PREDECISIONAL

9 CONFINEMENT EVALUATION

9.1 Review Objectives

There are three objectives for the review of the chapter on confinement evaluation. The first is to evaluate the applicant estimate of the amount of radionuclides that would be released to the environment under normal operations, anticipated occurrences, and design basis accident conditions. The estimates of releases, together with local environmental transport mechanisms (i.e., meteorology and hydrology) and distances to the controlled area boundary, are used to determine whether the design meets regulatory performance standards. These specific evaluations against regulatory dose standards are performed in Chapter 11, Radiation Protection Evaluation; and Chapter 15, Accident Analysis, of this AR.

The second review objective is the evaluation of proposed monitoring systems. This evaluation includes monitoring systems for storage confinement systems and additional systems for measuring effluents during normal operations and accidents.

The third review objective is to evaluate systems for protection of stored materials from degradation.

Because this was not a site-specific TSAR (U.S. Department of Energy, 1998a), a complete evaluation of confinement was not possible. It was assumed that compliance with appropriate regulations by any reference to cask-specific information will be evaluated in the cask vendor SAR review.

9.2 Areas of Review

The following areas of review are addressed in Section 9.4, Conduct of Review:

Radionuclide Confinement Analysis

Confinement Monitoring

Protection of Stored Materials from Degradation

9.3 Regulatory Requirements

This section identifies the portions of 10 CFR Part 72 relevant to the review areas addressed by this chapter. The applicable regulatory requirements from 10 CFR Part 72 for the confinement evaluation are

- 72.24(c), (d), (f), (g), (k), and (l)
- 72.44(c)(1)(i)
- 72.104 (a)–(c)
- 72.106 (b)
- 72.122(b)(4) and (h)(1), (3), (4), and (5)(i)
- 72.126(c) and (d)
- 72.128(a)(1) and (3)

9.4 Conduct of Review

The design of the CISF is based on the utilization of transportation and storage casks that have been certified, licensed, or both, under 10 CFR Part 72. For this reason, no analyses of cask designs and radiological release rate calculations are presented by the applicant in Chapter 11, Confinement Evaluation, of the CISF TSAR. The confinement evaluation for the proposed CISF with respect to radiological release calculations, continuous monitoring, and evaluation of stored material degradation relies on the analyses performed by the vendors to obtain the NRC certification of the candidate transportation and storage casks. No information regarding chemical composition and mechanical properties of materials of construction of critical components is given in the CISF TSAR or RAI 11-1 (U.S. Department of Energy, 1998b).

Additional features, such as surface contamination detection capabilities, wash-down facilities, and an HVAC system, are incorporated by the DOE into the CISF design to further lower the radiological releases that can be caused by normal and off-normal events. The design of the CISF is such that it will ensure that receiving, transferring, handling, storing, and continuous monitoring of the casks would be in accordance with the cask system vendor SARs.

9.4.1 Radionuclide Confinement Analysis

Chapter 11, Confinement Evaluation, of the CISF TSAR was reviewed to identify the quantities of radionuclides that would be released during normal, off-normal, and accident conditions, including design basis accidents. The review was conducted in accordance with the guidance provided in Chapter 9 of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

The proposed confinement system for the SNF is a dry and sealed system. Preapproved, NRC-certified, casks for storage and transportation will be used in the CISF design (Section 11.1, Confinement Design Characteristics, of the CISF TSAR).

The storage and transportation cask systems received at the CISF will be used as described in the vendor SARs. Chemical composition and mechanical properties of materials of construction for all critical components important to safety are described in the vendor SARs. It is noted in the CISF TSAR, that other than the vendor systems, the CISF is not required to provide any confinement boundary for SNF received at the CISF.

Confinement design features include both welded (sealed) and mechanical closure systems. Confinement design features for welded closure systems consist of redundant closure welds. The mechanical closure systems consisting of redundant metallic o-rings are required to be monitored for leakage. A seal monitoring system is needed to adequately demonstrate that a seal can function and maintain a helium atmosphere in the cask for the 20-yr license period, although some designs may not require an inert atmosphere and, therefore, periodic checking is sufficient [NUREG–1536, Chapter 7.0, volume 2, page 7-4 (U.S. Nuclear Regulatory Commission, 1997)]. The NRC accepted that the welded systems do not have releases or leakage of regulatory concern under normal conditions and do not require monitoring of the seals for leakage [NUREG–1567, Chapter 9.0, page 9-7 (U.S. Nuclear Regulatory Commission, 2000)]. No information was provided in the CISF TSAR on the chemical and mechanical properties of welds and welding processes. This

information, including proper specification for all welds, should be included in the vendor SAR. It was assumed that welded seal closures will be adequately tested and inspected to ensure the welds behave similarly to the adjacent parent material of the cask.

The estimates of radioactive material that can be released to the environment due to failure of fuel rods are not given in the CISF TSAR. Details of the evaluations of radionuclide confinement and estimates of release from the mechanical closure systems during storage were evaluated in the cask-specific SARs. Estimates of radionuclide release during storage under design basis accident conditions should be provided, as well as the data sources consulted to find tabulated values or to support an estimated value of a physical property. The fraction of the radionuclides available for release from failed fuel rods from PWR and BWR, considered acceptable by the NRC, is provided in Table 9-2 of NUREG–1567, Chapter 9 (U.S. Nuclear Regulatory Commission, 2000).

An estimate of total radioactive material releases from the confinement for normal operation, anticipated occurrences, and design basis accidents is not given in the CISF TSAR. The average monthly concentration of air and water effluents is not calculated in the CISF TSAR. The DOE should identify all the sources for material release and release quantities. The applicant must specify maximum allowed leakage rates for the total primary confinement boundary and redundant seals and leakage per seal preferentially in tabular form. The annual radionuclide release to the environment was not provided as required by 10 CFR 72.24(l)(1).

Both welded and mechanical closure systems should be evaluated for accident conditions. Drop events of transport casks, transfer casks and SNF canisters are considered to have an effect on the CISF confinement (Section 11.1, Confinement Design Characteristics, of the CISF TSAR). The DOE has considered that the probability of experiencing a drop event is unlikely due to the design and operation of transfer facility lift equipment in the CISF. It is stated in the CISF TSAR that cask vendors will evaluate drop events of these components. The cask vendor evaluations should meet the CISF design criteria for the maximum lift height anticipated for CISF operation. Demonstration of the capability of these welded and mechanical closure casks from postulated drop events should be shown in the cask-specific SARs.

SNF will be received at the CISF in canisters, and bare fuel will not be handled (Sections 11.1, Confinement Design Characteristics, and 11.3, Potential Release Source Term, of the CISF TSAR). The CISF is designed to utilize only certified or licensed cask systems. It is stated in the TSAR that the maximum radionuclide inventory will be within the maximum design expected inventory of the design basis SNF characteristics (Section 11.3, Potential Release Source Term, of the CISF TSAR). The cask-specific SARs should provide the radionuclide inventory and the maximum values must be within the numbers specified in the cask-specific SAR. No analytical calculations dealing with estimation of SNF characteristics are presented in the CISF TSAR. The vendor SARs should include analytical calculations of SNF characterization.

The site for the CISF has not yet been selected. As a result, a site-specific radiological effluent analysis of a loss of confinement under anticipated and accident events is not presented for each cask system to be used in the CISF.

9.4.2 Confinement Monitoring

Review of this section includes two aspects. One aspect was the continuous monitoring of closure seals effectiveness and the other was related to the measurement of radionuclides released to the environment under normal and accident conditions (Section 11.2, Confinement Monitoring, of the CISF TSAR). The confinement designs include both welded and mechanical closure storage systems.

