National Nuclear Security Administration Orders Self-Study Program

DOE-STD-3009-94

PREPARATION GUIDE FOR
U.S. DEPARTMENT OF ENERGY NONREACTOR NUCLEAR FACILITY DOCUMENTED SAFETY ANALYSES

NNSA SERVICE CENTER

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DOE-STD-3009-94
PREPARATION GUIDE FOR U.S. DEPARTMENT OF ENERGY NONREACTOR NUCLEAR FACILITY DOCUMENTED SAFETY ANALYSES
FAMILIAR LEVEL

OBJECTIVES

Given the familiar level of this module and the resources listed below, you will be able to:

1. State five general requirements for contractors who are responsible for a hazard category 1, 2, or 3 nuclear facility, as related to establishing a safety basis.

2. State the actions a contractor must take when it is made aware of a potential inadequacy of the documented safety analysis (DSA).

3. State the three contractor requirements related to technical safety requirements (TSRs).

4. State the safe harbor methods used to prepare a DSA for an NNSA nonreactor nuclear facility.

5. Discuss the purpose of a preliminary DSA for a new facility.

6. State the purpose of a final DSA.

7. State the three types of TSRs.

8. State the purpose of limiting conditions for operations.

9. State the purpose of action statements as used in TSRs.

10. State the purpose of an unreviewed safety question (USQ) determination.

11. Discuss the approval basis for DSAs.

Note: If you think that you can complete the practice at the end of this level without working through the instructional material and/or the examples, complete the practice now. The course manager will check your work. You will need to complete the practice in this level successfully before taking the criterion test.

RESOURCES

10 CFR 830, "Nuclear Safety Management, Subpart B, Safety Basis Requirements."
DOE-STD-3009-94, change 2, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facilities Documented Safety Analyses,* April 2002.
DOE G 421.1-2, *Implementation Guide for Use in Developing Documented Safety Analyses to Meet Subpart B of 10 CFR 830*
DOE G 423.1.1, *Implementation Guide for Use in Developing Technical Safety Requirements*
DOE G 424.1-1, *Implementation Guide for Use in Addressing Unreviewed Safety Question Requirements*
DOE O 420.1, *Facility Safety*
DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*
DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*
DOE-STD-1104-96, *Review and Approval of Nuclear Facility Safety Basis Documents (Documented Safety Analyses and Technical Safety Requirements)*
DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*

INTRODUCTION

The familiar level of this module is divided into three sections. The first section is an introduction to DOE-STD-3009-94. In the second section, which covers chapters 1 through 17 of the standard we will discuss DSA preparation guidance,. The third section covers evaluation guideline that appear in appendices 1–5 of the standard. We have provided several examples and practices throughout the module to help familiarize you with the material. The practice will also help prepare you for the criterion test.

Before continuing, you should obtain a copy of the references. You may need to refer to these documents to complete the examples, practices, and criterion test.

SECTION 1, INTRODUCTION TO DOE-STD-3009-94

DOE-STD-3009-94 describes a DSA preparation method that is acceptable to the National Nuclear Security Administration (NNSA). It was developed to assist hazard category 2 and 3 facilities in preparing DSAs that will satisfy the requirements of 10 CFR 830, Nuclear Safety Management.

Beyond conceptual design and construction, the methodology in the standard is applicable to the spectrum of missions expected to occur over the lifetime of a facility (e.g., production, shutdown/standby, decontamination, and decommissioning). As the phases of facility life change, suitable methodology is provided to update an existing DSA and to develop a new DSA if the new mission is no longer adequately encompassed by the existing DSA (e.g., a change from production operations to decontamination and decommissioning). This integration of the DSA with changes in facility mission and associated updates should be controlled as part of an overall safety management plan.

A unique element of DSA documentation is the required provisions for decontamination and decommissioning (D&D). This forward-looking aspect of facility operations is independent of facility mission and is intended to be a means of ensuring that current facility operations take into account D&D operations that will occur in the future.

For facilities transitioning into D&D, the safety basis of the D&D operations is documented throughout a DSA. This DSA, of which the principal emphasis is on the D&D operations themselves, provides the necessary analysis and supporting information to describe the facilities as they undergo shutdown, deactivation, decontamination, and decommissioning or dismantlement. The facility consists of the physical building, its constituent components, and the actual processes of D&D being performed. The DSA also includes the temporary engineering and administrative controls used to maintain the safety basis. This description and evaluation would envelop major configurations during the D&D operations for which the safety basis is sought. This is consistent with the intent of DSAs for operating facilities where not all operations conducted are detailed in the DSA.

GUIDING PRINCIPLES

The standard incorporates and integrates approaches regarding DSA format and content. To ensure a consistent application of the standard among users, the following guiding principles are provided.

- The focus of the standard is on hazard category 2 and hazard category 3 facilities.
- Hazard analysis and accident analysis are merged to ensure that the proper emphasis is placed on identification and analysis of hazards. The hazard analysis distinguishes when accident analysis is required as a function of potential offsite consequence. Guidance for hazard and accident analysis is not based on probabilistic risk assessment.
- Defense in depth, worker safety, and environmental issues are identified in the hazard analysis.
- Defense in depth, as discussed in the standard, consists of two components:
    - equipment and administrative features providing preventive or mitigative functions so that multiple features are relied on for prevention or mitigation to a degree proportional to the hazard potential, and
    - integrated safety management programs that control and discipline operations.
- Guidance is provided for evaluating the safety of a facility for which documentable, deterministic design basis accidents (DBAs) do not exist to establish bounding accidents that envelope the safety of existing facilities. Guidance is also provided on the treatment of beyond DBAs.
- Distinction is made between safety-class (SC) structures, systems, and components (SSCs), and safety-significant (SS) structures, systems, and components, and the balance of facility structures, systems, and components. Safety-class structures, systems, and components are related to public protection and are defined by comparison with the numerical evaluation guideline (EG). Safety-significant structures, systems, and components are identified for specific aspects of defense in depth and worker safety as determined by the hazard analysis. Specific definitions are provided for these two terms.
- Consequences from normal operations are addressed in the radiation protection, hazardous material protection, and waste management chapters of the standard.
- Guidance is provided in each chapter on the application of the graded approach.
- A common DSA format (chapter, title, and organization) for all nonreactor nuclear facilities is desirable but not essential. Content needs to be flexible to allow for different facility types, hazard categories, and other grading factors.

- Facility descriptive material is intentionally split to emphasize structures, systems, and components of major significance:
  - Chapter 2, Facility Description, of the standard provides a brief, integrated overview of the facility structures, systems, and components.
  - Chapter 4, Safety Structures, Systems, and Components, of the standard provides detailed information only for those structures, systems, and components that are safety class and safety significant. This application of the graded approach will provide for a significant reduction of DSA volume, while maintaining a focus on safety.
  - The programmatic chapters, including chapters 6–17 provide a summary description of the key features of the various safety programs as they relate to the facility being analyzed. These chapters are not meant to be used as the vehicle for the determination of adequacy of these programs.

The safety management programmatic requirements identified in 10 CFR 830, and illustrated in figure 1, form the boundaries within which the safety analysis is performed and represent the means of ensuring safe operation of the facility. Hazard analysis and accident analysis are performed to identify specific controls and improvements that feed back into overall safety management. Consequence and likelihood estimates obtained from this process also form the bases for grading the level of detail and control needed in specific programs. The result is documentation of the safety basis that emphasizes the controls needed to maintain safe operation of a facility.

The level of detail provided in the DSA depends on numerous factors. Applying the graded approach assists the preparer in establishing an acceptable level of detail.

