inspection, discuss issues with the residents or other inspection team members, if applicable, to identify common issues that cross other cornerstones. For example, procedural adherence problems in the Occupational Radiation Safety, Emergency Preparedness, Operational Safety, and Criticality Safety cornerstones. Review the common finding as stated above and determine if the licensee was aware of the common issues.

Additional sampling of the licensee's corrective action program feedback loop is required if: (1) recurrent issues or highly risk significant findings were identified; or (2) adequate corrective actions were not taken in response to reduced safety performance.

3. Human Performance

Because all activities impacting Radiation Safety have a partial basis in personnel actions, human performance should be evaluated to ensure that human errors are considered and minimized for those activities with exposure potential.

a. Radiation Worker Performance

Scope: Inspection activities in this area consists of observing radiation worker (including Radiation Protection (RP) technicians) performance to verify that they are aware of and use appropriate radiological controls (such as properly controlling radioactive material and using respiratory protection equipment) when performing work involving radiological hazards.

The focus is on whether licensee identified radiation worker performance events were appropriately corrected, were not recurrent and were being trended to identify underlying performance issues (such as poor training). This includes observations of work during plant walk downs, performed as part of other inspectable areas (such as ALARA Planning and Controls and Radioactive Material Processing and Shipping), to verify that workers (including technicians) understand and use appropriate controls to maintain exposures within regulatory limits and ALARA, and to prevent an unauthorized release of radioactive material to the environment.

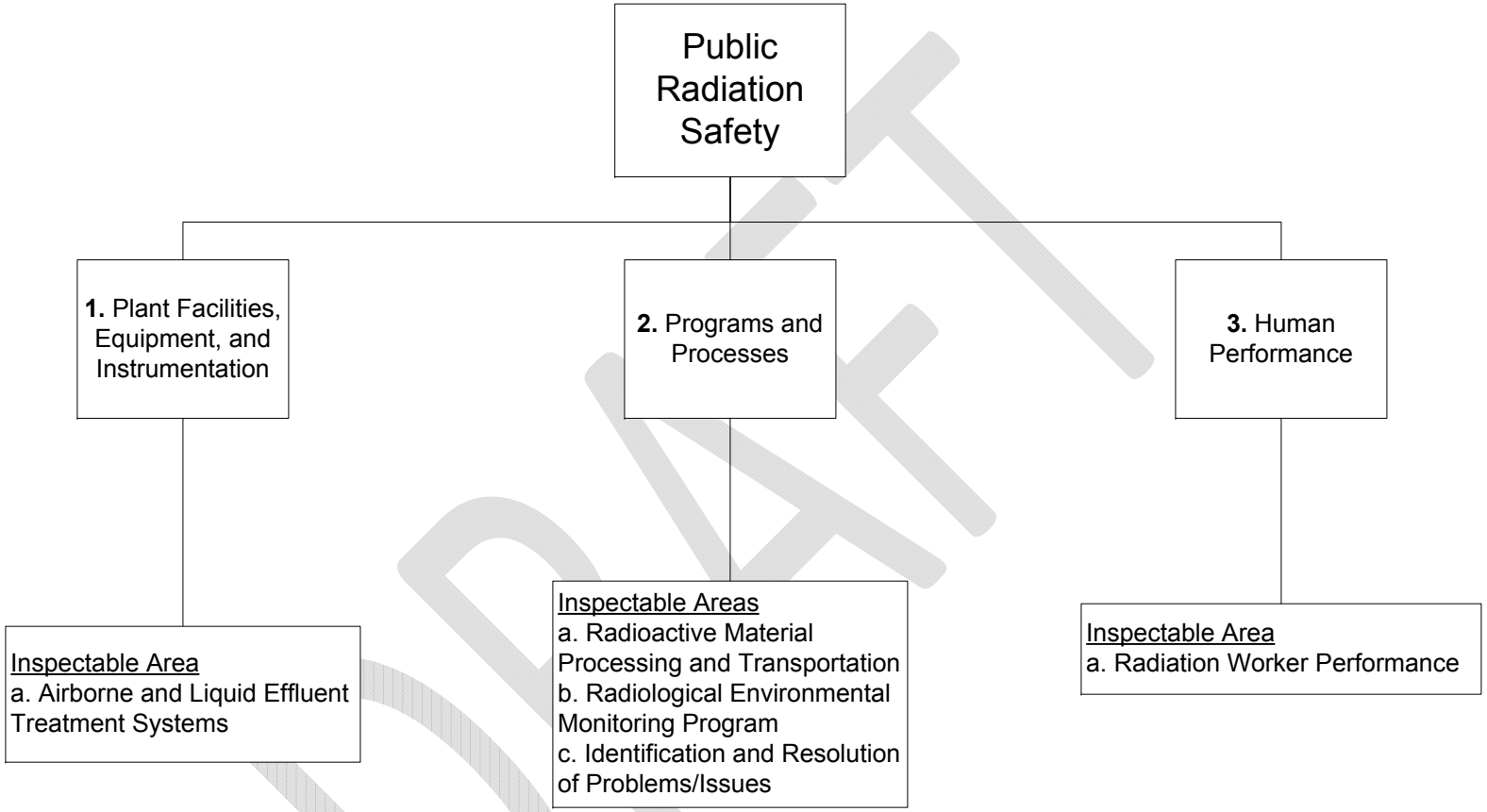
Basis: Inspection in this area supports the Occupational and Public Radiation Safety cornerstones.

This area is inspected to verify that workers understand the radiological hazards associated with nuclear plant operation, effectively identify and control these hazards, identify and resolve adverse trends or deficiencies, and maintain proper oversight of work. The associated risk is the potential for a significant, unplanned exposure resulting either directly or in part by the failure of a worker to perform a required task owing to poor knowledge or training.