The NRC has accepted that welded closures require no monitoring. On the other hand, the mechanical closure seals require continuous monitoring per 10 CFR 72.122(h)(4). The applicant has not described the monitoring capability or surveillance plans, for mechanical closure seals in Section 11.2, Confinement Monitoring, of the CISF TSAR. The specific cask vendors should propose, as part of the SAR, active instrumentation, surveillance procedures, or both to comply with 10 CFR 72.122(h)(4). In the CISF TSAR, it is assumed that specific cask SARs provide description of monitoring devices and appropriate specifications for confinement monitoring.

In addition to the required instrumentation for monitoring of mechanical closure storage systems, additional confinement monitoring features are included in the CISF design, as described in Section 11.2, Confinement Monitoring, of the CISF TSAR. The features include (i) cask/canister interspace sampling prior to lid removal, (ii) general area airborne and HVAC exhaust monitors, and (iii) sample counting laboratory facility. How frequently these monitoring features would be used is not specified in the subject CISF TSAR section. The applicant should specify the monitoring frequencies to be used during operation of the CISF.

The following areas will be evaluated during the licensing of certified cask-specific SARs:

- Details of mechanical seal monitoring instrument and/or periodic surveillance procedures
- Method of identification of monitor failure
- Provisions to resume monitoring capability following failure or an accident

The weld seal should also be inspected for inert gas leakage to confirm that the leakage values are within the design leak rates. The weld seal test and inspection results should be included in vendor SARs.

The site-specific applicant should provide a controlled area boundary dose calculation on the basis of the seal leakage rate and other factors depending on the site and other specific characteristics of the CISF.

9.4.3 Protection of Stored Materials from Degradation

Review of Section 11.6, Protection of Stored Materials from Degradation, of the CISF TSAR was performed to establish that the fuel and cladding would not experience significant degradation over the proposed storage time.

Precertified casks will be used in the CISF design for transportation and storage. The CISF design as stated in the CISF TSAR, relies on the requirements specified in the respective SAR for each cask system vendor.

The information provided in the vendor SARs will be evaluated during the licensing of the cask to determine whether it is in compliance with the appropriate NRC regulatory requirements (10 CFR 72.24 and 72.122).

9.5 Evaluation Findings

Evaluation of confinement at the CISF installation is based on the requirement that only transportation and storage casks approved by the NRC will be used. The site-specific CISF SAR must demonstrate that all cask systems used on the site comply with all CISF requirements. Evaluation findings specific to each area of review are provided.

9.5.1 Radionuclide Confinement Analysis

- The staff has reviewed the information presented in Section 11.1, Confinement Design Characteristics, of the CISF TSAR and found reasonable assurance that the information satisfies the requirements for radionuclide confinement analysis as far as possible for this non-site-specific CISF installation. The information provided on the design of the confinement system is sufficient to meet the requirements of 10 CFR 72.24(c) and (f), 72.44(c)(1)(i), 72.122(b)(4), 72.122(h)(3) and (5), and 72.128(a)(3).

- Chemical composition and mechanical properties of materials of construction of all critical components important to safety should satisfy the requirements of 10 CFR 72.24(c) and (l).

The site-specific SAR must provide the following information:

- Documentation that the dose consequences from the design events are within the regulatory limits, as prescribed by 10 CFR 72.24(k) and 72.106(b). Further evaluation findings on dose assessments are presented in Subsection 11.4.3, Dose Assessment, of this AR.

- Documentation that the data sources used to estimate the quantities of radionuclides released are reliable

The site-specific SAR must provide the following information, either directly or by reference, to vendor SARs or CoCs:

- The quantity of radioactive materials that could be released to the environment under normal operations are anticipated occurrences to satisfy the requirements of 10 CFR 72.24(l) and 72.104(a), (b), and (c).

- Documentation that the capability of welded and mechanical closure casks provide redundant sealing of the confinement system closure joints.

- Appropriate tests to demonstrate that the cask confinement system will maintain confinement of radioactive material under normal, off-normal, and credible accident conditions.

- Site-specific radiological effluent analysis of a loss of confinement under accident conditions for each cask system that will be used in the CISF to satisfy the requirements of 10 CFR 72.106(b).

- Confirmation that the cask vendor assumptions for specific meteorological site characteristics and boundary distance are valid when an actual site is selected for the CISF.

9.5.2 Confinement Monitoring

- The instrumentation and procedures for confinement monitoring were not discussed in the CISF TSAR. The applicant relies on procedures described in the vendor cask-specific SARs. The staff found reasonable assurance that the procedures specified in the SARs satisfy the requirements for confinement monitoring as far as possible for this non-site-specific CISF installation under 10 CFR 72.122(h)(4), and 72.128(a)(1). The DOE should specify how frequently the additional confinement monitoring features added to the CISF design monitoring features would be used.

The site-specific SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Monitoring instrument and surveillance procedures are adequate to perform their required functions to meet the requirements of 10 CFR 72.122(i) and 72.126(c).

- The monitoring systems for mechanical seals will perform their intended functions and will incorporate a method of identification of monitor failure to meet the requirements of 10 CFR 72.24(g) and 72.126(d).

9.5.3 Protection of Stored Materials from Degradation

- The protection of stored material from degradation was not discussed in the CISF TSAR. The applicant relies on requirements described in the cask system vendor SARs. The staff found reasonable assurance that the information satisfies the requirements for protection of stored materials from degradation as far as possible for this non-site-specific CISF installation under 10 CFR 72.24(d) and 10 CFR 72.122(h)(1).

The site-specific SAR must provide the following information, either directly or by reference to cask SARs or CoCs:

- Documentation that the fuel matrix and fuel cladding are protected from degradation through appropriate temperature control

- Documentation that an inert atmosphere is used and a maximum concentration of oxidizing gases in the atmosphere is established

- Experimental results demonstrating that fuel cladding is protected from degradation if noninert gas is used

9.6 References

U.S. Department of Energy. 1998a. *Topical Safety Analysis Report of Centralized Interim Storage Facility*. Vols. I and II. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

U.S. Department of Energy. 1998b. *CISF TSAR Response to RAIs*. Washington, DC: U.S. Department of Energy.

U.S. Nuclear Regulatory Commission. 1997. *Standard Review Plan for Dry Cask Storage Systems*. NUREG–1536. Washington, DC: U.S. Nuclear Regulatory Commission.

U.S. Nuclear Regulatory Commission. 2000. *Standard Review Plan for Spent Fuel Dry Storage Facilities*. NUREG–1567, Final Report. Washington, DC: U.S. Nuclear Regulatory Commission.

10 CONDUCT OF OPERATIONS EVALUATION

10.1 Review Objective

The objective of the review and evaluation is to ensure the applicant has described an appropriate infrastructure to manage, test, and operate the facility, including provisions for effective training, emergency planning, and physical security programs. Because this is not a site-specific TSAR (U.S. Department of Energy, 1998), a complete review of the conduct of operations is not possible. It has been assumed that compliance with appropriate regulations by any reference to cask-specific information will be evaluated in the cask vendors' SAR review. Information that must be provided in the site-specific SAR for the CISF is identified.

10.2 Areas of Review

The following areas of review are addressed in Section 10.4, Conduct of Review:

Organizational Structure

Corporate Organization
On-site Organization
Management and Administrative Controls

Preoperational Testing and Startup Operations

Preoperational Testing Plan
Operating Startup Plan

Normal Operations

Procedures
Records

Personnel Selection, Training, and Certification

Personnel Organization
Selection and Training of Operating Personnel
Selection and Training of Security Guards

Emergency Planning

Physical Security and Safeguards Contingency Plans

10.3 Regulatory Requirements

This section identifies the portions of 10 CFR Part 72 relevant to the review areas addressed by this chapter. The applicable regulatory requirements from 10 CFR Part 72 for the conduct of operations evaluation are

- 72.24(h), (i), (j), (k), (n), (o), (p)
- 72.28(a), (b), (c), (d)
- 72.32
- 72.40(a)(4), (9), (13)
- 72.190
- 72.192
- 72.194

10.4 Conduct of Review

The review of conduct of operations of the CISF includes Chapter 13, Conduct of Operations, of the CISF TSAR (U.S. Department of Energy, 1998) and cited references. The review is based on the respective elements required by Regulatory Guide 3.48 (U.S. Nuclear Regulatory Commission, 1989) and the documentation submitted by the applicant.