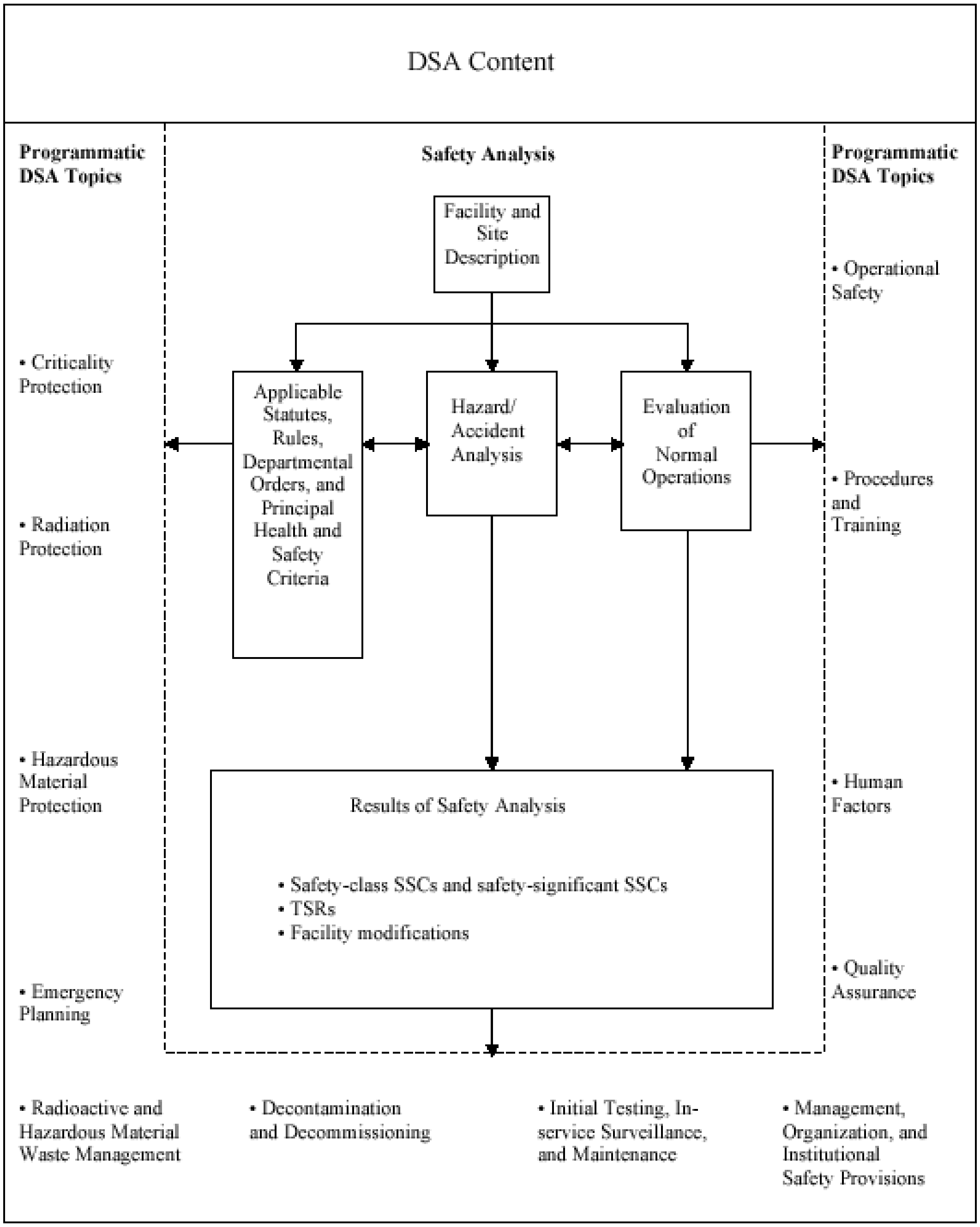

Figure 1 DSA Scope and Integration

The foundation for effectively preparing a DSA is the assembly and integration of an experienced preparation team. The size and makeup of the team depend on the magnitude and type of facility hazards and the complexity of the processes that are addressed in the DSA. In determining the makeup of the preparation team, careful consideration should be given to the key hazard analysis activity. The safety analysis base team should include individuals experienced in process hazard and accident analyses, facility systems engineers, and process operators. Individuals with experience in specific subject matter such as nuclear criticality, radiological safety, fire safety, chemical safety, or process operations may be needed in the hazard analysis on a regular or as-needed basis. Consistent, accurate exchange of information among the team members is at least as important as the makeup of the team itself. This can be assured through meaningful integration of the required tasks.

Once team makeup is determined, base information needed to support DSA development is gathered. Maximum advantage should be taken of pertinent existing safety analyses and design information that are immediately available, or can be retrieved through reasonable efforts. Other information arises from existing sources such as process hazards analyses, fire hazards analyses, explosive safety analyses, health and safety plans, and environmental impact statements. The need for additional or specific information becomes apparent throughout the hazard analysis process. The remaining key steps for efficient completion of the safety analysis and DSA development process are:

- Identify the DSA project functions, using project information, and ensure the team matches the functions that are required.
- Perform a hazard analysis to provide facility hazard classification, evaluate worker safety and defense in depth, and identify unique and representative accidents to be carried forward to an accident analysis. Safety-significant SSCs and TSRs are designated in hazard analysis as well.
- Perform an accident analysis and assess the results to identify any safety-class SSCs and accident-specific TSRs that are based on comparison of accident consequences to the evaluation guideline.
- Develop the chapters for the DSA by providing the information necessary to support the results of the safety analysis. These chapters detail the results of the analysis, describe the facility and the safety SSCs and the safety management programs that relate to the facility safety basis.
- Prepare the executive summary.

Several specific topics are directly relevant to understanding the conceptual basis of the standard. These topics are worker safety, defense in depth, programmatic commitments, SSC and TSR commitments, and correlation of the standard to 10 CFR 830 requirements.

SAFETY MANAGEMENT PROGRAM COMMITMENTS

Sections 10 CFR 830.204(b)(5) and 830.204(b)(6) of the Rule require that the DSA define the characteristics of the safety management programs necessary to ensure the safe operation of the facility.

Program commitments (e.g., radiation protection, maintenance, quality assurance) encompass a large number of details that are more appropriately covered in specific program documents (e.g., plans and procedures) external to the DSA. The cumulative effect of these details, however, is recognized as being important to facility safety, which is the rationale for a top-level program commitment becoming part of the safety basis.

NNSA facilities that use and rely on site-wide, safety support services, organizations, and procedures, may summarize the applicable site-wide documentation provided its interface with the facility is made clear. The DSA then notes whether the reference applies to a specific commitment in a portion of the referenced documentation or is a global commitment to maintaining a program for which a number of details may vary without affecting the global commitment. Any documents referenced in the DSA must be available upon request.

TSR AND SSC COMMITMENTS

To comply with 10 CFR 830, specific safety controls must be developed in the DSA. In keeping with the graded-approach principle, distinctions are made to avoid wasting effort by providing detailed descriptions of all facility SSCs. While a basic descriptive model of the facility and its equipment must be provided, highly detailed descriptions are reserved for two categories of SSCs comprising the most crucial aspects of facility safety. These two categories are safety-class SSCs and safety-significant SSCs.

HAZARD ANALYSIS

The initial analytical effort for all facilities is a hazard analysis that systematically identifies facility hazards and accident potentials through hazard identification and hazard evaluation. The focus of the hazard analysis is on thoroughness and requires evaluation of the complete spectrum of hazards and accidents. This largely qualitative effort forms the basis for the entire safety analysis effort, including specifically addressing defense in depth and protection of workers and the environment. Basic industrial methods for hazard analysis, its interface with more structured quantitative evaluations, and the basis for both have been described in references such as the American Institute of Chemical Engineers, *Guidelines for Hazard Evaluation Procedures* (1992). These guidelines have been accepted by the Occupational Safety and Health Administration as the standard for analytical adequacy in characterizing commercial chemical processes that perform the same type of unit operations conducted at NNSA nonreactor nuclear facilities. Appropriately applied, they help fulfill the requirements of DSAs for hazard category

2 and 3 facilities as specified in 10 CFR 830.

The basic identification of hazards inherent in the process provides a broad, initial basis for identifying needed safety programs such as radiation protection and hazardous chemical protection. The hazard analysis then moves beyond basic hazard identification to evaluation of the expected consequences and estimation of likelihood of accidents.

Throughout the evaluation process, preventive and mitigative SSCs and pertinent elements of programmatic controls are identified. This identification also establishes functional requirements for SSCs, which will subsequently delineate the technical information needed to establish performance criteria. The DSA summarizes these requirements and criteria for safety-class and safety-significant SSCs only. Refinement of the information obtained in hazard evaluation leads to overall definition of defense in depth, worker safety, and environmental protection. The most significant aspects of defense in depth and worker safety are subject to definition designation as safety-significant SSCs and coverage by TSRs. Other items noted are encompassed by the details of safety management programs (e.g., procedures, training, maintenance, quality assurance), which can be captured in top-level fashion in TSR administrative controls. The hazard evaluation conducted to assess the accident spectrum associated with hazards germane to the DSA indicates the adequacy of programmatic efforts and provides input to programmatic activities whose discipline provides a significant margin of safety.

The final purpose of hazard analysis is to identify a limited subset of accidents that are carried forward to accident analysis. Identifying DBAs in safety analysis and the use of DBAs is appropriate in defining a facility safety basis. DBAs are a device for designing individual equipment or systems to meet functional requirements. An accident can be defined as a DBA if relevant SSCs were specifically designed to function during that accident and appropriate documentation of this fact exists.

The range of accident scenarios analyzed in a DSA should define the envelope of accident conditions to which the operation could be subjected. For operational accidents, a derivative DBA is defined based on the physical possibility of phenomena as defined in the hazards analysis. Use of a lower binning threshold such as 10^{-6}/yr is appropriate, but should not be used as an absolute cutoff for dismissing physically credible, low probability operational accidents without any evaluation of preventive and mitigative features in hazard analysis. Examples of a candidate derivative DBA would be an ion exchange column or a red oil explosion at a facility where the phenomena is physically possible and documentation is not available substantiating ventilation, and building confinement systems are specifically designed for such an occurrence.

For natural event accidents, derivative DBAs are defined by a frequency of initiator based on DOE O 420.1, *Facility Safety*, and its associated implementation standards. For external man-made accidents, derivative DBAs are assumed if the event can occur with a frequency $>10^{-6}$/yr as conservatively estimated, or $>10^{-7}$/yr as realistically estimated. Use of a frequency cutoff for external events represents a unique case for external events only, based on established Nuclear Regulatory Commission (NRC) precedents.

ACCIDENT ANALYSIS

The complete spectrum of accidents is examined in hazard analysis. A limited subset of accidents that bound the envelope of accident conditions to which the operation could be subjected are carried forward to accident analysis where safety-class SSCs are designated by comparing accident consequences to the evaluation guideline. These scenarios are the accidents requiring formal definition.

Note: You do not have to do example 1 on the following pages, but it is a good time to check your skill and knowledge of the information covered. You may do the example 1 or go to section 2.

EXAMPLE 1

Using the familiar level of this module and the resources, complete the following exercises.

1. State the two components that make up defense in depth.

2. State the conditions in which an accident can be defined as a DBA.

3. Discuss the purpose of DOE-STD-3009-94.

Note: When you are finished, compare your answers to those contained in the example 1 self-check. When you are satisfied with your answers, go to section 2.

EXAMPLE 1 SELF-CHECK

1. State the two components that make up defense in depth.
   Defense in depth, as discussed in the standard, consists of two components:

   - equipment and administrative features providing preventive or mitigative functions so that multiple features are relied on for prevention or mitigation to a degree proportional to the hazard potential, and
   - integrated safety management programs that control and discipline operations.

2. State the conditions in which an accident can be defined as a DBA.
   An accident can be defined as a DBA if relevant SSCs are specifically designed to function during that accident and appropriate documentation exists.

3. Discuss the purpose of DOE-STD-3009-94.
   DOE-STD-3009-94 was developed to assist hazard category 2 and 3 facilities in preparing DSAs that will satisfy the requirements in 10 CFR 830, "Nuclear Safety Management."

SECTION 2, PREPARATION GUIDANCE

This section summarizes the guidance offered in DOE-STD-3009-94 for the contents of the seventeen chapters of a DSA. The standard includes preparation guidance to ensure consistent and appropriate treatment of all DSA requirements for the various NNSA nonreactor nuclear facilities. .

CHAPTER 1, SITE CHARACTERISTICS

This chapter of a DSA should provide a description of site characteristics necessary for understanding the facility environs important to the safety basis. The chapter covers the following topics and issues that are typically included in a DSA:

- description of the location of the site, location of the facility within the site, its proximity to the public and to other facilities, and identification of the point where the evaluation guideline are applied;
- specification of population sheltering, population location and density, and other aspects of the surrounding area of the site that relate to assessment of the protection of the health and safety of the public;
- determination of the historical basis for site characteristics in meteorology, hydrology, geology, seismology, volcanology, and other natural events to the extent needed for hazard and accident analyses;
- identification of design basis natural events;
- identification of sources of external accidents, such as nearby airports railroads, or utilities such as natural gas lines;
- identification of nearby facilities impacting, or impacted by, the facility; and
- validation of site characteristic assumptions common to safety analysis that were used in prior environmental analyses and impact statements, or of the need to revise and update such assumptions used in facility environmental impact statements.