Recurrent problems in this area have been identified by the industry as a root or contributing cause in many exposure events and in some events involving the unplanned release of radioactive material to the environment. This is of special concern during maintenance activities, when radiologically significant work is often performed by contract staff having varying levels of experience.

Recurrent problems in this area have been identified by the industry as a root or contributing cause in many exposure events and in some events involving the unplanned release of radioactive material to the environment. This is of special concern during maintenance activities, when radiologically significant work is often performed by contract staff having varying levels of experience.

Figure D-1, Public Radiation Safety Cornerstone Key Attributes



Appendix E, Emergency Preparedness Cornerstone

Objective

The objective of this cornerstone is to verify that the licensee is capable of implementing adequate measures to protect public health and safety in the event of a radiological or chemical emergency (for those chemicals under U.S. Nuclear Regulatory Commission jurisdiction).

Key Attributes and Inspectable Areas

Figure E-1 shows the key attributes of licensee performance that affect emergency preparedness. These key attributes and the inspectable areas are described below.

1. Emergency Readiness (Emergency Response Organization (ERO), Including Fire Brigade)

   Implementation of the emergency plan is dependent on the readiness of the ERO to respond to emergencies. Licensee training programs provide the ERO knowledge base, and the drills provide opportunities to gain proficiency and maintain skills in individual duties and team function in the integrated organization. Licensee assessment of ERO performance during drills and exercises identifies successful performance and areas for improvement. The ability to augment onsite ERO staff ensures full staffing of the ERO within the timeliness goals of the emergency plan.

   a. ERO Drill Participation

   Scope: Inspection activities in this area focus on participation in drills or exercises, proficiency development, and skill maintenance (including the self-assessment noted below (2.a)). Inspection activities include review of drill participation frequency for members of the ERO.

   Basis: This area is inspected to assure that the licensee is implementing the program in accordance with the Emergency Response Plan, Emergency Implementing procedures, license condition, 10 CFR 40.31(j) and 40.35(f), and 10 CFR 70.22(i) and 70.32(i).

   b. Timely ERO Augmentation

   Scope: Inspection activities in this area include ERO notification system functionality, ERO response timeliness, and ERO staffing duty roster. Inspection activities also include review of the results of the licensee's testing of ERO notification system, evaluation of ERO augmentation timeliness during drills, exercises and actual events, and review of adequacy and qualifications of ERO staff on duty roster.

   Basis: This area is inspected to assure that the licensee is implementing the program in accordance with the Emergency Response Plan, Emergency Implementing procedures, license condition, 10 CFR 40.31(j) and 40.35(f), and 10 CFR 70.22(i) and 70.32(i).

2. Emergency Performance (ERO, Including Fire Brigade)

The adequacy of the implementation of the emergency plan is dependent on the performance of the ERO in their emergency plan assignments. The technical aspects of these assignments generally align with the expertise of the individual, but also include duties unique to emergency response. The opportunity to demonstrate proficiency is provided in drills, exercises, and actual events that require implementation of the emergency plan. ERO performance during initial and re-qualification drills and exercises provide an indication of expected ERO performance during an actual event.

a. Emergency Performance

Scope: Inspection activities in this area focus on:

1) Timely and Accurate Classification of Events
2) Timely and Accurate Notification Emergency Classification to Offsite Government Authorities
3) Timely and Accurate Development of Protective Action Recommendations (PARs)
4) Timely and Accurate Notification of PARs to Offsite Authorities
5) Timely and Effective Fire Brigade Performance
6) ERO Performance Assessment

Basis: This area is inspected to assure that the licensee is implementing the program in accordance with the Emergency Response Plan, Emergency Implementing procedures, license condition, 10 CFR 40.31(j) and 40.35(f), and 10 CFR 70.22(i) and 70.32(i).

3. Procedure Quality

To ensure adequate emergency preparedness and response, the procedures that control preparedness and response facilities, equipment, and actions must be correct. Maintenance and testing procedures are essential to ensuring the capability and functionality of emergency response facilities and equipment is adequate. Emergency plan implementing procedures are essential to ensuring ERO performance, in accordance with the emergency plan, is adequate. Unclear, out of sequence, or generally poor quality procedures may result in ERO response errors that lead to the inadequate implementation of the emergency plan.

a. Procedure Quality

Scope: Inspection activities in this area focus on the clarity and quality of emergency plan implementing procedures with regard to risk-significant procedures (i.e., those procedures associated with the emergency performance attributes 2.a.1) through 2.a.4) above) through observation of ERO performance in the exercise conducted every 2 years, in drills, or during walkthroughs conducted by inspectors.

Basis: This area is inspected to assure that the licensee is implementing the program in accordance with the Emergency Response Plan, Emergency Implementing procedures, license condition, 10 CFR 40.31(j) and 40.35(f), and 10 CFR 70.22(i) and 70.32(i).

4. Facility and Equipment Performance

Licensees are required to maintain emergency response facilities and equipment specified in the emergency plan needed to implement licensee emergency response. This includes assurance of the operability of the public warning system (PWS) where one is required.

a. Availability of PWS

Scope: Inspection activities in this area focus on determining whether the PWS is able to perform its design function as specified in the emergency plan. Inspection includes a review of the licensee's testing activities for the PWS.

Basis: This area is inspected to assure that the licensee is implementing the program in accordance with the Emergency Response Plan, Emergency Implementing procedures, license condition, 10 CFR 40.31(j) and 40.35(f), and 10 CFR 70.22(i) and 70.32(i).

b. Availability of Facilities and Equipment

Scope: Inspection activities in this area focus on determining whether surveillance testing of facilities and equipment assures that they are capable of performing their intended safety functions. Inspections review surveillance test results for adequacy in meeting the requirements.