10.4.1 Organizational Structure

The review includes consideration of guidance provided in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000), lessons learned from prior reviews, and the documentation submitted by the DOE. In conducting the review of the organizational structure, the staff has examined and determined whether the elements required by Regulatory Guide 3.48 (U.S. Nuclear Regulatory Commission, 1989) are submitted.

10.4.1.1 Corporate Organization

The staff has examined the information presented in Subsection 13.1.1, Corporate Organization, of the CISF TSAR, including a chart of the organizational and reporting responsibilities. The review includes the line of authority to the on-site CISF project manager. The corporate organization is included within the DOE headquarters organization with CISF responsibilities being assigned to various members of this staff. No specific discussion of the qualifications, educational backgrounds, or experience of these persons has been provided in the CISF TSAR, and the qualifications of these persons are accepted as members of the DOE staff. The transfer of responsibilities between the DOE headquarters and on-site personnel during various stages of the CISF design, construction, and operation has been examined. The description of the delegation of authority for the management and operation of the CISF to the CISF contractor has been examined, including the responsibilities that the DOE retained for the CISF. The relationship between the DOE headquarters staff and the CISF project manager, who would be the senior DOE official at the CISF site, has been examined. No specific frequency for audits of the site by the DOE headquarters organization to evaluate the application and effectiveness of management controls, plant procedures, and other activities affecting safety has been specified in the CISF TSAR.

10.4.1.2 On-site Organization

The specific material evaluated includes corporate functions, responsibilities, and the authorities, duties, and responsibilities of the primary positions in the DOE on-site CISF organization. This review includes textual material and organizational charts provided in Subsection 13.1.1.2, Applicant's In-House Organization, and 13.1.2.1, On-site Organization, of the CISF TSAR. The key positions evaluated include the CISF project manager; the QA manager; the chief counsel; the assistant manager, Office of Institutional Affairs; the chief financial officer; and the chief safety officer. The review includes the interrelationships specified with contractors and suppliers and the duties and responsibilities of positions in applicant technical staff. The staff concludes that the specific reporting relationships and responsibilities of individuals responsible for functions important to safety are adequate. Specifically, positions with responsibilities for functions related to radiation protection, nuclear criticality safety, training and certification of the staff, emergency planning and response, operations, maintenance, engineering, and QA have been examined. The staff concludes that these relationships and responsibilities are adequate for safe operation of the facility. The reporting relationships of staff members responsible for radiation protection, nuclear criticality safety, and QA are sufficiently separate from the entities responsible for facility operations. The applicant plan for providing alternates to act in the absence of individuals assigned to key positions is sufficient. The CISF TSAR contains no specific designation of stop-work authority for the CISF. Although the specific numbers of various staff members to be assigned to each CISF shift is not specified in the CISF TSAR, the DOE has committed that sufficient numbers of qualified staff will be available to deal with all normal and off-normal events. The minimum qualifications for each staff member as presented in CISF TSAR Subsections 13.1.1.4, Applicants Technical Staff, and 13.1.3, Personnel Qualification Requirements, are adequate.

The scope and nature of the authorities and responsibilities of the Facility Safety Review Committee as presented in Subsection 13.1.1.2.7, Facility Safety Review Committee, of the CISF TSAR were examined. The review includes the representativeness of the membership of the committee and the extent to which operating and safety support organizations are included. The specific responsibilities of this committee for developing and reviewing tests and test results and other activities related to safety functions are adequate. The minimum qualifications for the members of this committee and the nature of the reporting relationship to the CISF project manager are adequate. The review and assessment responsibilities of the Facility Safety Review Committee should be expanded to be consistent with the information included in the technical specifications in Subsection 14.5.6, Reviews and Assessments, of the CISF TSAR.

10.4.1.3 Management and Administrative Controls

The staff has reviewed the proposed system of management and administrative controls presented in Subsection 13.1.2, Operating Organization, Management, and Administrative Control System, of the CISF TSAR. The arrangements for staffing both during normal working hours and for shift work to provide 24-hr coverage of necessary site functions are adequate. Management and administrative functions and procedures examined include those for the development of administrative and general plant procedures (Subsections 13.2.1, Administrative Procedures for Conducting Test Program, and 13.4.1, Facility Procedures, of the CISF TSAR); the program for surveillance, testing, audit, and inspection of items and activities important to safety (Subsections 13.2.1, Administrative Procedures

for Conducting Test Program; 13.4, Facility Operations; 13.4.2, Facility Records; and 13.4.3, Facility Review and Audit Program, of the CISF TSAR); procedures for change control (Subsections 13.2.1, Administrative Procedures for Conducting Test Program; 13.2.2, Test Program Description; 13.4.1, Facility Procedures; and 13.4.4, Modifications to Facilities and Equipment, of the CISF TSAR); employee training and certification programs (Subsection 13.3, Training Program, of the CISF TSAR); and record preparation and maintenance (Subsections 13.3.3, Administration and Records; and 13.4.2, Facility Records, of the CISF TSAR). The staff concludes that these management and administrative control programs are adequate for safe operation of the CISF. The review also emphasized the proposed system for initial preparation, review, change, and approval of procedures.

The staff has reviewed the programs of surveillance, testing, and inspection presented in CISF TSAR Subsections 13.2.1, Administrative Procedures for Conducting Test Program; 13.3.1.4, Training Program Evaluations; and 13.4.3, Facility Review and Audit Program and concludes that preoperational, operational, and post modification or corrective action surveillance, testing, and inspection have been adequately addressed.

The review has also assessed the program for conducting internal and external audits to evaluate the effectiveness of management controls, plant procedures, and other activities affecting safety presented in Subsection 13.4.3, Facility Review and Audit Program, of the CISF TSAR. The staff has evaluated audit frequency, methods for documenting and communicating audit findings, resolution of issues, and implementation of corrective actions. The CISF TSAR does not specify minimum facility audit frequencies. These should be included in Subsection 13.4.3, Facility Review and Audit Program, and Section 14.5, Administrative Controls, of the CISF TSAR.

The program for change control presented in Subsections 13.2.1, Administrative Procedures for Conducting Test Program, and 13.4.1.2, Changes to Procedures, of the CISF TSAR, has been examined including how change control would be integrated into the management control system and how change would be coordinated between potentially affected organizations. The staff concludes that appropriate controls exist to ensure changes are properly effected and that staff will be properly trained after changes occurred.

A review has also been conducted of the system for maintaining facility records presented in Subsection 13.4.2, Facility Records, of the CISF TSAR. The staff concludes that system would generate and properly preserve the information necessary to assess the safe operation and decommissioning of the site.

10.4.2 Preoperational Testing and Startup Operations

The review of preoperational testing and startup operations included consideration of guidance provided in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000) and the documentation submitted by the applicant. In conducting the review , the staff has examined whether the elements required by Regulatory Guide 3.48 (U.S. Nuclear Regulatory Commission, 1989) have been submitted. The plans for preoperational testing and startup presented in Section 13.2, Pre-Operational Testing and Operation, of the CISF TSAR have been reviewed. The staff concludes that necessary tests will be conducted. The plan also includes provisions for proper

evaluation, approval, and use of the test results. The plans and procedures proposed in Section 13.2, Pre-Operational Testing and Operation, of the CISF TSAR are adequate as they properly document the test descriptions, responses expected, and contingent corrective actions appropriate for the purposes of the preoperational and startup operations. The administrative procedures proposed for conducting the testing and startup to determine if they addressed preparing, approving, and executing the test procedures and evaluating, documenting, and approving the test results are found to be adequate. The methods and procedures proposed for incorporating changes to procedures or systems presented in CISF TSAR Section 13.2, Pre-Operational Testing and Operation, and Subsection 13.4.4, Modifications to Facilities and Equipment, of the CISF TSAR are adequate. The assignment of organizational responsibility for conducting the preoperational testing and startup operations presented in Subsection 13.2.1, Administrative Procedures for Conducting Test Program, of the CISF TSAR is sufficient, and the qualifications of personnel assigned those responsibilities, as presented in Subsection 13.1.3, Personnel Qualification Requirements, will ensure that all responsibilities will be assigned to persons with the requisite qualifications.