CHAPTER 2, FACILITY DESCRIPTION

This chapter of a DSA should provide descriptions of the facility and processes to support assumptions used in the hazard and accident analyses. These descriptions focus on all major facility features necessary to understand the hazard analysis and accident analysis, not just safety SSCs. Information in this chapter typically includes

- an overview of the facility, its inputs, and its outputs, including mission and history;
- a description of the facility structure and design basis;
- a description of the facility process systems and constituent components;
- instrumentation, controls, operating parameters, and relationships of SSCs;
- a description of confinement systems;
- a description of the facility safety support systems;
- a description of the facility utilities; and
- a description of facility auxiliary systems and support systems.

CHAPTER 3, HAZARD AND ACCIDENT ANALYSIS

This chapter of a DSA should describe the process used to identify and assess hazards to evaluate the potential internal, man-made external, and natural events that can cause the identified hazards to develop into accidents. This chapter also presents the results of this hazard identification and assessment process. Hazard analysis

- considers the complete spectrum of accidents that may occur due to facility operations;
- analyzes potential accident consequences to the public and workers;
- estimates the likelihood of occurrence;
- identifies and assesses associated preventive and mitigative features;
- identifies safety-significant SSCs; and
- identifies a selected subset of accidents, designated DBAs, to be formally defined in accident analysis.

Subsequent accident analysis evaluates these DBAs for comparison with the evaluation guideline to identify and assess the adequacy of safety-class SSCs. This chapter covers the topics of hazard identification, facility hazard categorization, hazard evaluation, and accident analysis. Information in this chapter typically includes:

- a description of the methodology for and approach to hazard and accident analyses;
- a description of hazardous materials and energy sources present by type, quantity, form and location;
- a facility hazard categorization, including segmentation;

- a description of the hazard analysis of the spectrum of potential accidents at the facility in terms of largely qualitative consequence and frequency estimates; and
- an accident analysis of DBAs identified in the hazard analysis.

Hazard Analysis

This section of the DSA should describe the hazard identification and evaluation performed for the facility. The purpose of this information is to present a comprehensive evaluation of potential process-related, natural events, and man-made external hazards that can affect the public, workers, and the environment due to single or multiple failures. Consideration will be given to all modes of operation, including startup, shutdown, and abnormal testing or maintenance configurations.

Hazard identification and evaluation provide a thorough evaluation of the spectrum of risks to the public, workers, and the environment due to accidents involving any of the hazards identified. The evaluation identifies preventive and mitigative features, including identification of expected operator response to incidents and provisions for operator protection in the accident environment.

A basic flowchart for hazard/accident analysis is provided in figure 2. The major features of hazard analysis and the graded approach are captured in this figure. Hazard identification provides the basis for the final hazard categorization of the facility. That categorization is input for the graded approach for hazard evaluation. Hazard category 3 facilities are not required to perform formal, quantitative accident analysis.

Figure 2 identifies the specific point where the analyst must move beyond the general outline of the standard and use the graded approach to determine appropriate hazard analysis methodology. Techniques that are more elaborate will be associated with processes that are more complex. Experience and capabilities of analysts are also a major consideration in efficient performance of a comprehensive hazard evaluation.

Systematic application of the chosen techniques to the operations in a facility generates a number of accidents based on types of events and system performance in response to the events. These accidents can be binned in accordance with predefined consequence and frequency ranking thresholds.

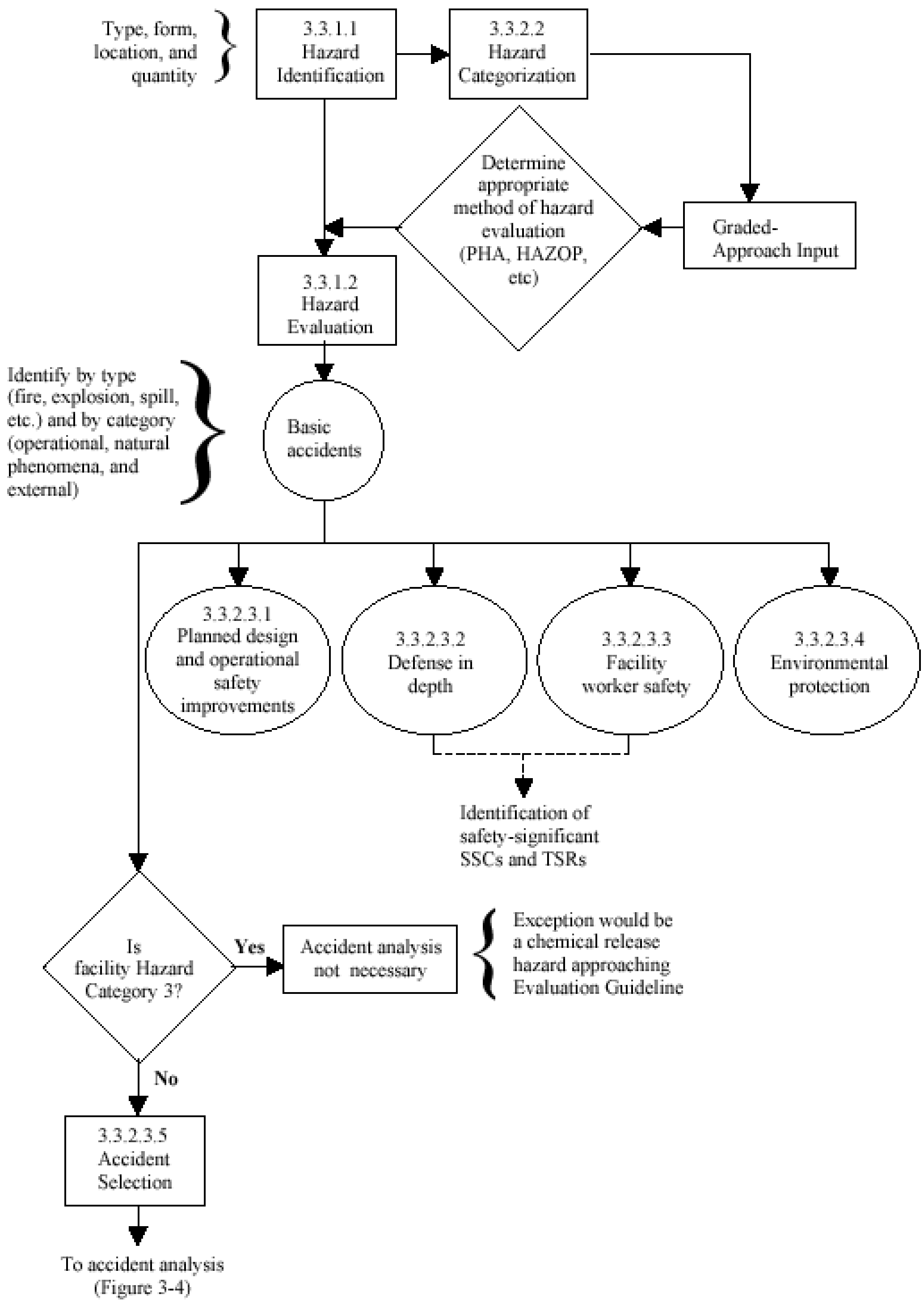

Figure 2 Flow chart for performing a hazard analysis

Products of the hazard evaluation include

- an identification of planned design and operational safety improvements;
- a summary of defense in depth, including identification of safety-significant SSCs and other items needing TSR coverage, including relevant programs covered under TSR administrative controls;
- a summary of the significant worker protection features, including identification of safety-significant SSCs and relevant programs covered under TSR administrative controls;
- a summary of the design and operational features that reduce the potential for large material releases to the environment; and
- a selection of a set of bounding accidents.

Hazard Evaluation

Hazard evaluation characterizes the identified hazards in the context of the actual facility and process. For example, a simple hazard identification would be that 2000 grams of plutonium oxide are in a steel container under a hood waiting for entry into a glove box. One accident, which places this hazard in the actual context of facility parameters, involves spilling the contents of the container on the room floor. The hazard evaluation would qualitatively consider the action of moving the container into the glove box to evaluate the likelihood of spilling the contents. It would also consider mitigative features that would affect potential consequences.

Public and worker safety issues are the traditional focus of hazard evaluations. The DSA hazard evaluation also examines the potential for large-scale environmental contamination. The information on environmental contamination may be used in a separate cost-benefit analysis, not related to the DSA effort, to determine if additional preventive or mitigative features are needed in the facility.

Accident Analysis

Each accident sequence needs to be analyzed through the use of a documented, deterministic, DBA. Whenever possible, DBAs are analyzed using the simplest applicable deterministic, phenomenological calculations. The nondeterministic aspects of DBA analysis are simplified by estimating overall sequence frequencies in broad frequency ranges in hazard analysis. This process is considered sufficient for DSA purposes and accident analysis need only document the basis for the binning performed in hazard analysis. Detailed probabilistic calculations are neither expected nor required. Natural events and man-made external events are special cases. Natural event DBAs are those events with a phenomenon initiating frequency as specified in DOE O 420.1, *Facility Safety*. External events are not typically design bases for facilities. However, they will be referred to as “DBAs;” and analyzed as such if the frequency of occurrence is estimated to exceed 10^{-6}/yr conservatively calculated, or 10^{-7}/yr realistically calculated.

Accident analysis typically starts with formal descriptions of accident scenarios. Such descriptions may be supported by basic event trees. All major assumptions in scenarios must be identified. The next step is determination of accident source terms. Source terms for accidents are obtained through phenomenological and system response calculations. Once a source term has been determined, consequences due to atmospheric dispersion or other relevant pathways of concern are determined. As with every phase of the analysis, the effort expended is a function of the estimated consequence. If the source term is small, a simple, dispersion hand calculation for consequences would be sufficient. If source terms are large, computer modeling to determine consequences may be required. The consequences finally determined are compared to the evaluation guideline (see appendix A). From this activity, it is determined if safety-class SSC designation is needed. The need for accident specific TSRs to meet the evaluation guideline will also be determined. Detailed description of safety-class SSCs and TSRs are presented in Chapter 4, “Safety Structures, Systems, and Components,” and chapter 5, “Derivation of Technical Safety Requirements.” The nature of the accidents to be analyzed will vary, depending upon the facility and processes considered. However, it is anticipated that for most facilities or processes, the number of accidents requiring formal analysis will not be large. The categories of DBAs examined are

- operational accidents caused by initiators internal to the facility,
- natural events, and
- man-made external events caused by man-made initiators external to the facility.