Basis: This area is inspected to assure that the licensee is implementing the program in accordance with the Emergency Response Plan, Emergency Implementing procedures, license condition, 10 CFR 40.31(j) and 40.35(f), and 10 CFR 70.22(i) and 70.32(i).

5. Offsite Emergency Preparedness Support

State and local government authorities maintain offsite emergency preparedness programs and, where required (Letter of Agreement between licensee and local authorities), implement protective actions to protect public health and safety. The licensee is required by the emergency plan to supply appropriate information to offsite authorities to allow timely implementation of this support.

a. Offsite Emergency Preparedness Support

Scope: Inspection activities in this area focus on information that the licensee provided to offsite support (such as the fire department and medical support), as defined in the emergency plan. Inspection activities include review of the licensee's training and orientation of offsite support groups and, potentially, discussions with offsite support group representatives to determine that training and orientation were offered and conducted as required by the emergency plan.

Basis: This area is inspected to assure that the licensee is implementing the program in accordance with the Emergency Response Plan, Emergency Implementing procedures, license condition, 10 CFR 40.31(j) and 40.35(f), and 10 CFR 70.22(i) and 70.32(i).

6. Corrective Action Program (CAP)

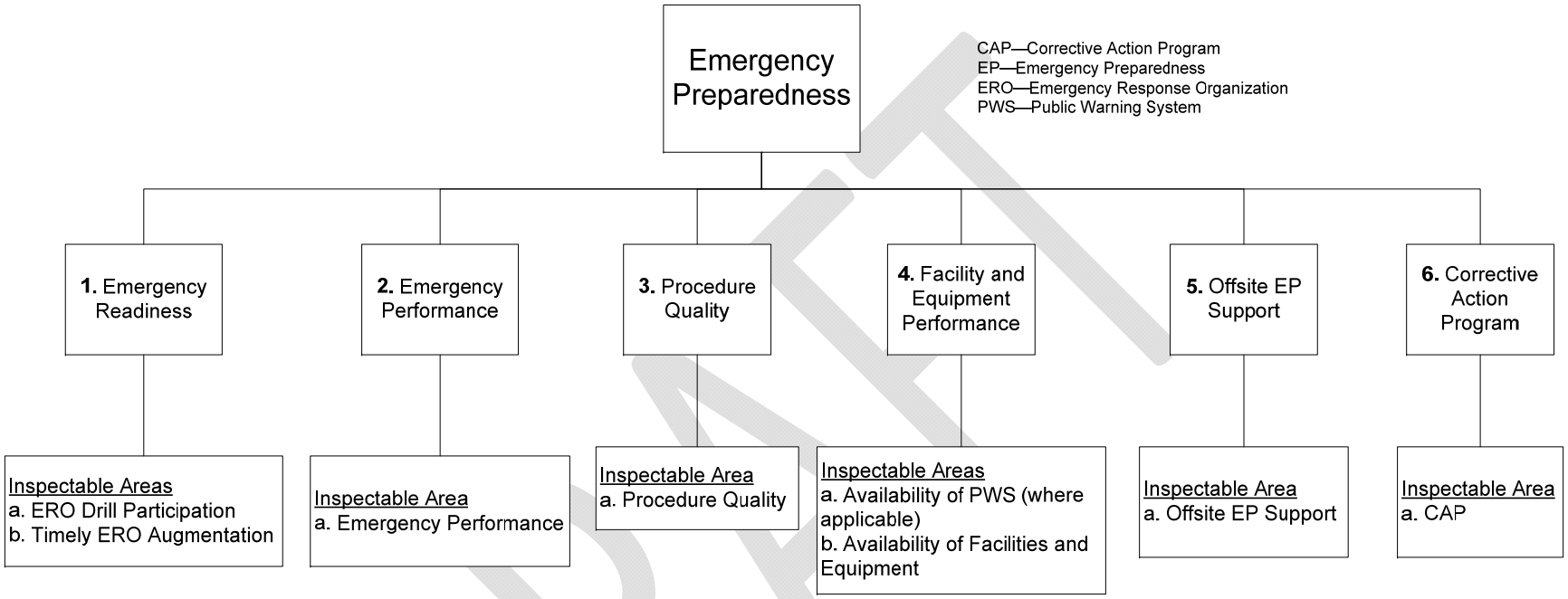
The licensee's CAP is expected to identify and correct problems or indications of problems in the above key attributes that could lead to degraded emergency preparedness components. The CAP should identify early indications of problems before they have actual safety impacts.

a. CAP

Scope: Inspection activities in this area include reviews of selected emergency preparedness items in the licensee's CAP to determine whether the items were adequately identified and corrected.

Basis: This area is inspected to assure that the licensee is implementing the program in accordance with the Emergency Response Plan, Emergency Implementing procedures, CAP license condition, 10 CFR 40.31(j) and 40.35(f), and 10 CFR 70.22(i) and 70.32(i).

Figure E-1, Emergency Preparedness Cornerstone Key Attributes



Appendix F, Security Cornerstone

Objective

The objectives of this cornerstone are:

1. To verify that the licensee's safeguards systems and programs for both fixed site and transportation shipments promote the common defense and security by protecting against: (a) acts of radiological sabotage; (b) loss, theft, and diversion of special nuclear material(SNM); and (c) unauthorized disclosure of classified and sensitive unclassified information; and

2. To verify that the licensee's physical protection systems minimize the possibility for unauthorized removal of SNM and facilitate the location recovery of missing SNM.

Key Attributes and Inspectable Areas

Figure F-1 shows those attributes of licensee performance that affect security systems. These key attributes and the inspectable areas are described below.