10.4.2.1 Preoperational Testing Plan

In determining if the preoperational testing plan would be sufficiently comprehensive, the plans for preoperational testing and operation presented in Section 13.2, Pre-Operational Testing and Operation, of the CISF TSAR, were examined. Individual test plans have not yet been prepared; however, the DOE has committed to provide the NRC with a preoperational test plan, including test summaries for all systems, 90 d prior to the start of testing (U.S. Department of Energy, 1998). Construction testing will be performed by the facility constructor, and operational testing will begin as control of the systems is turned over to the DOE. The preoperational testing and operation procedures presented in Section 13.2, Pre-Operational Testing and Operation, of the CISF TSAR, give reasonable confidence that the DOE has made appropriate commitments to test all systems important to safety. The testing objectives are also properly identified along with the general methods to be used to meet these objectives. Provisions made for incorporating changes, as presented in Subsection 13.2.1, Administrative Procedures for Conducting Test Program, of the CISF TSAR are adequate. The preoperational testing plan will provide reasonable assurance that tests associated with the following would be adequate:

- Construction testing
- Preoperational testing specified in technical specifications
- Calibration and testing of instruments and monitors with a safety or security function
- Tests of supplier-owned equipment to be used in functional operations (e.g., storage confinement, cask haul trailer, and positioning equipment)
- Tests of physical and programmed limits on travel of lifting and transfer equipment (e.g., travel over the pool, lift heights, and positioning force)
- Load tests of rigging, spreaders, and lift points

Evaluations of the effectiveness of procedures and considerations of potentially improved alternatives have been appropriately addressed by the preoperational test program. Although each of these items is not specifically called out in the CISF TSAR, the administrative procedures and commitments made relative to the test program provide reasonable assurance that these items will be properly considered. The DOE commitment to conduct dry runs in the CISF TSAR, Subsection 13.2.2.1, Pre-Operational Testing, is adequate as well as the associated commitment to make any changes necessitated by these tests. The DOE commitment to conduct routine operational and full-load testing of equipment in the CISF TSAR, Subsection 13.2.2.2, Operational Testing, is also adequate.

10.4.2.2 Operating Startup Plan

The operating startup plan in the CISF TSAR, Subsection 13.2.2.2, Operational Testing, was reviewed for adequacy. The specific plan has not yet been prepared; however, the program to administer it and the commitments to conduct it have been presented throughout the CISF TSAR, Subsection 13.1.2, Operating Organization, Management, and Administrative Control System, and Section 13.2, Pre-Operational Testing and Operation. The operational testing program described in Subsection 13.2.2.2, Operational Testing, of the CISF TSAR, will ensure that all SSC important to safety will be tested and SSC function as designed and parameters are within ranges bounded by the safety analysis, and verifies operations will be performed in a safe manner.

10.4.3 Normal Operations

In conducting the review of normal operations, the staff has examined whether the elements required by Regulatory Guide 3.48 (U.S. Nuclear Regulatory Commission, 1989) were submitted. The review included consideration of guidance provided in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000), and the documentation has been submitted by the applicant. The review of normal operations includes evaluations of those portions of the CISF TSAR that addressed procedures and records. The review has focused on material in the CISF TSAR related to normal operations presented in Section 13.4, Facility Operations.

10.4.3.1 Procedures

The DOE commitments for use of procedures, as presented in Subsection 13.4.1, Facility Procedures, of the CISF TSAR, is adequate. The CISF TSAR describes the DOE commitment to conduct all operations that are important to safety according to written procedures and to have proposed procedures and revisions reviewed and approved by the health, safety, and QA organizations, as appropriate, independent of the operating management (U.S. Department of Energy, 1998). Although all the specific proposed written procedures are not identified, there is an adequate commitment to develop and use procedures for all routine and projected contingency operations. The proposed procedure review, change, and approval practices for operation, maintenance, and testing procedures have been examined. The DOE has committed to providing procedures that address all administrative, design control, radiation protection, operation, maintenance, surveillance and test, and QA activities that are related to safety. Those areas that would be covered by procedures include all operations identified in the proposed technical specifications and operating, maintenance, testing, and surveillance functions important to safety.

The material examined includes a description of the processes for preparing, changing, and distributing procedures. The subjects identified for conduct using procedures correlate to the narrative and flowsheet descriptions of operations presented in Chapter 5, Operating Procedures, of the CISF TSAR.

Response plans include additional analysis or management controls to deal with situations when the facility is operating outside of normal operating limits defined by the technical specifications. Subsection 13.4.1, Facility Procedures, of the CISF TSAR must be expanded to discuss response plans for consistency with the technical specifications given in Subsection 14.5.5, Response Plans, of the CISF TSAR.

10.4.3.2 Records

The CISF program for the maintenance of facility records described in Subsection 13.4.2, Facility Records, of the CISF TSAR, has been reviewed to ascertain that the records required to be maintained by NUREG–1567, Section 10.4.3.2 (U.S. Nuclear Regulatory Commission, 2000), are identified for retention for the appropriate periods. The description of the management system for maintaining records has been evaluated to ensure that records will be properly maintained and preserved for the required time periods. The CISF commitment to control and manage records in a systematic fashion, including use of a master file and record storage procedures, is adequate. The DOE has committed to maintaining computer storage of records such that data could be retrieved in an accurate and timely manner (U.S. Department of Energy, 1998).

10.4.4 Personnel Selection, Training, and Certification

In conducting the review of personnel selection, training, and certification, the staff has examined whether the elements required by Regulatory Guide 3.48 (U.S. Nuclear Regulatory Commission, 1989) have been submitted. The review includes consideration of guidance provided in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000) and the documentation submitted by the applicant. The descriptions of the organization responsible for personnel selection, training, and certification; the program that would be established and implemented to ensure that personnel whose responsibilities included functions that are important to safety would be appropriately qualified and trained; and the process to be used for selecting and training security guards are adequate.

10.4.4.1 Personnel Organization

The description of the organization and management of the training component presented in Section 13.3, Training Program, of the CISF TSAR has been evaluated. The review has been supported by an examination of the responsibilities and qualifications of the individual responsible for conducting the training program listed in Subsection 13.1.2.2.6, Site Services Manager, of the CISF TSAR and the qualification requirements for that person presented in Subsection 13.1.3.1.6, Site Services Manager, of the CISF TSAR to determine if they are adequate.

10.4.4.2 Selection and Training of Operating Personnel

The functions that are important to safety, as determined from those operations that would be performed in accordance with written procedures listed in Subsection 13.4.1, Facility Procedures, of the CISF TSAR, correlate with the qualifications specified for personnel performing those functions in Subsection 13.1.3, Personnel Qualification Requirements, of the CISF TSAR. The personnel qualifications specified satisfy the minimum qualification requirements for operating, technical, and maintenance supervisory personnel and qualifications, in résumé form, of persons who would be assigned to managerial and technical positions. The qualifications of individuals will be provided for a site-specific CISF SAR. The scope of the following aspects of the training program as presented in Subsection 13.3.1, Program Description, of the CISF TSAR has been evaluated:

- General employee training
- Nuclear safety training
- Fire brigade training
- Technical training
- Initial training
- On-the-job training and qualifications
- Continuing training
- Special training
- Personnel certification requirements
- Training program evaluations

Operational training includes appropriate topics such as installation design and operations, instrumentation and control, methods for dealing with operating functions, decontamination procedures, and emergency procedures. Radiation safety training includes topics such as the nature and sources of radiation, methods of controlling exposure and contamination, radiation monitoring, shielding, dosimetry, biological effects, and criticality hazards control. The basis used to identify the type and level of training by job description as presented in Subsection 13.3.1, Program Description, of the CISF TSAR are adequate to ensure that the training would be appropriate for each position.