Methods of documentation of accidents should include the following:

- The methods used to estimate radiological or other hazardous material source terms for DBAs, including the basic approach for estimating physical facility damage from DBAs; the general basis for assigning material-at-risk (MAR) quantities not directly derived from hazard identification, if differing values are used; and the basis for material release and respirable fractions or the release used.
- The methods used to estimate dose and exposure profiles, including assumptions on variables such as meteorological conditions, time-dependent characteristics, activity, and release rates or duration for radioactive or other hazardous materials that could be released to the environment.

Design Basis Accidents

There are four major categories of DBAs: internally initiated operational accidents; natural events for the site that could affect the facility; and man-made externally initiated events such as airplane crashes, transportation accidents; and adjacent facility events that can either cause releases at the facility under examination or have a major impact on facility operations.

Beyond Design Basis Accidents

Operational beyond DBAs are simply those operational accidents with more severe conditions or equipment failures than are estimated for the corresponding DBA. For example, if a deterministic DBA assumed releases were filtered because accident phenomenology did not damage filters, the same accident with loss of filtration is a beyond DBA. The same concept holds true for natural events, but beyond DBAs are defined by the initiating frequency of the natural event itself (i.e., frequency of occurrence less than DBA frequency of occurrence). Beyond DBAs are not evaluated for man-made external events.

CHAPTER 4, SAFETY STRUCTURES, SYSTEMS, AND COMPONENTS

The purpose of this DSA chapter is to provide information that is necessary to support the safety basis requirements of 10 CFR 830 for derivation of hazard controls. The chapter provides details on those facility structures, systems, and components that are necessary for the facility to protect the public, provide defense in depth, or contribute to worker safety. Descriptions are provided of the attributes that are required to support the safety functions identified in the hazard and accident analyses and to support subsequent derivation of TSRs. Expected products of this chapter, as applicable based on the graded approach, include:

- descriptions of safety SSCs, including safety functions;
- identification of support systems that safety SSCs depend on to carry out safety functions;
- identification of the functional requirements that are necessary for the safety SSCs to perform their safety functions, and the general conditions caused by postulated accidents under which the safety SSCs must operate;
- identification of the performance criteria necessary to provide reasonable assurance that the functional requirements will be met; and
- identification of assumptions needing TSR coverage.

Safety-Class Systems, Structures, and Components

Information that describes the functions for safety-class SSCs should be provided in this chapter. Descriptions for each safety-class SSC must be complete enough to indicate suitability of safety analysis inputs and assumptions. This chapter should include a summary list of safety-class

SSCs. This summary list should identify, in tabular form, safety-class SSCs, the accidents considered in chapter 3 for which safety-class designations were made, safety functions, functional requirements, and performance criteria judged to require TSR coverage.

Safety-Significant Structures, Systems, and Components

Information that describes the functions for safety-significant SSCs should be provided in this chapter. Descriptions for each safety-significant SSC must be complete enough to allow for verification of the accuracy of the safety analysis inputs and assumptions.

This chapter should include a summary list of safety-significant SSCs. This summary list should identify, in tabular form, safety-significant SSCs, the rationale from chapter 3 for which safety-significant designation was made, safety functions, functional requirements, and performance criteria judged to require TSR coverage.

CHAPTER 5, DERIVATION OF TECHNICAL SAFETY REQUIREMENTS

The purpose of this DSA chapter is to provide information that is necessary to support the safety basis requirements in 10 CFR 830 for the derivation of hazard controls.

This chapter should build on the essential control functions in chapter 3 and chapter 4 to derive TSRs. This chapter is meant to support and provide the information necessary for the separate TSR document that is required by 10 CFR 830.205, “Technical Safety Requirements.” Derivation of TSRs consists of summaries and references to pertinent sections of the DSA in which design and administrative features are needed to prevent or mitigate the consequences of accidents. Design and administrative features addressed include

- features that provide significant defense in depth
- features that provide for significant worker safety
- features that provide for the protection of the public

This chapter should include

- information to derive any of the following TSR parameters for individual TSRs
    - safety limits
    - limiting control settings
    - limiting conditions for operation
    - surveillance requirements
- information to derive TSR administrative controls for specific control features or to specify programs necessary to perform institutional safety functions;
- the identification of passive design features addressed in the DSA; and

- the identification of TSRs from other facilities that affect the facility's safety basis.

TSR Coverage

This section provides assurances that TSR coverage for the facility is complete. This section lists the features identified in chapters 3 and 4 that are needed to

- provide significant defense in depth
- provide for significant worker safety
- provide for significant public safety in accordance with implementation of the evaluation guideline

Derivation of Facility Modes

This section derives basic operational modes used by the facility that are relevant to derivation of TSRs. The definition of modes required in this section expands and formalizes the information provided in chapter 3 regarding operational conditions associated with accidents.

TSR Derivation

This information can be organized by the hazard protected against, specific features, or even actual TSRs if desired. The choice of a specific method of organization is left to the discretion of the DSA preparer.

CHAPTER 6, PREVENTION OF INADVERTENT CRITICALITY

The purpose of this chapter is to provide information that will support the development of a safety basis in compliance with the provisions of 10 CFR 830.204, *Documented Safety Analysis*, regarding the definition of a criticality safety program. If this information is available in a site-wide criticality safety program description and it complies with the Rule requirements, then it can be included by reference and summarized in this chapter.

This chapter should include a

- a definition of a criticality safety program that ensures that operations with fissionable material remain subcritical under all normal and credible abnormal conditions, identifies applicable nuclear criticality safety standards, and describes how the program meets applicable nuclear criticality standards;
- description of the basis and analytical approach the facility uses for deriving operational criticality limits; and
- summary of design and administrative controls used in the criticality safety program.

Criticality Concerns

This section of chapter 6 should identify the fissile material available within the facility and provide information on the location of potential criticality hazards, the fissile material form, and the maximum quantities involved.

Criticality Controls

This section of chapter 6 should summarize information relevant to criticality control. It should include a general discussion of the criticality safety design limits, their bases, and any design criteria used to ensure sub-critical configurations under all normal, abnormal, and accident conditions; the parameters used for the prevention and control of criticality; the methods for the application and validation of these parameters; and the application of the double contingency principle in criticality safety.

Engineering Controls

This section of this chapter should summarize the safety design limits on engineered controls and the basis placed on equipment designs or operations to ensure sub-critical conditions under all normal, abnormal, and accident conditions. This section should also summarize the configuration control program as it relates to the configuration of the equipment used to store, handle, transport, or process fissile material.

Administrative Controls

This section of this chapter should summarize the administrative controls used to prevent accidental criticality. It should include a discussion of the administrative controls on nuclear material safety limits such as mass, moderators, and changes in geometry configurations, and procedures for handling, storing, and transporting fissile materials. It should also include the administrative controls for reviewing and approving changes to process or system configurations.

Application of Double Contingency Principle

This section of chapter 6 should summarize the methods used to ensure that at least more than one unlikely, independent, and concurrent change in process conditions would be necessary before a criticality accident is possible. The contingency or criticality safety evaluation should identify how the double contingency principle, as defined in DOE O 420.1, *Facility Safety,* is being met. The result of the contingency or criticality safety evaluation helps identify safety SSCs, controls, and the TSR limit designations.

Criticality Safety Program

This section of chapter 6 should present an overview of the organizational structure and interfaces and the technical and administrative practices of the criticality protection policy and programs. It should demonstrate how the criticality safety program satisfies the criticality safety standards.

Criticality Safety Organization

This section of chapter 6 should summarize the organizational structure that administers the criticality safety program. It should include information about staffing levels, positions of authority and responsibilities, and staff qualifications. It should discuss the interfaces and interrelationships with other safety organizations and facility operations and reference the administrative plans and procedures that implement the criticality safety program.
The summary should include

- the purpose, organization, and functions of any committees responsible for criticality safety; and
- a description of the charter of responsibilities, scope of reviews, and qualifications and requirements for committee members.

Criticality Instrumentation

This section of chapter 6 should summarize the criticality alarm system and detection systems used to mitigate exposures from a criticality event. Include in the summary the methods and procedures used to determine the placement of the monitoring equipment and the selection of the equipment functions and sensitivity, if required.

CHAPTER 7, RADIATION PROTECTION

This chapter summarizes provisions for radiation protection. Summaries focus on radiation protection based on facility hazards to describe the scope of the radiation protection program. Expected products of this chapter, as applicable based on the graded approach, include

- a description of the overall radiation protection program and organization;
- a description of the radiological as low as reasonably achievable (ALARA) policy and program;
- a description of radiation exposure control, including administrative limits, radiological practices, dosimetry, and respiratory protection;
- an identification of radiological monitoring to protect workers, the public, and the environment;
- a discussion of radiological protection instrumentation; and
- a description of the plans and procedures for maintaining records of radiation sources, releases, and occupational exposures.

CHAPTER 8, HAZARDOUS MATERIAL PROTECTION

This chapter summarizes provisions for hazardous material protection other than radiological hazards. Summaries focus on hazardous material protection based on facility hazards to provide a basic understanding of the scope of the hazardous material protection program. Expected products of this chapter, as applicable based on the graded approach, include

- a description of the overall hazardous material protection program and organization;
- a description of the hazardous material ALARA policy and program;
- a description of hazardous material exposure control, including identification of hazardous material, administrative limits, occupational medical programs, and respiratory protection;
- an identification of hazardous material monitoring to protect workers, the public, and the environment;
- a discussion of hazardous material protection instrumentation; and
- a description of the plans and procedures for maintaining hazardous material records, hazard communications, and occupational exposures.

CHAPTER 9, RADIOACTIVE AND HAZARDOUS WASTE MANAGEMENT

This chapter describes the provisions for radioactive and hazardous waste management. Expected products of this chapter, as applicable based on the graded approach, include

- a description of the overall radioactive and hazardous waste management program and organization;
- a description of the site-specific radioactive, mixed, and hazardous material waste management policy, objectives, and philosophy;
- an identification of hazardous waste streams, including types, sources, and quantities; and
- a description of the waste management process, and waste treatment and disposal systems, including design and administrative controls.