Note: There are various categories of licensees, as such; regulatory requirements for each specific class of facility or material license holder will vary. Each licensee shall establish and maintain physical security in accordance with regulatory requirements and orders specific to each class of facility or material license. Additionally, controlled areas, as identified below, are those areas that either meet the specifications of a: (1) Protected Area; (2) Material Access Area; (3) Controlled Access Area; (4) Vital Area; or (5) Vault.

1. Access Authorization

   Access authorization measures will vary based on the type of material that the facility is licensed to possess. This area measures the ability of the licensee to implement its access authorization program in accordance with regulatory requirements. Inspection areas for this key attribute include (1) security plans and procedures; (2) personnel screening; (3) fitness for duty (FFD); and (4) personnel monitoring programs. These key areas provide integral information as to how the licensee grants, monitors, denies, and revokes individuals' unescorted access authorization into controlled areas. This is a risk significant area because the personnel screening, FFD program and monitoring processes are used to verify personnel reliability and trustworthiness prior to granting unescorted access to a site's controlled areas and to assure continued reliability and trustworthiness throughout the period of unescorted access and authorization. The establishment of reliability and trustworthiness for persons granted unescorted access to controlled areas is a major component of protection against the insider threat. The behavioral observation process is used to monitor the continuation of trustworthiness for persons authorized unescorted access and for escorted visitors. An individual with malevolent intent or an individual under the influence of drugs or alcohol could be granted unescorted access due to a human or program failure. The frequency of this type of event has been low, but the safety significance of this type of event could be medium to high.

a. Security Plans and Procedures

Scope: Inspection activities in this area include the review of the facilities' security plans and procedures to verify compliance with applicable regulatory requirements.

Basis: This area is inspected because facility security plans and procedures outline how the licensee plans to meet regulatory requirements in 10 CFR Part 73 and applicable Orders.

b. Personnel Screening

Scope: Inspection activities in this area include the review of records to verify that screening requirements have been met.

Basis: This area is inspected because the licensee is required to maintain an access authorization program, which includes background investigations and psychological assessments, for granting individuals unescorted access to controlled areas with the objective of providing assurance that the individuals are trustworthy and reliable and do not constitute an unreasonable risk to public health and safety including the potential to commit radiological sabotage, and loss, theft or diversion of special nuclear material as required by 10 CFR Part 73 and applicable Orders.

c. Fitness for Duty

Scope: Inspection activities in this area include the review of records to verify that FFD screening requirements have been met.

Basis: This area is inspected because the licensee is required to maintain a FFD program that provides reasonable assurance that the workforce will perform tasks in a reliable and trustworthy manner and that they are not under the influence or impaired from any cause as required by 10 CFR Part 73 and applicable Orders.

d. Personnel Monitoring Programs

Scope: Inspection activities in this area include the review of licensee personnel monitoring program procedures and interviews to verify compliance with regulatory requirements.

Basis: This area is inspected because licensees are required, by 10 CFR Part 73 and applicable Orders, to implement behavioral observation to detect indications of behavioral problems that could constitute a threat to public health and safety.

2. Access Control

Access control measures will vary based on the type of material that the facility is licensed to possess. This area measures the ability of the licensee to implement its access control program in accordance with regulatory requirements. Inspection areas for this key attribute include: (1) security plans and procedures; and (2) access control measures (identification and search) for controlled areas. These inspection areas verify

that the licensee has effective access controls and equipment in place designed to detect and prevent access by unauthorized individuals and vehicles, and prevent the introduction of contraband (firearms, explosives, incendiary devices, etc.) into controlled areas that could be used to commit radiological sabotage and loss, theft or diversion of special nuclear material. This is a risk significant area because the access control program verifies the identification, authorization and search of personnel, packages and vehicles prior to entry into controlled areas. The identification and authorization process is to assure that, once personnel have been screened to verify their trustworthiness, those persons have a need for access and to confirm that only those persons who have been screened and have a need are granted access to the facility and controlled areas. Some of the equipment involved are metal detectors, explosive detectors, x-ray machines, biometric sensors, computers, key-cards, hard keys, and card-readers.

The search function is to prevent the introduction of contraband (firearms, explosives, incendiary devices, etc.) that could be used to commit radiological sabotage and loss, theft or diversion of special nuclear material. The search function for detection of firearms, explosives and incendiary devices on individuals, in packages, or vehicles, is accomplished by equipment or a hands-on search. These identification and authorization functions are accomplished during issuing of badges and through the use of biometrics or card-readers. The licensee must also positively control all points of personnel and vehicle access into controlled areas. Failures in the licensee's access control program could allow unauthorized access or the introduction of contraband, described above, into controlled areas or allow unauthorized egress with radioactive material and thus the consequence of risk to radiological sabotage and loss, theft or diversion of special nuclear material is considered moderate to high.

a. Security Plans and Procedures

Scope: Inspection activities in this area include the review of the facilities security plans and procedures to verify compliance with applicable regulatory requirements.

Basis: This area is inspected because facility security plans and procedures outline how the licensee plans to meet regulatory requirements in 10 CFR Part 73 and applicable Orders.

b. Access Control Measures

Scope: Inspection activities in this area include the reviews to verify the licensee implements an access control program that only allows access to only those persons who have a need for access and verify that those persons have been properly screened prior to entry into controlled areas.

Basis: This area is inspected because the licensee access control measures are critical to the effective implementation of a facility's security program in preventing radiological sabotage and loss, theft and diversion of special nuclear material as required by 10 CFR Part 73 and applicable Orders.