The requirements for certification of personnel who would operate equipment and controls that are important to safety are clearly identified in Subsection 13.3.1.3, Personnel Certification Requirements, of the CISF TSAR. In Subsection 13.3.1, Program Description, of the CISF TSAR, the DOE has committed to a training program that would ensure that personnel had the minimum physical requirements and health conditions necessary for certification (U.S. Department of Energy, 1998).

The methods to be used for testing to determine the effectiveness of the training program as described in Subsection 13.3.1.4, Training Program Evaluations, of the CISF TSAR are adequate to make evaluations against established objectives and criteria.

The frequency of retraining, and the nature and duration of retention of training and testing records as presented in Subsections 13.3.1.1.1, Nuclear Safety Training; 13.3.1.1.2, Fire Brigade Training; 13.3.1.2.3, Continuing Training; 13.3.1.3, Personnel Certification Requirements; and 13.3.3,

Administration and Records, of the CISF TSAR are adequate. Nuclear safety related retraining will be required at least every 2 yr. The program for maintaining training records is adequate to ensure that records will be kept up to date and retained for the appropriate length of time.

The review assessed the implementation of the training program before conducting operations involving radioactive material (i.e., preoperational training). Subsection 13.2.1, Administrative Procedures for Conducting Test Program, of the CISF TSAR, contained the DOE commitment to provide appropriate administrative controls to ensure that the testing is performed in a consistent manner by qualified personnel. Although the DOE has not provided a specific commitment to substantially complete staff training and certification before receipt of the radioactive material to be stored, Subsection 13.3.1, Program Description, of the CISF TSAR, has stated that the training program will ensure that only certified personnel will operate equipment important to safety (U.S. Department of Energy, 1998). This commitment provides reasonable assurance that a sufficient number of certified personnel will be available to support operations with radioactive material.

No specific standards have been identified to be used for selection, training, and certification of personnel other than a commitment in the CISF TSAR, Section 13.3, Training Program, that the training program would meet the requirements of 10 CFR Part 72, subpart I.

The staff has assessed the scope of general employee training and nuclear safety training, including the designation of the personnel responsible for development of training programs, conduct of training and retraining of employees (including new employee orientations), and maintaining up-to-date records on the status of trained personnel. The staff concludes that these aspects of the training program are adequately defined.

Transfer facility staff requirements should be enhanced to match those provided in the technical specifications presented in Subsection 14.5.2.1, Transfer Facility Staff, of the CISF TSAR.

10.4.4.3 Selection and Training of Security Guards

The staff did not evaluate this aspect of the CISF TSAR.

10.4.5 Emergency Planning

In conducting the review of emergency planning, the staff has examined whether the elements required by Regulatory Guides 3.48 and 3.67 (U.S. Nuclear Regulatory Commission, 1989, 1992) have been submitted in the CISF TSAR. The review included consideration of guidance provided in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000) and the documentation submitted by the applicant. The description of emergency planning in Section 13.5, Emergency Planning, of the CISF TSAR, has been evaluated to determine if the emergency plan complied with the requirements of 10 CFR 72.32(a). The CISF TSAR includes descriptive information on the applicant plans for coping with emergencies.

The review has determined that the types of radioactive material accidents accounted for in the emergency plan encompass all accident-level events, or conditions addressed in the CISF TSAR

accident analyses are adequate. Because the CISF TSAR is not site specific, off-site response organizations has not been identified. However, the CISF TSAR has contained a commitment to provide the appropriate off-site response organizations an opportunity to comment on the plan (U.S. Department of Energy, 1998).

10.4.6 Physical Security and Safeguards Contingency Plans

The staff did not evaluate this aspect of the CISF TSAR.

10.5 Evaluation Findings

10.5.1 Organizational Structure

- The staff has reviewed the information presented in Section 13.1, Organizational Structure, of the CISF TSAR, and found reasonable assurance that the information presents an acceptable organizational structure. A plan has been presented for the conduct of operations, including the planned managerial and administrative controls system, the applicants organization, and a program for the training of personnel pursuant to 10 CFR Part 72, Subpart I, that satisfies the requirements of 10 CFR 72.24. The CISF TSAR specifies the technical qualifications, including the required training and experience, to be possessed by CISF staff in positions related to safety functions; describes the proposed training program; provides the details of the operating organization, including delegations of responsibility and authority and the minimum skills and experience required for various positions; and includes a commitment by the applicant to have and maintain an adequate complement of trained and certified personnel prior to receipt of SNF in accordance with 10 CFR 72.28. The review of the corporate organization has led to a determination that the applicant would be qualified to conduct the operations proposed for the CISF, would have a training program that met the requirements of 10 CFR 72.190 and 72.192, and would, with reasonable assurance, conduct CISF licensed activities without endangering the health and safety of the public as required by 10 CFR 72.40.

The site-specific CISF SAR must provide the following information:

- Specific delegation of the stop-work authority at the CISF should be defined to demonstrate compliance with 10 CFR 72.28(c).

- Specific audit frequency for the site by the DOE headquarters to evaluate the application and effectiveness of management controls, plant procedures, and other activities affecting safety to demonstrate compliance with 10 CFR 72.24(h).

- Minimum audit frequency for Operational QA of the CISF should be specified in Subsection 13.4.3, Facility Review and Audit Program, and should also be included in Section 14.5, Technical Specifications, to demonstrate compliance with 10 CFR 72.24(n).

10.5.2 Preoperational Testing and Startup Operations

- The staff has reviewed the information presented in Section 13.2, Preoperational Testing and Operation, of the CISF TSAR, and found reasonable assurance that the information presents an acceptable preoperational testing and startup testing plan. There are no SSC important to safety whose functional adequacy or reliability are not demonstrated by prior use, obviating the need for a schedule for resolving related safety questions in accordance with 10 CFR 72.24(i). An acceptable description of the program for preoperational testing and initial operations has been provided in accordance with 10 CFR 72.24(p). Based on an evaluation of the preoperational and startup testing plans, there is reasonable assurance that the licensed activities proposed to be conducted at the CISF can be conducted without endangering the health and safety of the public as required by 10 CFR 72.40.

10.5.3 Normal Operations

- The staff has reviewed the information presented in Chapter 13, Conduct of Operations, of the CISF TSAR. The staff concludes that the DOE has presented an acceptable program for the development, management, and use of procedures and records. An appropriate administrative control system for procedures and records has been presented, as required by 10 CFR 72.24(h). The development, modification, and use of procedures will adequately support achieving and maintaining the technical qualifications of the applicant to conduct facility operations in a safe manner, as required by 10 CFR 72.40. Based on an evaluation of the planned program for conducting normal operations, there is reasonable assurance that the licensed activities proposed to be conducted at the CISF can be conducted without endangering the health and safety of the public as required by 10 CFR 72.40.

The site-specific CISF SAR must provide the following information:

- A consistent discussion of response plans and technical specifications in Subsections 13.4.1, Facility Procedures, and 14.5.5, Response Plans.