CHAPTER 10, INITIAL TESTING, IN-SERVICE SURVEILLANCE, AND MAINTENANCE

This chapter describes the essential features of the testing, surveillance, and maintenance programs. Expected products of this chapter, as applicable based on the graded approach, include

- a description of the facility initial testing program;
- a description of the facility in-service surveillance program; and
- a description of the planned, predictive, preventive, and corrective facility maintenance programs.

CHAPTER 11, OPERATIONAL SAFETY

This chapter discusses general aspects of operational safety. It focuses on the bases for the conduct of operations program specified by DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*.

This chapter describes the bases for the conduct of operations program and the fire protection program. Expected products of this chapter, as applicable based on the graded approach, include

- an identification of the aspects of conduct of operations directly applicable to the facility,
- an integrated summary of the main features of the facility conduct of operations program, and
- a description of the facility fire protection program.

Conduct of Operations

This section of the chapter summarizes applicability of conduct of operations to the facility and briefly identifies salient features of the conduct of operations program. Specific topical areas from DOE Order 5480.19 that should be considered are

- shift routines and operating practices
- control area activities
- communications
- control of on-shift training
- control of equipment and system status
- lockouts and tagouts
- independent verification
- log keeping
- operations turnover
- operations aspects of facility chemistry and unique processes
- required reading
- timely orders to operators
- operator aid postings
- equipment and piping labeling

Fire Protection

This section of the chapter provides a realistic discussion of the magnitude of facility fire hazards in terms of overall combustible and explosive loading in proximity to hazardous materials being protected. This information should be based on and correlate with accident descriptions in chapter 3, *Hazard and Accident Results*.

Results of overall assessments, such as fire hazards analyses and actual facility walk-downs, should be summarized as appropriate to put fire interaction with material into a proper perspective. The purpose of this section is to define the main fire protection issues of interest in the DSA.

CHAPTER 12, PROCEDURES AND TRAINING

This chapter describes the processes by which the technical content of the procedures and training programs are developed, verified, and validated. These processes will ensure that the facility is operated and maintained by qualified personnel. A programmatic commitment to ongoing procedures and training programs is considered a necessary part of safety assurance. Expected products of this chapter, as applicable based on the graded approach, include

- a summary of the overall facility procedures and training programs;
- a description of the processes by which the form and content of procedures and training materials are developed, verified, and validated for normal, abnormal, and emergency operations, surveillance testing, and maintenance;
- a summary of the processes for maintaining written procedures, and training materials;
- a summary of the processes for modifying procedures, training materials, and training records;
- a summary of the methods used to feed back operations experience, new analyses, and other DSA changes to the procedures and training programs; and
- a description of the mechanisms to identify and correct technical or human factor deficiencies.

Training Program

This section of the chapter summarizes the facility-training program, including brief statements addressing the safety management policies and philosophies used as a basis for the program. This section includes a summary of the processes by which the technical content of training programs is developed, verified, and validated.

This summary includes training methods and qualification requirements for

- conduct of normal, abnormal, and emergency operations;
- on-shift and classroom training;
- criticality training;
- radiation and hazardous material protection training;
- surveillance testing and maintenance training;
- fire protection training;
- quality assurance training; and
- emergency preparedness training.

CHAPTER 13, HUMAN FACTORS

This chapter focuses on human factors engineering, its importance to facility safety, and the design of the facility to optimize human performance. Human factors consist of

- human factors engineering that focuses on designing facilities, systems, equipment, and tools so they are sensitive to the capabilities, limitations, and needs of humans; and
- human reliability analysis that quantifies the contribution of human error to the facility risk.

This chapter demonstrates that human factors are considered in facility operations where humans are relied on for preventive actions and for operator mitigative actions during abnormal and emergency operations. In this respect, the human-machine interface is an integral part of facility safety and, thus, requires special treatment in the DSA. The emphasis is on human-machine interfaces required for ensuring the safety function of safety SSCs that are important to safety and on the provisions made for optimizing the design of those human-machine interfaces to enhance reliable human performance.

Identification of Human-Machine Interfaces

This section of the chapter summarizes the safety SSCs requiring human-machine interfaces to function and the required human-machine interface. These are identified in conjunction with the results of the hazard analysis and accident analysis discussed in chapter 3, that identify safety SSCs. This section should include human-machine interfaces necessary for the surveillance and maintenance of safety SSCs during normal operations, and the human-machine interfaces required for ensuring safety function during normal, abnormal, and emergency operations. The section should include a description of the actions identified so that the reviewer can understand what the humans are expected to do and the importance to facility safety of their action.

Optimization of Human Resource Interfaces

This section of the chapter summarizes a systematic inquiry into the optimization of human-machine interfaces with safety SSCs to enhance human performance. Checklists document the systematic inquiry. Discussions will be proportionate to the importance to safety and may consider the following design elements:

- furnished instrumentation, provisions for communication and operational aids to support timely, reliable performance for safety functions;
- layout and design of controls and instrumentation, and provision for labeling that apply the principles of ergonomics and human engineering;
- work environments, including physical access, the need for protective clothing or breathing apparatus, noise levels, temperature, humidity, distractions, and other factors bearing upon physical comfort, alertness, and fitness; and
- staffing considerations (e.g., minimum staffing levels, allocation of control functions, overtime restrictions, facility status turnover between shifts, procedures, training, etc.).

CHAPTER 14, QUALTIY ASSURANCE

This chapter describes the provisions for a quality assurance program. Expected products of this chapter include

- a description of quality assurance program and organization,
- a description of document control and records management, and
- a description of the quality assurance process ensuring that performed safety related work meets requirements.

Quality Assurance Program and Organization

This section of the chapter summarizes the program, including the safety management policies and philosophies used as a basis for the program. The chapter references facility documents detailing the program; identifies the organizational structure of the quality assurance program, including staffing levels and qualifications, positions of authority and responsibilities; and interfaces with other safety organizations and facility operations.

CHAPTER 15, EMERGENCY PREPAREDNESS PROGRAM

This chapter summarizes the emergency preparedness functions and response at the facility. Expected products of this chapter include

- an identification of the scope of the facility emergency preparedness plan (EPP); and
- a description of the philosophy, objectives, organization, and emergency response for facility emergency preparedness.

Scope of Emergency Preparedness

This section of the chapter summarizes the spectrum of emergencies that the EPP is designed to encompass. Discussions should focus on demonstrating that emergency preparedness planning adequately encompasses the facility hazards discerned in the hazard analysis. The use of bounding categories of emergencies (i.e., fire, spills, criticality) and bounding consequences from emergencies should be sufficient for documenting the scope of emergency preparedness.

Emergency Response Organization

This section of the chapter summarizes the emergency response organization that is activated in case of on-site and off-site operational emergencies. This chapter should define the authorities and responsibilities of key individuals and groups, and identify the communication chain for notifying, alerting, and mobilizing the necessary personnel. This chapter should also identify the position of the person with the overall responsibility for directing emergency responses; describe interrelationships with federal, state, tribal, and local organizations for off-site emergency response and for the protection of the environment and the public; and summarize and reference any prearranged plans, agreements, understandings, and/or other arrangements for mutual assistance by non-NNSA entities.

Training and Exercises

This section of the chapter summarizes the emergency training program, including initial and annual retraining for all facility emergency response personnel. The chapter should include a summary of the drills and exercises that are an integral part of the emergency management program. The summary should address the range of different populations exposed to facility hazards (e.g., public, general facility population, facility visitors).

CHAPTER 16, PROVISIONS FOR DECONTAMINATION AND DECOMMISSIONING

This chapter describes provisions that facilitate future D&D of a facility. Design of significant modifications to an existing facility must consider provisions for D&D. This chapter also contains guidance on the description of the conceptual D&D plan for existing facilities. Expected products of this chapter include

- a description of design features incorporated in major modifications of an existing facility to facilitate future D&D of the facility,
- a description of operational considerations to facilitate future D&D, and
- a description of a conceptual D&D plan.

Description of Conceptual Plans

This section of the chapter summarizes conceptual plans for D&D. This summary documents that the planning of operations and design or modifications minimizes the potential for spread of contamination that would complicate or reduce effectiveness of future D&D or environmental restoration activities. Assessment of future D&D activities must be based on an evaluation of the type and magnitude of hazards and the complexity of processes. The evaluation considers the vulnerabilities to normal and abnormal events and operational plans to minimize contamination and prevent an increase in residual risk during or after decommissioning in a manner similar to the hazard analysis described in section 3.3, *Hazard Analysis*. The evaluation, however, is conceptual in nature and does not require the extent of documentation required of a DSA hazard analysis.

The description of design features to facilitate D&D operations is limited to major modifications of existing facilities.

CHAPTER 17, MANAGEMENT, ORGANIZATION, AND INSTITUTIONAL SAFETY PROVISIONS

This chapter presents information on management, technical, and other organizations that support safe operation. This chapter also enumerates the requirements used to develop the safety management programs, includes descriptions of the responsibilities of and relationships between the non-operating organizations having a safety function and their interfaces with the line operating organization, and presents sufficient information on the safety management policies and programs to demonstrate that the facility operations are embedded in a safety conscious environment. Expected products of this chapter include

- a description of the overall structure of the organizations and personnel with responsibilities for facility safety and interfaces between those organizations; and
- a description of the programs that promote safety consciousness and morale, including safety culture, performance assessment, configuration and document control, occurrence reporting, and staffing and qualification.

Organizational Responsibilities

This section of the chapter summarizes the organization’s responsibilities and authorities; its interfaces with other organizations described in this chapter or other chapters of the DSA, including the line operating organization; and the general safety programs and issues for which it is responsible. The chapter should also discuss:

- technical and engineering support, maintenance, and modifications;
- safety issue discovery, communication, management, and resolution;
- independent safety review, audit, and compliance determination; and
- safety analysis services, including USQ evaluation.

Note: You do not have to do example 2 on the following page, but it is a good time to check your skill and knowledge of the information covered. You may do the example 2 or go to the section 3.

EXAMPLE 2

1. Discuss what is included in chapter 1 of a DSA.

2. In what chapter of a DSA would you expect to see a summary of the use of radiation work permits?

3. Discuss the purpose of a DSA as it applies to facilities transitioning into D&D.

Note: When you are finished, compare your answers to those contained in the example 2 self-check. When you are satisfied with your answers, go on to section 3.