3. Physical Protection

Physical protection systems will vary based on the type of material that the facility is licensed to possess. This area measures the functionality of components and training of security force personnel in the sites implementation of its physical protection system in accordance with regulatory requirements. Inspection areas for this key attribute include: (1) security plan and procedures; (2) equipment performance, testing and maintenance; and (3) security training. These key areas verify that the licensee has an effective physical protection system in place designed to protect against radiological sabotage and loss, theft or diversion of special nuclear material. This is a risk significant area because the physical protection system verifies the functionality, reliability, and sensitivity of security system equipment along with verifying that security officers are properly trained and qualified to implement the facilities security program effectively. An effective physical protection system depends on having properly trained and qualified security officers who are properly equipped. Additionally, the equipment used by the physical protection system must be designed, tested and maintained in order to implement the physical protection system effectively and support the protective strategy. Failures in this area could allow for unauthorized access to special nuclear material in controlled areas, thus the risk significance associated with this attribute would be medium to high.

a. Security Plans and Procedures

Scope: Inspection activities in this area include the review of facilities' security plans and procedures to verify compliance with applicable regulatory requirements.

Basis: This area is inspected because facility security plans and procedures outline how the licensee plans to meet regulatory requirements in 10 CFR Part 73 and applicable Orders.

b. Equipment Performance, Testing, and Maintenance

Scope: Inspection activities in this area focus on critical security system and intruder detection equipment.

Basis: This area is inspected because the functionality, reliability, and sensitivity of security system equipment are critical to the effective implementation of a facility's security program as required by 10 CFR Part 73 and applicable Orders.

c. Security Training

Scope: Inspection activities in this area focus on initial training and periodic requalification, including weapons training

Basis: This area is inspected because effective implementation of a licensee's security program depends on having properly trained and qualified security personnel who are properly equipped as required by 10 CFR Part 73 and applicable Orders.

4. Contingency Response

Contingency response measures will vary based on the type of material that the facility is licensed to possess. This area measures the ability of the licensee to protect against radiological sabotage and loss, theft and diversion of special nuclear materials. The implementation of the facility's protective measures includes demonstrating that these measures work, and that the security organization can successfully protect against individual(s) with malevolent intent. Inspection areas for this key attribute include: (1) security plan and procedures; (2) protective measures evaluation; and (3) security training. These inspection areas verify that the licensee has designed a contingency response plan to protect against radiological sabotage and loss, theft or diversion of special nuclear material. This is a high risk significant system necessary to protect against the radiological sabotage and loss, theft or diversion of special nuclear material. The licensee should be able to demonstrate the ability to respond appropriately and protect against radiological sabotage and loss, theft or diversion of special nuclear material. The ability of the security organization to respond effectively to contingency events is contingent upon: (1) the number of security force personnel; (2) the intrusion detection system's being able to detect; (3) the alarm status being communicated to the alarm station(s); (4) the assessment functions and the training of security personnel; (5) communications on and off site; and (6) proficiency of security response personnel, including handling of and qualification with assigned weapons, equipment, and the use of proper tactics. Protection against the loss or misuse of special nuclear material (SNM), i.e., enriched uranium or plutonium, is a critical function of a facility's security program. The consequence of radiological sabotage and loss, theft or diversion of special nuclear material, if an attack were to occur, is moderate to high.

a. Security Plans and Procedures

Scope: Inspection activities in this area include the review of facilities' security plans and procedures to verify compliance with applicable regulatory requirements.

Basis: This area is inspected because facility security plans and procedures outline how the licensee plans to meet regulatory requirements in 10 CFR Part 73 and applicable Orders.

b. Protective Measures Evaluation

Scope: Inspection activities in this area include the review of licensee conducted drills and exercises to verify that the facility's protective measures remain effective.

Basis: This area is inspected because effective protective measures are necessary to assure protection against radiological sabotage, theft and diversion of special nuclear materials. Therefore, it is an important aspect of the licensee's contingency response as required by 10 CFR Part 73 and applicable Orders.

c. Security Training

Scope: Inspection activities in this area focus on initial training and periodic requalification, including weapons training

Basis: This area is inspected because effective implementation of a licensee's security program depends on having properly trained and qualified security personnel who are properly equipped as required by 10 CFR Part 73 and applicable Orders.

5. Information Security (Safeguards Information (SGI)/Classified/National Security Information (NSI))

Information security programs will vary based on the type of material that the facility is licensed to possess and the type of information at the facility. The scope of this key attribute is verifying the effectiveness of the licensee's information protection system in protecting against the unauthorized disclosure of protected information at licensed facilities. Inspection areas for this key attribute include: (1) security plan and procedures; (2) designation and storage; (3) processing, reproducing and transmitting; and (4) removal and destruction. These inspection areas verify that the licensee has designed an information protection system that protects against the unauthorized disclosure of protected information. Protection against the unauthorized disclosure of protected information (i.e., safeguards information/classified information/national security information) is a critical function of a facility's security program. The protection of information works in concert with physical protection to complete the Security Cornerstone. The control of information provides for the timely detection of unauthorized disclosure of information. The inspection in this key attribute of the Security Cornerstone is used to assess the effectiveness of the licensee's program for controlling access, designation, storage, processing, reproduction, transmitting, removal, and destruction of information. Failures in this area could allow for the unauthorized disclosure of protected information resulting in risk significant consequences with a moderate to high outcome.

a. Security Plans and Procedures

Scope: Inspection activities in this area include the review of facilities' security plans and procedures to verify compliance with applicable regulatory requirements.

Basis: This area is inspected because facility security plans and procedures outline how the licensee plans to meet regulatory requirements in 10 CFR Part 73, Part 95, and applicable Orders.

b. Designation and Storage

Scope: Inspection activities in this area include the review of licensee information security program to verify that the licensee appropriately designates and stores protected information to prevent unauthorized disclosure.

Basis: This area is inspected because protection against the unauthorized disclosure of protected information (i.e., safeguards information/classified information/national security information) is a critical function of a facility's security program as required by 10 CFR Part 73, Part 95, and applicable Orders.

c. Processing, Reproducing, and Transmitting

Scope: Inspection activities in this area include the review of licensee information security program to verify that the licensee appropriately processes, reproduces and transmits protected information to prevent unauthorized disclosure.