10.5.4 Personnel Selection, Training, and Certification

- The staff has reviewed the information presented in Section 13.3, Training Program, of the CISF TSAR presented an acceptable program for the selection, training, and certification of personnel. A plan and program for training personnel has been submitted that provided reasonable assurance that operation of equipment and controls important to safety would be limited to trained and certified personnel or would be under the direct visual supervision of an individual trained and certified in the operation, and that supervisory personnel would be properly certified, as specified by the requirements of 10 CFR 72.24, 72.40, 72.190, and 72.192. The CISF TSAR contains adequate information regarding the proposed technical qualifications, including training and experience requirements, a description of the training program, the responsibilities for conducting training, and commitments to ensure that operations would be conducted only by certified personnel in accordance with the requirements of 10 CFR 72.28. Additionally, the information presented in the CISF TSAR provides reasonable assurance that the physical condition and general health of certified

personnel would not be such as might cause operational errors that could endanger personnel or the public health and safety, in accordance with the requirements of 10 CFR 72.194. Based on an evaluation of the program for personnel selection, training, and certification, there is reasonable assurance that the licensed activities proposed to be conducted at the CISF could be conducted without endangering the health and safety of the public as required by 10 CFR 72.40.

The site-specific CISF SAR must provide the following information:

- A consistent discussion of transfer facility staff requirements and technical specifications in Section 13.3, Training Program, and Subsection 14.5.2.1, Transfer Facility Staff.

10.5.5 Emergency Planning

- The staff has reviewed the information presented in Section 13.5, Emergency Planning, of the CISF TSAR, and concludes that the DOE has presented an acceptable plan for coping with emergencies, as required by 10 CFR 72.24 and 72.32. Based on an evaluation of the emergency plan, there is reasonable assurance that the licensed activities proposed to be conducted at the CISF could be conducted without endangering the health and safety of the public, in accordance with 10 CFR 72.40.

10.5.6 Physical Security and Safeguards Contingency Plans

- The staff did not evaluate this aspect of the CISF TSAR.

10.6 References

U.S. Nuclear Regulatory Commission. 1989. *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage)*. Regulatory Guide 3.48, Rev. 01. Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

U.S. Nuclear Regulatory Commission. 1992. *Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities*. Regulatory Guide 3.67. Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

U.S. Nuclear Regulatory Commission. 2000. *Standard Review Plan for Spent Fuel Dry Storage Facilities*. NUREG–1567 Washington, DC: U.S. Nuclear Regulatory Commission.

U.S. Department of Energy. 1998. *Topical Safety Analysis Report of Centralized Interim Storage Facility*. Vols. I and II. Rev. 1. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

11 RADIATION PROTECTION EVALUATION

11.1 Review Objective

The objective of this chapter is to describe the requirements and considerations associated with the radiation protection evaluation of the proposed CISF. As used here, radiation protection refers to organizational, design, and operational elements primarily intended to limit radiation exposures associated with normal operations and anticipated occurrences. The evaluation of radiological consequences of accidents is addressed in Chapter 15, Accident Analysis, of this AR.

The primary objectives of the radiation protection evaluation are to determine if the design features and proposed operations provide reasonable assurance that

- Radiation exposures and radionuclide releases will be maintained at levels that are ALARA
- Occupational radiation doses will not exceed the limits specified in the NRC radiation protection standards
- Radiation doses to the general public during normal conditions and anticipated occurrences will meet regulatory standards.

Because this was not a site-specific TSAR (U.S. Department of Energy, 1998a), a complete evaluation of all issues dealing with radiation protection was not possible. It was assumed that compliance with appropriate regulations by any reference to cask-specific information will be evaluated in the cask vendor SAR reviews.

11.2 Areas of Review

The following areas of review are addressed in Section 11.4, Conduct of Review:

As Low As Reasonably Achievable Considerations

As Low As Reasonably Achievable Policies and Programs
Design Considerations
Operational Considerations

Radiation Protection Design Features

Installation Design Features
Access Control
Radiation Shielding
Confinement and Ventilation
Area Radiation and Airborne Radioactivity Monitoring Instrumentation

Dose Assessment

On-site Dose
Off-site Dose

Health Physics Program

Organization
Equipment, Instrumentation, and Facilities
Policies and Procedures

11.3 Regulatory Requirements

This section identifies the portions of 10 CFR Part 72 relevant to the review areas addressed by this chapter. Virtually the entire contents of 10 CFR Part 20, Standards for Protection Against Radiation, are also applicable to this review. The applicable regulatory requirements from 10 CFR Parts 20 and 72 for the radiation protection evaluation are

- 20.1101(a), (b), (c) and (d)
- 20.1201(a)(1)(i) and (ii), and (2)(i) and (ii)
- 20.1301(a)(1), (2), (b) and (d)
- 20.1302(a)
- 20.1406
- 20.1501(a)(1) and (d)
- 20.1701
- 20.1702(a), (b), (c) and (d)
- 72.24(e), (l)(i)
- 72.104(a), (b) and (c)
- 72.122(e)
- 72.126(a)(3), (4), (5), (6) and (c)(2)

11.4 Conduct of Review

The review included consideration of guidance provided in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

11.4.1 As Low As Reasonably Achievable Considerations

11.4.1.1 As Low As Reasonably Achievable Policies and Programs

The ALARA policy of the CISF site is described in Subsection 9.1.1, Policy Considerations, of the CISF TSAR. The policy states that the CISF is designed and will be operated to provide radiation protection for workers so that occupational radiation exposures are maintained ALARA. The following are specific criteria that the DOE has committed to implement in the operation of the CISF:

- Radiological releases and exposures to personnel will be maintained below the applicable limits of 10 CFR Part 20
- All exposures will be kept ALARA, with technological, economic, and social factors taken into consideration
- Appropriate radiation protection controls will be incorporated into all work activities
- All personnel will understand and follow ALARA procedures
- Access to radiation areas will be restricted

- Individual and collective doses will be tracked to identify trends and causes
- Periodic training and exercises will be conducted for management, radiation workers, and other site personnel in radiation protection principles and procedures, individual and group protective measures, specific plant procedures, and emergency response
- ALARA considerations will be integrated into all plant design and procedural change activities

11.4.1.2 Design Considerations

The ALARA design considerations at the CISF are described in Subsection 9.1.2, Design Considerations, of the CISF TSAR. The CISF design reflects consideration of the ALARA principles given in Regulatory Guide 8.8 (U.S. Nuclear Regulatory Commission, 1978). Specific ALARA considerations in the CISF design include the following items:

- SSC that require maintenance or repair are designed to minimize maintenance frequency and personnel-stay times in radiation areas
- Robotic and remotely operated equipment and remote video systems will be used to minimize personnel exposure to radiation sources
- Operations personnel will be in shielded, remote operating stations
- Dedicated, shielded transporters will be used to move casks to the storage areas
- Administrative, security, and radiation protection activities will be placed away from radiation areas
- Temporary and permanent radiation shielding will be used
- Area radiation monitoring with local and remote readouts will be used in the transfer facility
- Continuous remote monitoring will be used for casks in the storage area
- Access to radiation areas will be restricted
- Ventilation systems will be used in the transfer facility radiation areas, including monitoring of all effluents and filtration systems to reduce possible human exposures and releases of radiation to the environment
- Cask venting systems will be connected directly to the transfer facility ventilation system to reduce radiological release concentrations and to allow monitoring
- Decontamination facilities will be provided for transportation casks to reduce radiological contamination of other SSC and personnel during cask handling

11.4.1.3 Operational Considerations

The ALARA operational considerations for the CISF facility are detailed in Subsection 9.1.3, Operational Considerations, of the CISF TSAR. Operating plans and procedures are developed in accordance with NRC Regulatory Guides 8.8 and 8.10 (U.S. Nuclear Regulatory Commission, 1977, 1978). The following are specific operating plans and procedures that reflect consideration of ALARA principles:

- Storage casks will be prepared away from radiation areas, including testing and alignment of cask fixtures
- Preventive and corrective maintenance on cranes, robotics, lighting, instrumentation, and other handling equipment will be performed during times when no casks are processed in the transfer facility or outside radiation areas
- Dry runs during start-up testing will be used to determine probable radiation exposures; results will be factored into operating procedures and facility design
- Operational personnel will be given preoperational and continuing training, including dry runs, on procedures to minimize radiation exposures
- Contingency procedures are developed for off-normal occurrences and accidents, including recovery operations
- Operations research on procedures, handling equipment, instrumentation, and personnel protective equipment to minimize radiation exposure will continue throughout the lifetime of the facility

11.4.2 Radiation Protection Design Features

11.4.2.1 Installation Design Features

Subsection 9.3.1, Installation Design Features, of the CISF TSAR, contains information on the design features of the installation. This information will be used in conjunction with the information regarding design features for ALARA considerations evaluated in Subsection 11.4.1.2, Design Considerations, of this AR.