EXAMPLE 2 SELF-CHECK

1. Discuss what is included in chapter 1 of a DSA.
   - Description of the location of the site, location of the facility within the site, the site's proximity to the public and to other facilities, and identification of the point where the evaluation guideline is applied
   - Specification of population sheltering, population location and density, and other aspects of the surrounding area of the site that relate to assessment of the protection of the health and safety of the public
   - Determination of the historical basis for site characteristics in meteorology, hydrology, geology, seismology, volcanology, and other natural phenomena events to the extent needed for hazard and accident analyses
   - Identification of design basis natural events
   - Identification of sources of external accidents, such as nearby airports, railroads, or utilities such as natural gas lines
   - Identification of nearby facilities impacting, or impacted by, the facility under evaluation
   - Validation of site characteristic assumptions common to safety analysis that were used in prior environmental analyses and impact statements, or of the need to revise and update such assumptions used in facility environmental impact statements

2. In what chapter of a DSA would you expect to see a summary of the use of radiation work permits?
   Chapter 7, Radiation Protection

3. Discuss the purpose of a DSA as it applies to facilities transitioning into D&D.
   For facilities transitioning into D&D, the safety basis of the D&D operations is documented in a DSA. The DSA provides the necessary analysis and supporting information to describe the facilities as they undergo shutdown, deactivation, decontamination, and decommissioning or dismantlement.

SECTION 3, EVALUATION GUIDELINE

The evaluation guideline specifies a numerical radiological dose value to be used in identifying safety-class SSCs. Calculation methods and assumptions needed to provide general consistency in dose estimation are also described, with relevant background and interpretation discussions included as appropriate.

The methodology provided in the standard focuses on characterizing facility safety with or without well-documented design information. The evaluation guideline construct is intended for use with existing facilities.

EVALUATION GUIDELINE

The evaluation guideline is 25 rem total effective dose equivalent (TEDE). The dose estimates to be compared to it are those received by a hypothetical maximally exposed off-site individual (MOI) at the site boundary for an exposure duration of two hours. The nominal exposure duration of two hours may be extended to eight hours for those release scenarios that are especially slow to develop. Dose calculations for comparison against the evaluation guideline are based on the concept of an unmitigated release to determine if the potential level of hazard in the specific facility warrants safety-class SSC.

The value of 25 rem TEDE is not to be used as a hard pass/fail level. Unmitigated releases should be compared against the evaluation guideline to determine if they challenge the evaluation guideline, rather than exceed it. This is because consequence calculations are highly assumption driven and uncertain.

It should be made clear that the evaluation guideline is not to be treated as a design acceptance criterion, nor as justification for nullifying the general design criteria relative to defense in depth safety measures. The value of 25 rem TEDE is not considered an acceptable public exposure either. It is, however, generally accepted as a value indicative of no significant health effects.

There is no predetermined frequency cutoff value, such as 1E-6 per year, for excluding low frequency operational accidents. For operational accidents, there is no explicit need for a frequency component to the unmitigated release calculations since the determination of need is driven by the bounding consequence potential. Natural events are defined in terms of the frequency of the initiating event, while external events are defined with a cutoff frequency of 10^{-6} per year, conservatively calculated, or 10^{-7} per year, realistically calculated.

Unmitigated release is meant to consider material quantity, form, location, dispersability, and interaction with available energy sources, but not to consider safety features that would prevent or mitigate a release. Final dose estimations representing the anticipated behavior of the facility under accident conditions should be based on the mitigated DBAs, wherein full or partial functionality of safety-class SSCs is assumed. In cases where the designated safety-class SSCs are not capable of performing their required safety function without significant upgrade, other compensatory measures such as MAR limits may be implemented in the facility and incorporated into the DSA.

Comparison of the unmitigated consequences for a limited subset of potential accidents to the evaluation guideline is performed to determine if the need for designation of safety-class SSCs exists. If the evaluation guideline values are approached by the unmitigated consequences of a release scenario, a need for safety-class SSC designation is indicated. Safety-class SSCs are only one of many layers of hardware- and administrative-based controls that are incorporated into an NNSA operation for the protection of the public, worker, and environment consistent with the precepts of the defense in depth philosophy. The safety-class designation helps to focus a higher level of attention and requirements on this select subset of all controls intended for the protection of the public.

If the need for safety-class designation is determined, all preventive and mitigative features associated with the sequence of failures that result in a given release scenario and any features whose functionality is assumed as part of the scenario definition itself are candidates for safety-class SSC designation. The process of designating one or more safety SSCs as safety-class is judgment-based and depends on many factors, such as effectiveness, a general preference of preventive over mitigative and passive over active features, relative reliability, and cost considerations.

DOSE COMPARISON CALCULATIONS

General discussion is provided for source term calculation and dose estimation and prescriptive guidance for the latter. The intent is that calculations should be based on reasonably conservative estimates of the various input parameters.

The dose estimate is that dose received during a two-hour exposure to plume, considering inhalation, direct shine, and ground shine. Other slow developing release pathways such as ingestion of contaminated food, water supply contamination, or resuspension are not included. However, quick release accidents involving other pathways, such as a major tank rupture that could release large amounts of radioactivity in liquid form to water pathways, should be considered. In this case, real potential uptake locations should be the evaluation points.

The airborne pathway is of primary interest for nonreactor nuclear facilities. This position is supported by NUREG-1140, "A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licenses," which states that for all materials of greatest interest for fuel cycle and other radioactive material licenses, the dose from the inhalation pathway will dominate the overall dose. For some types of facilities such as, waste storage, the surface water and groundwater pathways may be more important, but accident releases usually develop more slowly than airborne releases. More time would also be available for implementing preventive and mitigative measures. Therefore, the emphasis on safety-class SSCs, in terms of immediate availability and operation, is not generally necessary for safety SSCs associated with these pathways.

Scenario Definition

The concept of a DBA has historically been applied in the nuclear industry for deterministic evaluation of potentially high consequence accidents. The DBA analyses encompass evaluations of the need for and the adequacy of those important SSCs whose failure could have an adverse impact on the public. For many NNSA facilities, due largely to their age and the absence of safety documentation, the original design bases for their SSCs, including safety-related features, are severely lacking or nonexistent. In recognition of this deficiency, the standard requires the development and analysis of derivative DBAs, which for simplicity were also referred to as "DBAs" in the body of the standard, for the existing facilities in lieu of actual DBAs. The primary purpose of the DBA analysis is to identify SSCs that warrant safety-class designation. In doing so, the concept of unmitigated release was developed to conservatively estimate the consequence potential from the candidate DBAs that are selected from the hazard analysis without taking credit for any safety features. Note that the standard already requires that unmitigated consequences be estimated as part of a hazard analysis, though largely in a qualitative manner. Thus, the unmitigated release calculation is a critical step in the DBA formulation process that estimates the potential magnitude of the radiological release. The result of the calculation is compared to the evaluation guideline to determine if any safety-class SSC is required and to provide insight for selecting the appropriate safety-class SSC(s) for each DBA scenario.

For existing NNSA non-reactor nuclear facilities, some safety systems may already be known and designated as such (e.g., fire protection systems and confinement systems, which include HEPA filtration). Some safety-class designations for such safety systems may also be self-evident. Nevertheless, it is necessary to provide the basis for such designation, and the appendix in the standard provides the guidance for the analysis and the documentation required. In some cases, it has been found that these analyses provide useful insight into subtle safety issues.

Unmitigated Release Calculation

The unmitigated release calculation represents a theoretical limit to scenario consequences assuming that all safety features have failed, so that the physical release potential of a given process or operation is conservatively estimated. The unmitigated release should characterize both the energies driving the release, and the release fractions according to the physical realities of the accident phenomena at a given facility or process. As a result, some assumptions must be made to define a meaningful scenario. To capture these assumptions and their resulting potential impact on safety SSC designation and/or TSR protection, the unmitigated calculation should

- take no credit for active safety features, such as ventilation filtration systems in the case of a spill,
- take credit for passive safety features that are assessed to survive accident conditions where that capability is necessary to define a physically meaningful scenario,
- take no credit for passive safety features producing a leak path reduction in source term, such as building filtration, and
- assume the availability of passive safety features that are not affected by the accident scenario.

Design Basis Accident Calculation

Once a set of safety-class SSCs has been identified, accident consequences can be estimated in a DBA calculation that represents the accident scenario progression where safety-class SSCs successfully perform their intended safety function.

For each scenario in the DSA, sufficient documentation of the unmitigated and mitigated accident scenarios (DBAs) should be made so that the thought process of determining the safety-class SSCs is well understood. In all cases, the level of protection provided by the identified safety-class SSCs should be evident. However, this does not require explicit reporting of unmitigated consequences in the DSA, if it is evident that the unmitigated release consequences are large, i.e., well above the evaluation guideline.

Source Term Calculation

The radioactive airborne source term is typically estimated as the product of five factors:

- MAR
- damage ratio (DR)
- airborne release fraction (ARF)
- respirable fraction (RF)
- leak path factor (LPF)

MAR

The MAR values used in hazard and accident analyses must be consistent with the values noted in hazard identification and should represent documented maximums for a given process or activity. Such documentation may be present in TSRs or lower-tier documents referenced in TSRs, as necessary. While DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, excludes material in qualified containers from consideration for the purposes of hazard classification, the existence of such material should be acknowledged in a DSA. Such material should later be excluded from the source term for the applicable accident scenarios if the containers can perform their functions under the accident environments.

DR

The DR is that fraction of material affected by the accident generating conditions. DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities,* notes that some degree of ambiguity can result from overlapping definitions of MAR and DR in various applications. One consistent definition should be used throughout a given DSA.

ARFs and RFs

Bounding estimates for radionuclide ARFs and RFs for a wide variety of MAR and release phenomena are systematically presented in DOE-HDBK-3010-94. In those cases where there may be significant direct shine contribution to dose, that contribution should be evaluated without the use of the respirable fraction.

LPF

The LPF is the fraction of material passing through some confinement deposition or filtration mechanism. Several LPFs may be associated with a specific accident, (e.g., fraction passing from a glove box, fraction passing from a room, fraction passing through filtration vis-à-vis door leakage). For the purposes of the unmitigated release calculation, the LPF should be set to unity.