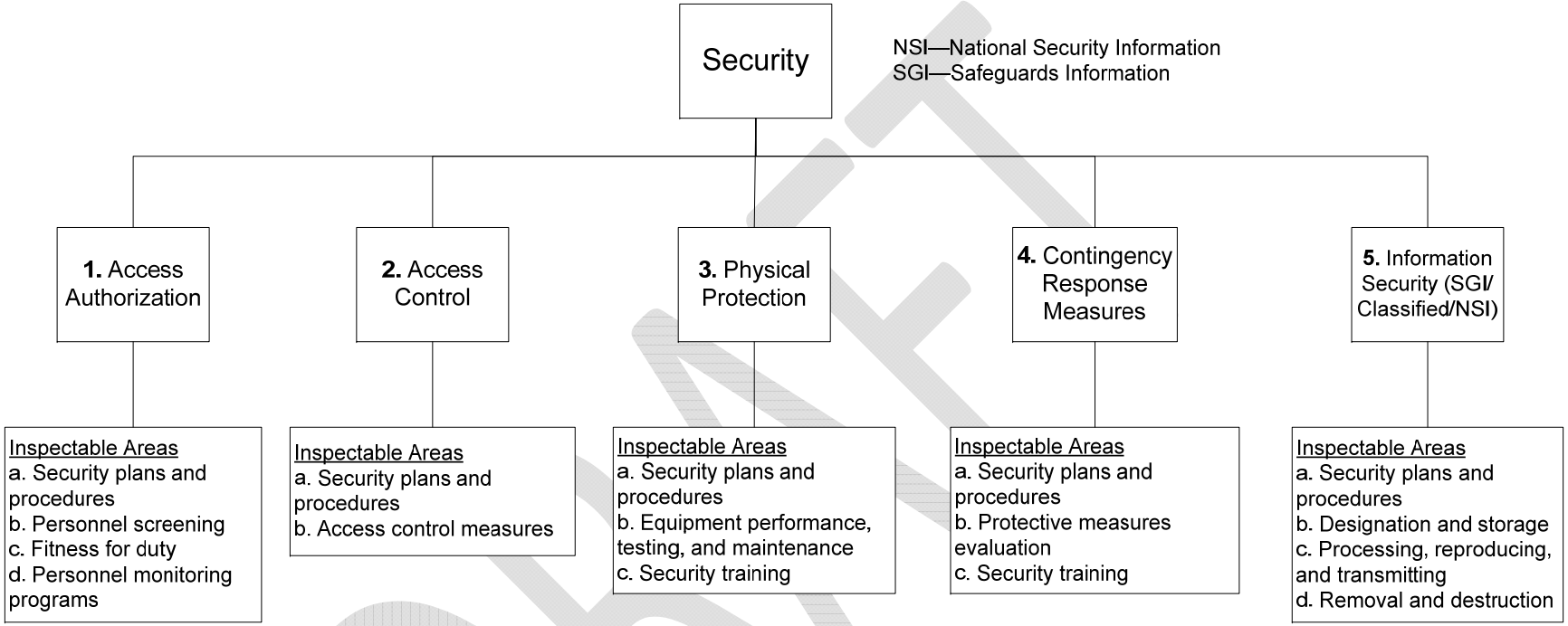
Basis: This area is inspected because protection against the unauthorized disclosure of protected information (i.e., safeguards information/classified information/national security information) is a critical function of a facilities security program as required by 10 CFR Part 73, Part 95, and applicable Orders.

d. Removal and Destruction

Scope: Inspection activities in this area include the review of licensee information security program to verify that the licensee appropriately removes and destroys protected information to prevent unauthorized disclosure.

Basis: This area is inspected because protection against the unauthorized disclosure of protected information (i.e., safeguards information/classified information/national security information) is a critical function of a facility's security program as required by 10 CFR Part 73, Part 95, and applicable Orders.

Figure F-1, Security Cornerstone Key Attributes



Appendix G, Material Control and Accounting Cornerstone

Objective

This cornerstone has the following objectives:

1. To verify that the licensee's material control and accounting (MC&A) program promotes the common defense and security by detecting and protecting against loss, theft, diversion, or misuse of special nuclear material (SNM), and facilitating the location and recovery of missing SNM.

2. To verify that the licensee adequately detects unauthorized production and unauthorized levels of enrichment of SNM at enrichment facilities.

Key Attributes and Inspectable Areas

Figure G-1 shows those attributes of licensee performance that affect MC&A systems. These key attributes and the inspectable areas are described below.

1. Measurement Systems and Measurement Control

   Adequate and appropriate measurement systems and equipment, and the control of those measurement systems, are important to ensure that all quantities of SNM in the accounting records are based on accurate and reliable measurements. This ensures that the licensees' MC&A program can detect and protect against loss, theft, diversion, or misuse of SNM.

   a. Adequacy of MC&A Measurement Systems

   Scope: Inspection activities in this area focus on the adequacy of MC&A measurement systems. Inspection activities include review of key measurement points, review of measurement and sampling techniques and equipment, and verification of measurement capability through observation of measurements being performed and samples being taken by licensee staff.

   Basis: This area is inspected to ensure adequate and appropriate measurement systems are used, as required by 10 CFR 74.31(c)(2), 74.33(c)(2), 74.45(b), and 74.59(d), systems should be tested and evaluated for the specific material being measured. At each measurement point, the material type to be measured and the measurement system to be used should be described. Measurement systems should consider the method of sampling, mass or volume determination, chemical or nondestructive assay, and isotopic analyses. Components of each measurement system should include the equipment required, range of application, sensitivity, precautions, and uncertainty estimates.

b. Measurement Control

Scope: Inspection activities in this area focus on the licensee's ability to monitor and control measurement systems to meet requirements. Inspection activities include review of control standard handling and usage, review and observation of measurement system calibrations, and review of mixing and sampling studies. The inspection activities include review of various statistical applications including control charts for the implemented measurement systems, review of statistical analysis reports, and review of measurement uncertainty determinations.