The CISF TSAR indicates that the minimum distance between the fence and the nearest storage cask will be at least 700 m to maintain dose rates within the limits of 10 CFR 72.104. Restricted areas will be used within the controlled area to limit access to radiation areas in order to maintain worker doses ALARA. Remote video monitoring will be used to reduce personnel exposure from inspection activities. Sufficient lighting will be provided in inspection areas to allow for the use of remote video monitoring.

11.4.2.2 Access Control

Subsection 9.3.2, Access Control, and Section 4.9, Physical Protection, of the CISF TSAR and response to RAI 9-6 (U.S. Department of Energy, 1998b) contain information on the control of access to areas of the CISF facility.

The controlled area will limit access through ownership of the property or through coordination of access restrictions with state/local officials. Entry to the controlled area will be provided by the main gatehouse located at the boundary of the CISF.

The restricted area is defined as the area within which the radiation dose rate can exceed 2 mrem/hr. Restricted areas within the CISF site will include the storage area, the transfer facility, and the transportation cask queuing area. The minimum distance between stored SNF and the edge of the unrestricted area will be 50 m. Unescorted access to the restricted area is limited to radiation workers, and the use of personnel dosimetry is required. Areas where SNF will be stored or used will be protected by two 8-ft fences with an isolation zone between them. The fences will be constructed of No. 11 American wire gauge or heavier wire and topped with barbed wire. The isolation zone between the fences will be 35-ft wide and includes an intrusion sensor alarm system. Lighting will be provided to allow 24-hr surveillance of the barriers. Detection devices consist of video cameras, card readers, and balanced magnetic door contacts. Unauthorized intrusion will also be prevented by security guard patrol, personnel, and vehicle motorized gates, door locks, and electronic door strikes. Access to the transportation cask queuing area will be limited by portable barriers when necessary, as determined by dose rates in the area.

No areas within the restricted area will be permanently designated as contaminated areas because under normal conditions, little radioactive contamination is expected. If contamination is found within the facility, however, the following provisions will limit personnel exposure:

- Mobile access barriers and equipment will provide temporary access and contamination control
- Male and female change rooms will be provided, including lavatories and showers
- Personnel protective clothing will be provided
- Personnel contamination monitoring stations will be set up
- Emergency personnel decontamination stations will be set up

11.4.2.3 Radiation Shielding

The detailed review of the radiation shielding at the CISF facility is presented in Chapter 7, Shielding Evaluation, of this AR. Based on the results of that review and the evaluation of potential doses from the release of airborne radioactivity, dose rates to the off-site public will be within the limits of 10 CFR 72.104 and therefore are acceptable. In addition, the design of radiation shielding adequately considered ALARA measures and would control annual doses to individual workers to less than the limits in 10 CFR 20.1201.

11.4.2.4 Confinement and Ventilation

The detailed review of the confinement analysis is presented in Chapter 9, Confinement Evaluation, of this AR. Information about the ventilation system at the CISF facility is demonstrated in Subsection 9.3.4, Ventilation, of the CISF TSAR and response to RAI 9-5 (U.S. Department of Energy, 1998b).

The canisters containing the SNF will be sealed and are not anticipated to release any material under normal conditions. The effects of accidental releases associated with the breach of a sealed canister are reviewed in Chapter 15, Accident Analysis, of this AR.

The external removable contamination on the storage casks will be limited to 300 dpm/cm^2. The CISF TSAR analyzed the impacts of a release of all the contaminated material on the exterior of one cask contaminated to this limit and determined that the maximum effect at the edge of the controlled area will be a dose to a member of the public of less than 1 mrem.

The transfer facility HVAC is designed to provide a slight negative pressure in the transfer facility so that all air leakage will go into the building. The HVAC system is designed so that all effluents will be released via a common exhaust vent that will be monitored for radionuclide releases. The system design includes in-line HEPA filters for ALARA purposes and a damper for bypass operations. The normal operation of the system will be in bypass mode, with the HEPA filters automatically being aligned on an alarm from the effluent radiation monitoring system. The HVAC system is not required to reduce releases below regulatory limits for normal operations or accident mitigation.

11.4.2.5 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

Information about the Monitoring Instrumentation at the facility is demonstrated in Subsection 9.3.5, Area Radiation and Airborne Radioactivity Monitoring Instrumentation, of the CISF TSAR, and response to RAI 9-10 (U.S. Department of Energy, 1998b).

The fixed radiation monitoring systems installed in the CISF consist of the transfer facility area radiation monitoring system and the transfer facility radioactive airborne effluent monitoring system. The transfer facility area radiation monitoring system is designed to monitor general area gamma and neutron dose rates in the transfer facility. Detectors will be located in the vicinity of transfer stations and in the shipping and receiving area to define radiation fields around cask systems. The systems consist of small silicon diode type detectors with wireless remote output. The detectors will have a range of 0.03 to 1,000 mrem/hr with adjustable remote and local alarms. It will be designed in accordance with the criteria of ANSI/ANS N13.1-1969 (American National Standards Institute and American Nuclear Society, 1969).

The transfer facility radioactive airborne effluent monitoring system will sample the effluent from the transfer facility HVAC system. The system is capable of detecting particulate, aerosol, and gaseous radionuclides with a range of operation that covers normal and postulated accident conditions. Each channel of the system has an adjustable alarm that signals the HVAC system to align the exhaust air flow through the HEPA filters. It is designed in accordance with the criteria of ANSI/ANS N13.1–1969. In addition to the permanent monitors, portable CAMs will be used to monitor the transfer facility during tasks that can generate airborne radioactivity. The CAMs are equipped with local audible alarms to warn of high airborne radioactivity levels.

No normal, off-normal, or accident-level events could result in dose rates that might jeopardize satisfaction of the basic safety criteria, so the monitoring system is not considered important to safety.

11.4.3 Dose Assessment

The detailed reviews of the dose assessment for shielded radioactive material are presented in Chapter 7, Shielding Evaluation; airborne radioactivity is presented in Chapter 9, Confinement Evaluation; and radionuclides in site effluents is presented in Chapter 14, Waste Confinement and Management Evaluation, of this AR. This section evaluates whether the cumulative effects from these pathways are acceptable.

11.4.3.1 On-site Doses

The evaluation of on-site doses from the CISF is presented in Subsection 9.4.2, Doses to Workers, of the CISF TSAR, and response to RAI 9-9 (U.S. Department of Energy, 1998b). Worker doses from CISF operations have been computed for transfer, placement, and inspection of several cask types that are representative of those that will be used on the CISF site. Annual collective and individual doses are determined by calculating the doses received from the operations involved with placing one full storage cask in storage position and multiplying by the maximum number of casks that will be placed in storage in the first year of operation (232 casks). Doses from inspection and monitoring operations after placement in storage are also calculated.

After accounting for dose reduction techniques during cask loading and inspection, the largest individual annual dose rate to any worker is 4.3 rem to an operator from a VECTRA MP187 cask (VECTRA Technologies, Inc., 1995). It is noted that further dose reduction can be achieved by cross-training the operators to perform all of the operations tasks (crane operator, prime mover operator, and other equipment operator) because the other operations tasks involve much lower annual dose estimates. Increasing the number of casks transferred in a year will increase the dose to workers proportionally. Therefore, the DOE should demonstrate that increasing the cask processing rate beyond 232 casks per year will not exceed the worker dose in excess of 5 rem/yr.