Dose Estimation

The relevant factors for dose estimation are receptor location, meteorological dispersion, and dose conversion values. Specific guidance for each is provided below.

Dose Calculation Location

For the purposes of comparison to the evaluation guideline, the comparison point is the location of a theoretical MOI standing at the site boundary. This location can also be beyond the NNSA site boundary if a buoyant or elevated plume is not at ground level at the NNSA site boundary. In such cases, the calculation location is taken at the point of maximum exposure, typically where the plume reaches the ground level. It is NNSA practice that on-site workers and the public are protected under the emergency response plans and capabilities of its sites. This protection, along with implementation of defense in depth and worker safety philosophy, safety-significant and safety-class SSC designations, and NNSA's safety management programs, address on-site safety. However, an annual assessment of any changes in the site boundary and potential effects on safety SSC classification should be performed in association with the required annual update of the DSA for a facility. Privatization and site turnover initiatives may affect these determinations.

Atmospheric Dispersion

The 95th percentile of the distribution of doses to the MOI, accounting for variations in distance to the site boundary as a function of direction, is the comparison point for assessment against the evaluation guideline. The method used should be consistent with the statistical treatment of calculated X/Q values described in regulatory position 3 of NRC Regulatory Guide 1.145 for evaluating consequences along the exclusion area boundary. The determination of distance to the site boundary should be made according to the procedure outline in position 1.2 of Regulatory Guide 1.145. NRC Regulatory Guide 1.23 describes acceptable means of generating the meteorological data upon which dispersion is based. Accident phenomenology may be modeled assuming straight-line Gaussian dispersion characteristics, applying meteorological data representing a one-hour average for the duration of the accident. Accident duration is defined in terms of plume passage at the location of dose calculation, for a period not to exceed eight hours. Prolonged effects, such as resuspension, need not be modeled. The accident progression should not be defined so that the MOI is not substantially exposed (i.e., using a release rate that is specifically intended to expose the MOI to only a small fraction of the total material released, or defining time and wind speed so that the plume has not reached the MOI). The exposure period begins from the time the plume reaches the MOI.

For ground releases, the calculated dose equates to the centerline dose at the site boundary. For elevated, thermally buoyant, or jet releases, plume touchdown may occur beyond the site boundary. As noted in the discussion of receptor location, these cases should locate the dose calculation at the point of maximum dose beyond the site boundary, which is typically at the point of plume touchdown.

Accidents with unique dispersion characteristics, such as explosions, may be modeled using phenomenon-specific codes more accurately representing the release conditions. Discussion should be provided justifying the appropriateness of the model to the specific situation. For accident phenomena defined by weather extremes, actual meteorological conditions associated with the phenomena may be used for comparison to the evaluation guideline.

FUNCTIONAL CLASSIFICATION PROCESS

The use of the evaluation guideline is only one element in a larger safety SSC functional classification process that contributes to adequate safety. Other contributors are disciplined conduct of operations, training, and safety management programs such as radiation protection and emergency response. The functional classification process must recognize competing interests for resources and the need to optimize the application of resources for safety in a facility. Some principles that should be incorporated into a functional classification process are

- Protection of the public is contributed to by all facets of safety in design, including defense in depth, safety-class and safety-significant SSCs, and in many cases in NNSA, by remote siting;
- Protection of the public is paramount in safety design, but protection of workers is no less important. However, the degree of protection for facility workers achievable by safety SSCs is limited. Major contributions to overall safety assurance to the worker are institutional factors such as conduct of operations, training, and the safety management programs.
- Some considerations in the prioritization of facility safety issues, including:
  - Hazardous material inventory should be minimized at all times.
  - Safety SSCs are preferred over administrative controls.
  - Passive SSCs are preferred over active SSCs.
  - Preventive controls are preferred over mitigative controls.
  - Controls closest to the hazard may provide protection to both workers and the public.
  - Facility safety SSCs are preferred over personal protective equipment.
  - Controls that are effective for multiple hazards can be resource effective.

ADDITIONAL CONSIDERATIONS

Selection of the term “evaluation guideline” is deliberate because it is different from safety or risk acceptance criteria and siting criteria. Such acceptance criteria have traditionally been used in the design and siting stage of nuclear power reactors.

Acceptance criteria have been linked to accident scenarios that are prescribed in some manner, i.e., deterministic DBAs. The results of quantitative probabilistic risk assessments (PRAs), principally those of nuclear power or production facilities, are sometimes compared to another type of risk acceptance criteria, referred to as "safety goals." PRAs are fundamentally different analytical methods from deterministic safety analyses and produce a different type of product. For example, in PRAs the failure of a safety feature (hardware or human action) to perform an intended function is always postulated, irrespective of the safety classification of the feature. Therefore, in contrast to assumptions employed in deterministic safety analyses, in PRAs even safety-class SSCs are not treated differently from typical, industrial grade SSCs in release scenario characterization, with the exception of their estimated failure probabilities.

A conceptually different approach is needed for safety analyses of existing facilities, where an analysis of the safety of the facility, as is, is performed. The primary objective of the analytical process must then turn to the identification of needed controls, their potential inadequacies, and the corresponding corrective or compensatory measures. Furthermore, for existing NNSA facilities, DBAs are typically either non-existent or irrelevant, due to a variety of reasons, such as changes in the original mission or early design philosophies. Thus, the standard adopted the notion of derivative DBAs that for simplicity of notation were summarized as DBAs in the text. However, these DBAs are not the actual accident scenarios that formed some aspects of the basis for the facility design. For these existing facilities, safety assurance is provided through an aggressive approach based on a comprehensive analysis of all hazards leading to the release of radiological or toxicological material, and ensuring that the controls identified against each hazard are relevant, specific, and effective.

Remember that the value of 25 rem TEDE is not to be used as a hard pass/fail level. Unmitigated releases should be compared against the evaluation guideline to determine if they challenge the evaluation guideline, rather than exceed it. This is because consequence calculations are highly assumption driven and uncertain. There are uncertainties in initiating event intensity, plant SSC and personnel response, accident phenomenology, DRs, ARFs and RFs, and so on. Other factors may play a part in the decision, and the evaluation guideline value guides the decision-making process towards a level of uniformity that could not exist without some form of quantitative benchmark.

The evaluation guideline is not used as any measure of acceptable or adequate safety. Rather, it is a tool intended to carry the application of hazard analyses one step further to gradation of hazard-based controls with tangible results on the operating floor.

It may be argued that in lieu of, or in addition to, the evaluation guideline, NNSA should also promote the use of some form of risk acceptance criteria, so risk or safety analysts would know what is safe enough, or when the amount of analysis performed is sufficient. However, NNSA's experience with previous DSAs for existing facilities has shown that the use of risk acceptance criteria of any kind has resulted in shortcutting the hazard analysis process and in an inadequate identification and understanding of needed controls. Additionally, good practice dictates that safety improvement should be made whenever practical, regardless of the level of existing safety. In other words, there is no such thing as safe enough in an absolute sense.

The evaluation guideline value is not release frequency dependent since the determination of need is solely driven by the bounding consequence potential. Additionally, calculation of frequencies and consequences of various release scenarios involve accounting for large uncertainties on both scales. Limiting the evaluation guideline to one value on the consequence scale alone reduces the impact of uncertainties on the safety-class designation of SSCs with no loss of information on characterization of the needed controls because of comprehensive hazard analysis. The availability of typical preventive or mitigative features, such as the ventilation and filtration systems, given the occurrence of a DBA in NNSA's non-reactor nuclear facilities will reduce potential public doses to well within a small fraction of the evaluation guideline. Thus, an approach that also uses frequency of release would not result in different SSC classifications. Requiring frequency-based calculations would result in enlarging the paper process, thus undermining NNSA's emphasis on comprehensive hazard analysis, without significant payback in safety assurance on the operating floor.

The protection of the public and workers during normal operations is governed by 10 CFR 835, "Occupational Radiation Protection" This is not to imply, however, that safety SSCs should be identified based on compliance with 10 CFR 835. It is inherent in the hazard analysis process described in the standard that a comprehensive spectrum of accidents, including those that may have a higher likelihood, be identified, evaluated, and analyzed. Any accidents that have a significant consequence potential to the public or workers, independent of likelihood, must be thoroughly evaluated, including the identification of any appropriate safety SSCs or administrative controls.

Toxicological evaluation guideline is not specified. There is no industrial or regulatory precedent for safety-class designation of SSCs in facilities or processes with only toxicological hazards. Safety-significant designations that are based on qualitative guidelines can be triggered without distinction from radiological and toxicological hazards. However, controls for toxicological releases that trigger nuclear accidents or have nuclear impacts are potential candidates for safety-class designation.

Note: You do not have to do example 3 on the following page, but it is a good time to check your skill and knowledge of the information covered. You may do the example 3 or go directly to the practice.

EXAMPLE 3

1. Define the term “evaluation guideline.”

2. Discuss the purpose of a DBA calculation.

3. List the relevant factors for dose estimation.

Note: When you are finished, compare your answers to those contained in the example 3 self-check. When you are satisfied with your answers, go on to the practice

EXAMPLE 3 SELF-CHECK

1. Define the term "evaluation guideline."
   The radioactive material dose value that the safety analysis evaluates against. The evaluation guideline are established to identify and evaluate safety-class SSCs.

2. Discuss the purpose of a DBA calculation.
   A DBA represents the accident scenario progression where safety-class SSCs successfully perform their intended safety function.

3. List the relevant factors for dose estimation.
   The relevant factors for dose estimation are receptor location, meteorological dispersion, and dose conversion values.

PRACTICE

This practice is required if your proficiency is to be verified at the familiar level. The practice will prepare you for the criterion test. You will need to refer to the resources to answer the questions in the practice correctly. The practice and criterion test will also challenge additional analytical skills that you have acquired in other formal and on-the-job training.

1. Define the following terms: beyond design basis accident, decommissioning, decontamination, and design basis.

2. Discuss the purpose of DSAs.

3. Discuss the purpose of DOE-STD-3009-94.

4. Discuss the defense in depth approach to facility safety.

5. Discuss the purpose of a hazard analysis.

6. List the expected products of chapter 2 of a DSA.

7. Discuss the application of the graded approach to the derivation of TSRs.

8. Discuss what is typically included in chapter 10 of a DSA for the facility maintenance program.

9. List the expected products of chapter 11 of a DSA.

10. Define the term “evaluation guideline.”

Note: The course manager will check your practice and verify your success at the familiar level. When you have successfully completed this practice, go to the general level module.