Basis: Proper system calibrations, standards adequacy and traceability, and use of control and replicate measurements ensure systems are controlled to meet program objectives and the regulatory requirements in 10 CFR 74.31(c)(3), 74.33(c)(3), 74.45(c), and 74.59(e).

2. Control of Special Nuclear Material

Proper control of SNM is essential to protect against potential loss, theft or diversion. This is accomplished through proper item identification and item storage, item monitoring activities, periodic physical inventories, and an effective accounting system. For Category I facilities, proper control of strategic SNM also includes process monitoring procedures that ensure timely detection of the possible abrupt loss of five or more kilograms of strategic SNM. For enrichment facilities, control of SNM includes a program for detection of unauthorized production and enrichment.

a. Item Control and Item Monitoring

Scope: Inspection activities in this area focus on the licensee's ability to maintain current knowledge of the identity, SNM content, and location of items. Inspection activities include review of the licensee's periodic item monitoring activities, observation of item monitoring activities, and an item audit of a sample of items on the licensee's inventory to verify current knowledge is maintained.

Basis: The licensee's MC&A program maintains a record of all SNM items, regardless of quantity or duration of existence. Item control systems should provide current knowledge of the location, identity, and quantity of all SNM contained in all items that are not excepted from the requirements, as required by 10 CFR 74.31(c)(6), 74.33(c)(6), 74.43(b)(5) and (6), and 74.55. Maintaining current knowledge of items supports the cornerstone objective of detecting and preventing loss, theft, or diversion of SNM.

b. Physical Inventory

Scope: Inspection activities in this area include review and observation of the inventory process, from preparation and conduct of the inventory to reconciliation of the inventory. Inspection activity includes review of the reported inventory and the statistical analysis used to evaluate adequacy of the inventory.

Basis: By performing periodic physical inventories of all SNM, as required by 10 CFR 74.31(c)(5), 74.33(c)(4), 74.43(c), and 74.59(f), licensees confirm that a loss or diversion of a significant quantity of SNM has not occurred.

c. Process Monitoring

Scope: Inspection activities in this area focus on a Category I licensee's ability to detect an abrupt loss of five formula kilograms of strategic SNM in a timely manner. Inspection activities include a walk-down of the process areas to review material used in the areas, review of allowable exceptions to process monitoring, and review of potential substitute materials. Inspection activities include evaluation of evaluation of process monitoring procedures, audits of process monitoring records, and observation of process monitoring activities. Additional inspection activities include evaluation of quality control tests and review of trend analysis methods used for process monitoring.

Basis: This area is inspected because process monitoring activities provide early indications of diversion or theft, and a prompt detection system for significant abrupt diversions, of five or more kilograms of strategic SNM, as required by 10 CFR 74.53.

d. Detection of Unauthorized Production and Enrichment

Scope: Inspection activities in this area include review of an enrichment facility's detection program plans and procedures, process flow diagrams, and diversion scenarios. Inspection activities also include a walk-down of the processing areas to observe licensee unauthorized production and enrichment program activities and a review of records of licensee detection program activities since the last inspection.

Basis: This area is inspected because an effective program for detection of unauthorized production and enrichment, as required by 10 CFR 74.33(c)(5), protects against loss, theft, diversion, or misuse of SNM.

e. MC&A Accounting System

Scope: Inspection activities in this area include verification that the accounting system maintains current knowledge of SNM items through item inventory audits. Inspectors review the licensee's procedures for recovering from damage to, or tampering with, the accounting system. Inspectors verify that access to the MC&A accounting system is limited to authorized individuals and to authorized activities by challenging access to the system in the various process areas.

Basis: This area is inspected because an effective accounting and recordkeeping system, as required by 10 CFR 74.31(d), 74.33(d), 74.43(d), and 74.59(g), enables the licensee to maintain current knowledge of the SNM it possesses, to reconstruct the SNM inventory in case of computer failure, water or fire damage, or access by unauthorized persons, and to adequately resolve and recover from loss indicators.

3. MC&A Program

An effective MC&A program has an organizational structure that separates key MC&A functions from each other in order to provide overchecks that increase MC&A system reliability and counter the possibility of loss, theft, or diversion, of SNM. Staff performance of MC&A-related activities can significantly affect the control of special nuclear material. Inadequate performance by staff conducting MC&A activities can

result in the loss, theft, or diversion of SNM. To ensure proper functioning of the licensee's MC&A program, the procedures regarding MC&A-related activities must be correct. MC&A procedures, if not performed correctly, could result in a failure to achieve the objective of detecting and preventing loss, theft, diversion, or misuse of SNM. An effective recordkeeping system enables the licensee to maintain current knowledge of the SNM it possesses and to adequately detect and prevent loss, theft, or diversion, and recover from loss indicators.

a. MC&A Organization

Scope: Inspection activities in this area focus on ensuring the MC&A program is designed with adequate overchecks to counter defeat of the system and to free MC&A management from conflicts of interest with other licensee functions. Inspection activities include review of the licensee's organizational structure as it relates to the MC&A program. Inspectors verify that functional relationships between positions responsible for MC&A functions ensure proper checks and balances of safeguards responsibilities, and verify that responsibilities and authorities for each position assigned an SNM accounting function are clearly defined in position descriptions.

Basis: This area is inspected because an effective MC&A organizational structure, as required by 10 CFR 74.31(c)(1), 74.33(c)(1), 74.43(b)(1)-(4), and 74.59(b), separates key MC&A functions from each other in order to provide over-checks that increase MC&A system reliability and counter defeat of the system through deceit and falsification. The organizational structure is also meant to free MC&A management from conflicts of interest with other major functions such as production.

b. Staff MC&A Training and Qualification

Scope: Inspection activities in this area focus on the effectiveness of the licensee's program for conducting plant staff initial MC&A training and the methods used to determine qualification and requalification. This is mainly determined through observation of plant staff performance during conduct of MC&A-related activities and during walkthroughs conducted by inspectors. Inspectors evaluate any deficient performance to determine if it results from deficient training and qualification.

Basis: This area is inspected because adequate staff performance is maintained through training and qualification of licensee personnel. A training and qualification program, as required by 10 CFR 74.31(c)(1), 74.33(c)(1), 74.43(b)(4), and 74.59(c), helps ensure that personnel performing MC&A functions are adequately prepared to perform their functions correctly with a minimum of errors.

c. MC&A Procedure Quality

Scope: Inspection activities in this area focus on the clarity of plant procedures with regard to MC&A-related activities. Inspection activities include observation of plant staff performance during MC&A-related activities and during walkthroughs by inspectors. Inspectors evaluate any deficient performance to determine if it results from inadequate, deficient, or unclear procedures. While reviewing the use of procedures, inspectors also evaluate whether the procedure and activities observed result in compliance with regulations and license requirements. In addition, inspectors review selected changes to

procedures to determine whether the procedures provide adequate guidance to plant staff to meet NRC requirements.

Basis: To be performed correctly, the MC&A procedures required by 10 CFR 74.31(c)(1), 74.33(c)(1), 74.43(b)(3), and 74.59(b)(2) should cover all MC&A functions, and should be clear and technically correct. Measurement system procedures influence the capability of adequately assigning proper quantities of SNM to processing units and items. Inventory and item control procedures are essential to ensuring material is not loss, stolen, or diverted. Alarm and loss indicator response procedures are important in order to adequately assess the indicators and to determine if a loss actually occurred, and to recover from the loss. Unclear procedures or procedures that are out of sequence could result in staff errors that lead to the failure to control and account for material.

d. Recordkeeping

Scope: Inspection activities in this area include review of the licensee's program and controls for ensuring an accurate and reliable MC&A recordkeeping system.

Basis: This areas is inspected because an effective accounting and recordkeeping system, as required by 10 CFR 74.31(d), 74.33(d), 74.43(d), and 74.59(g), enables the licensee to maintain current knowledge of the SNM it possesses, to reconstruct the SNM inventory in case of computer failure, water or fire damage, or access by unauthorized persons, and to adequately resolve and recover from loss indicators.

4. Response and Followup

The licensee's ability to resolve alarms and loss indicators is essential to detecting and protecting against loss, theft, or diversion of SNM. Human error monitoring ensures that the frequency and consequence of human errors that may mask loss, theft, or diversion of SNM are minimized. Periodic independent assessments of the overall effectiveness of the MC&A program are essential to ensure that the MC&A program continues to detect and prevent loss, theft or diversion of SNM. The licensee's corrective action program (CAP) is expected to identify and correct problems or indications of problems in the above key attributes that could lead to degraded MC&A components. The CAP should identify early indications of problems before they have actual MC&A impacts.

a. Resolution of Alarms and Loss Indicators

Scope: Inspection activities in this area focus on the licensee's ability to adequately resolve abrupt alarm and SNM loss indicators in a timely manner.

Basis: This area is inspected because item control discrepancies, significant item or process monitoring indicators, and significant inventory discrepancies, could be indicators of an actual loss, theft, or diversion, of SNM. Prompt investigation and resolution of the indicator or discrepancy is important to ensure no loss, theft, or diversion has occurred, as required in the performance objectives of 10 CFR 74.31(a), 74.33(a), 74.41(a), and 74.51(a).

b. Human Error Monitoring (Category I facilities)

Scope: Inspection activities in this area focus on the effectiveness of the licensee's program for controlling the rate of human errors in MC&A information. This is mainly determined through observation of plant staff performance, review of job performance aids, review of the methods for automation of MC&A activities, and review of the licensee's human error quality control system for monitoring human errors.

Basis: For Category I facilities, due to the nature of the material possessed, staff performance is particularly critical. The licensee's program for human error monitoring, as required by 10 CFR 74.59(h)(3), ensures that the frequency and consequence of human errors are minimized, and enhances the likelihood of detection of errors when they do occur.

c. Independent Assessment of the MC&A Program

Scope: Inspection activities in this area focus on ensuring the licensee's independent assessment program assesses the health of the MC&A program through periodic, comprehensive, and independent assessments. Inspection activities include review of the assessment program, review of assessment reports, and verification that assessment findings and recommendations are addressed by licensee management in a timely manner. Inspectors verify that effective corrective actions are taken to address the issues identified.

Basis: This area is inspected because periodic independent assessments of the overall effectiveness of the MC&A program, as required by 10 CFR 74.31(c)(8), 74.33(c)(8), 74.43(b)(8), and 74.59(h)(4), are essential to ensure that the MC&A program continues to meet overall safeguards goals and to identify weaknesses or deficiencies in the program design or performance that may need correcting.

d. Corrective Action Program (Audits/Audit Findings, Infraction Followup, Event Followup, and Other CAP Findings)

Scope: Inspection activities in this area include reviews of selected MC&A items in the licensee's CAP to determine whether the items were adequately identified and corrected. This inspection is to complement the periodic inspection of the CAP program that evaluates implementation of the overall CAP program.

Basis: This area is inspected to determine whether the licensee is self-identifying and self-correcting problems in accordance with the corrective action program license condition.

Figure G-1, Material Control and Accounting Cornerstone Key Attributes