DOE-STD-3009-94
PREPARATION GUIDE FOR U.S. DEPARMENT OF ENERGY NONREACTOR NUCLEAR FACILITY DOCUMENTED SAFETY ANALYSES
GENERAL LEVEL

OBJECTIVES

Given the familiar level of this module, a scenario, and an analysis, you will be able to answer the following questions:

1. Is the contractor's action plan correct? If not, state what should have been done.

2. Were the correct sections of the documented safety analysis (DSA) referenced? If not, state the correct sections.

Note: If you think that you can complete the practice at the end of this level without working through the instructional material and/or the examples, complete the practice now. The course manager will check your work. You will need to complete the practice in this level successfully before taking the criterion test.

RESOURCES

DOE Orders Self-Study Program, DOE-STD-3009-94, *Preparation Guidance for U.S. Department Of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, October 2003.

10 CFR 830, "Nuclear Safety Management, Subpart B, Safety Basis Requirements."

DOE G 421.1-2, *Implementation Guide for Use in Developing Documented Safety Analyses to Meet Subpart B of 10 CFR 830.*

DOE G 423.1.1, *Implementation Guide for Use in Developing Technical Safety Requirements.*

DOE G 424.1-1, *Implementation Guide for Use in Addressing Unreviewed Safety Question Requirements.*

DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.*

DOE-STD-1104-96, *Review and Approval of Nuclear Facility Safety Basis Documents (Documented Safety Analyses and Technical Safety Requirements).*

INTRODUCTION

The familiar level of this module included the safety documents that make up the safety basis for a nuclear facility. The general level applies the knowledge gained in the familiar level to an example scenario, which includes a situation, the actions taken to remedy the situation, and the requirements related to the situation. Students will be asked to review the contractor's actions and decide if they are correct. Students will also be asked to decide if the correct requirements were cited in each situation. Please refer to the resources to make your analysis and answer the questions. You are not required to complete the example. However, doing so will help prepare you for the criterion test.

Note: You do not have to do the example on the following page, but it is a good time to check your skill and knowledge of the information covered. You may do the example or go on to the practice.

EXAMPLE SCENARIO

A routine National Nuclear Security Administration (NNSA) survey of facility operations raised a concern regarding the level of detail present in fire inspection procedures used to satisfy technical safety requirements (TSR) surveillances. Follow-up by facility engineering personnel led to the discovery that the fire system surveillance procedure that was credited for satisfying TSR surveillances for Building 234-H did not contain steps to perform the required inspections. The surveillances in question were the visual inspection of sprinkler heads and the visual inspection of sprinkler piping and fittings.

During a critique, personnel from the Facility Support Services Division (FSSD) indicated that they had revised the template for the procedure that was credited for performance of the annual surveillance on the 234-H fire system. This revision removed the two sections that described the visual inspection of the sprinklers and the piping. These inspections were required by National Fire Protection Association (NFPA) Code, but were not part of the Defense Programs (DP) TSRs at that time. These sections were removed by FSSD in anticipation of a proposed change to site procedure 2Q 5.11. This revision to the procedure template occurred sometime before September 2001. Subsequently, a DP-specific revision of the procedure was sent to the facility for review in September 2001, but the revision sheet did not indicate that these two sections of the procedure had been removed during the earlier template revision.

A phase II critique was held with FSSD and site fire protection engineering. During the critique, it was learned that during the period that the template for the 234-H annual test was revised, there was no formal process for controlling such changes. The procedure writers for FSSD typically sought to obtain consensus (no formal routing) for the change, and then make the change once they reached some level of agreement.

Apart from the FSSD inspection, the tritium fire protection coordinator conducts a quarterly inspection of fire systems. Facility management conducted a review to determine if the TSR requirements were adequately satisfied by this procedure and concluded that they were, thus preventing an actual TSR violation. NNSA concurred with this conclusion and a white paper was written to provide documentation.

Coincidental to the FSSD procedure revision in September 2001, the tritium facilities implemented an update to the DSA in October of 2001. For the fire system limiting condition for operations, the following surveillance requirements were added:

- a five year preventive maintenance on certain valves in the system
- visual inspection of the sprinkler heads
- visual inspection of the sprinkler piping and fittings

During the DSA implementation, a review was conducted to ensure that the newly applied TSR requirements were satisfied by the completion of a procedure. The 234-H annual inspection procedure that had just been completed was incorrectly credited as satisfying the TSR requirements under the assumption that it contained the required inspections.

Action plans taken

- Review all fire system surveillances from September 2001 to June 2002 and ensure that they are complete.
- Revise the procedure to indicate that it fulfills the requirements of the fire system surveillance requirements for the visual inspection of the sprinklers, piping, and fittings.
- Develop a formal change control process for the revision, review, and approval of procedures.

Sections of the DSA where you find information related to the scenario

- Section 10.4, “In-Service Surveillance Program”
- Section 12.3.1, “Development of Procedures”
- Section 12.3.2, “Maintenance of Procedures”
- Section 12.4.1, “Development of Training”

Take some time to review the example scenario and the actions the contractor took or didn’t take to correct the situation. Then decide if the contractor’s actions were complete and correct. Finally, determine if the requirements cited by the contractor apply to this situation. Write your answer on the next page and then compare your answer to the one contained in the example self-check.

Write your answer here.

EXAMPLE SELF-CHECK

Your answer does not have to match the following exactly. You may have added more corrective actions or cited other requirements from the resources that apply. To be considered correct, you answer must include, at least the following.

The action plans taken were complete and correct.

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The sections cited were correct. However, one additional section should have been included: Section 5.5.X.2, Surveillance Requirements.

Additionally, facilities that have DSAs with surveillance requirements that are performed by outside support work groups need to be diligent in ensuring that the documents used by the outside work groups perform the surveillance as required. A formal change control process, with facility involvement, for the implementing document is essential to ensure that the DSA requirements are being met.

Implementation of future DSAs will have the required rigor and diligence by the system engineer and management to ensure that lessons learned from this event are implemented. This will include a rigorous plan that has sufficient detail for the implementation, and rigorous checks and reviews will be performed to ensure that the facility and personnel have a complete understanding of the DSA.

PRACTICE

This practice is required if your proficiency is to be verified at the general level. If you are to be qualified as a facility representative, the practice will prepare you for the criterion test. You will need to refer to the CFR, guides, and standards listed in the resources to answer the questions in the practice correctly. The practice and the criterion test will also challenge additional analytical skills that you have acquired in other formal and on-the-job training for the facility representative position.

Please review the following scenario, and then answer these questions.

1. Is the contractor's action plan correct? If not, state what should have been done.
2. Were the correct sections of DOE-STD-3009-94 cited? If not, state the correct sections.

SCENARIO

Personnel were working in a facility operating room preparing to obtain material characterization samples from fissile material items that were introduced into a glove box earlier in the shift. The work was being performed per a standard operating procedure. During the preparations, the operators discovered that one of the fissile items in the glove box was not authorized to be in the glove box based on the item identifications previously recorded in the procedure. The operating procedure requires that before introducing fissile material into the glove box, two operations personnel must verify that only authorized items will be introduced by completing a nuclear safety control step that requires that the item identification, recorded on the can, be compared to the authorized item identifications recorded in the procedure. Additionally, an engineering representative is required to perform the same verification per a nuclear safety control step in the procedure. When these verifications were performed, the operations and engineering personnel failed to recognize that the item that was subsequently introduced to the glove box was not on the authorized item list in the procedure. The verification by operations personnel and an engineering representative of the item identifications on the fissile material cans versus the authorized list of item identifications previously recorded in the procedure are the two defenses for nuclear criticality safety double contingency analysis initiating event. The unauthorized item in the glove box exceeded the glove box fissile mass limit. However, introduction of the material did not cause the criticality safety limit to be exceeded.

An investigation of the event revealed the following.

The first error occurred when the new pail labels reflected wrong item numbers based on item 7 and item13 being repacked into the wrong pails outside of the repack hut. The common error precursor was complacency/overconfidence. Two operators and a radiological control inspector (RCI) were at room 304 for the purpose of sorting and repacking. The original pail removed from the vault was opened by operator 1. All radiological surveys were performed by the RCI. Items 7 and 13 were removed from the pail, and were placed outside of the repack hut for repackaging. Operator 2 stationed outside of the repack hut placed item 13 into pail B and item 7 into pail A.

Placement of the items should have been made by placing item 13 into pail A and item 7 into pail B. The A pail was transported to the vault and the B pail was transported to the dissolver maintenance room (DMR) for eventual introduction into the material characterization glove box. The self-check of the work was less than adequate.

The second error occurred when markings on items were incorrectly verified against the master sequencing procedure before items were introduced into the material characterization glove box. Two operators verified tamper-indicating device (TID) seals and pail identifiers, but did not verify item identifiers against the procedure. A nuclear safety specialist (NSS) verified pail and TID identifiers, but did not verify item identifiers, based on over-confidence that the right pails, items, and TID seals were to be bagged into the cabinet. The present procedure refers to "product container" identification instead of "item identification.

Normally, third-level operators sort and repack items to be transported to DMR. Material characterization operators then introduce material into the material characterization glove box. When the material characterization operators (two) and the NSS perform verifications in DMR, it is usually the first time that they have seen the pails/items, which constitutes a fresh set of eyes verifying identification of pails/items.

For this event, one of the material characterization operators was the same individual that sorted and repacked the items in room 304. Personnel interviews revealed that the operator had a high confidence level that the right item was in the pail because the qualified operator had sorted and repacked the item in room 304. Based on the confidence level of the one operator, a less than adequate verification was performed by all of the operators in DMR.

Action plans taken

- Engineering submitted a procedure change request to change all references where "product container" is listed to read "item" for clarification.
- The facility will issue an operating experience program lessons learned to facility operators covering the issues surrounding this event.

Sections of DOE-STD-3009-94 that apply to this scenario

- Section 6.4, "Criticality Controls"
- Section 6.4.1, "Engineering Controls"

Take some time to review the scenario and determine if the contractor's action plans were complete and correct, and determine if the correct sections from DOE-STD-3009-94 were cited.

Write your answers on the next page and then bring the completed practice to the course manager for review.

Note: The course manager will check your practice and verify your success at the general level. When you have successfully completed this practice, the course manager will give you the criterion test.