The greatest cumulative dose estimate is generated from the VECTRA MP187 storage cask, with an annual cumulative dose of 45-person-rem/yr.

11.4.3.2 Off-site Doses

The evaluation of off-site doses from the CISF is described in Section 9.6, Dose to Off-site Public, of the CISF TSAR, and response to RAI 9-11 (U.S. Department of Energy, 1998b). Direct exposure from a fully loaded storage array will produce an annual dose of 21.5 mrem/yr to a member of the public continuously present at the off-site location with the highest dose rate. It had also been determined that airborne releases due to cask contamination will contribute less than 1 mrem/yr to a member of the public. Radiation doses from other effluent pathways were expected to be negligible. Thus, the maximum off-site annual dose from the CISF is a total of 22.5 mrem/yr to the whole body. The DOE, however, has not shown that the dose to all individual organs (other than the thyroid) will be less than 25 mrem/yr. Although the external gamma and neutron radiation will deliver the same dose to all organs, the inhalation of the cask contamination may deliver a greater dose to an individual organ (i.e., the lungs) than the whole body. The maximum dose rate in an uncontrolled area will be less than 0.002 rem/hr during normal operations or anticipated occurrences. This dose rate in an unrestricted area is acceptable according to 10 CFR 20.1301.

11.4.4 Health Physics Program

The health physics program at the CISF is described in Section 9.5, Radiation Protection Program During Operation, of the CISF TSAR. The CISF radiation protection program is planned and organized in accordance with the criteria of NRC Regulatory Guides 8.8 and 8.10 and NUREG–0761 (U.S. Nuclear Regulatory Commission, 1977, 1978, 1981).

11.4.4.1 Organization

The organization of the health physics program is described in Subsection 9.5.1, Organization and Functions, of the CISF TSAR. The radiation protection supervisor will be responsible for the health physics program. The radiation protection supervisor will report to the technical services manager who is not responsible for facility operations. Sufficient radiation protection personnel will be available to perform routine functions and to respond to anticipated occurrences and accident conditions in a timely manner. Results of a detailed review of the CISF organization are presented in Chapter 10, Conduct of Operations Evaluation, of this AR.

11.4.4.2 Equipment, Instrumentation, and Facilities

The equipment, instrumentation, and facilities that will be provided for implementation of the health physics program is described in Subsection 9.5.2, Equipment, Instrumentation, and Facilities, of the TSAR.

The facility requirements to support radiation protection functions include the following items:

- Instrument calibration area
- Personnel decontamination area, including showers, basins, and frisker equipment
- Equipment decontamination area with sink and wash basin
- Personnel change rooms, including lockers
- Access control stations for entrance to and exit from radiation and contamination control areas
- Communication and video monitoring equipment to provide surveillance from outside of the radiation area
- Office space for the radiation protection staff
- Counting laboratory

Equipment and instrumentation that will be provided to support radiation protection functions include:

- A proportional counter for contamination smears

- Hand and foot contamination monitors stationed at building exits
- A multichannel analyzer to define radionuclide concentrations in liquid or gas samples
- A beta scintillator
- A whole-body counter
- Portable monitoring equipment
- Fixed general area radiation monitors in the vicinity of transfer stations and in the transfer facility receiving area
- An airborne effluent vent monitor to detect particulate, iodine, and gaseous releases
- Personnel protective equipment and clothing
- Personnel dosimetry instrumentation and equipment including TLDs, self-reading dosimeters, a TLD reader, and computer hardware/software to record and analyze radiological monitoring/sampling and personnel exposure data

11.4.4.3 Policies and Procedures

Subsection 9.5.3, Procedures, of the CISF TSAR, describes the procedures that will be followed in the health physics program. Radiation protection staff will use these procedures to perform the following activities:

- Taking contamination swipes
- Performing radiation surveys and posting areas based on the surveys
- Providing radiation work permits and performing preoperational briefings
- Providing radiation protection support for worker activities involving radiation exposure to maintain doses ALARA
- Evaluating personnel occupational doses to determine if ALARA objectives are being met
- Administering personnel dosimetry and bioassay programs
- Performing instrument calibration and testing
- Performing sampling and radiological analysis of liquid and solid wastes
- Providing ALARA reviews of plant procedures and monitoring of operations
- Performing radiological safety training and refresher training

- Maintaining records of the radiation protection program, including audit and other reviews of program content and implementation, radiation surveys, instrument calibrations, individual monitoring results, and records required for decommissioning

- Performing, monitoring, and recording environmental monitoring of effluents and boundaries

11.5 Evaluation Findings

11.5.1 As Low As Reasonably Achievable Policies and Programs

- The staff has reviewed the information presented in Subsection 9.1.1, Policy Considerations, of the CISF TSAR, and found reasonable assurance that the design and operating procedures of the CISF provides acceptable means for controlling and limiting occupational radiation exposures within the limits given in 10 CFR 20.1201(a) and for meeting the objective of maintaining exposures ALARA, in compliance with 10 CFR 72.24(e), 20.1101(b), 72.104(b).

The site-specific CISF SAR must provide the following information about the ALARA policy and program:

- A description of the organizational structure of the ALARA program and the responsibilities and activities of ALARA personnel

- How ALARA objectives will be achieved by minimizing contamination in accordance with 10 CFR 20.1406, through the use of proper surveys in accordance with 10 CFR 20.1701, 20.1702, and 72.126(a)

11.5.2 Radiation Protection Design Features

- The staff has reviewed the information presented in Subsection 9.3.1, Installation Design Features, of the CISF TSAR, and found that the radiation protection design features of the ISFSI have been adequately described in accordance with 10 CFR 72.24. The staff found that there is reasonable assurance that the design features are sufficient to ensure that radiation exposures are maintained ALARA in accordance with 10 CFR 20.1101 and 72.104(b). The staff found that there is reasonable assurance that the radiation protection design features will minimize contamination in accordance with 10 CFR 20.1406 and control the concentration of radioactive material in air in compliance with 10 CFR 20.1701. The staff found that there is reasonable assurance that the radiation protection design features will control exposures in accordance with 10 CFR 72.126.

The site-specific CISF SAR must provide the following information about the installation design features:

- The site of the facility with respect to population centers and a description of the attempts that are made to locate the site away from population centers to the extent feasible

- The location of transfer routes for CISF containers and a discussion of the attempts that are made to maintain distance from the site perimeter and minimize the length of the route and interaction with other traffic

The site-specific CISF SAR must provide the following information related to access control:

- A site layout showing the CISF controlled area and any traversing right-of-way
- A description of provisions for routing of potentially contaminated water from showers and decontamination stations to avoid unacceptable releases from the site

The site-specific SAR must provide the following information about the area radiation monitoring system and the radioactive airborne effluent monitoring system:

- The locations and types of fixed area radiation monitors and continuous airborne monitoring instrumentation should be detailed in drawings and specifications defining the CISF design

11.5.3 Dose Assessment

- The staff has reviewed the information presented in Sections 9.4, Estimated On-Site Collective Dose Assessment, and 9.6, Dose to Off-Site Public, of the CISF TSAR, and found that there is reasonable assurance that the facility will limit doses to workers and members of the public during normal operations in accordance with 10 CFR 20.1201, 20.1301, 72.104(a). The staff found reasonable assurance that the dose assessment has shown that radiation exposures will be ALARA in accordance with 10 CFR 20.1101 and 72.104(b). The site for the CISF is yet to be selected. Therefore, no information was available about any nearby nuclear facilities. Therefore, the cumulative effects of the combined operations of nearby facilities could not be evaluated to determine if they could constitute an unreasonable risk to the health and safety of the public following 10 CFR 72.122(e).

The site-specific CISF SAR must provide the following information:

- An evaluation of off-site collective radiation dose to members of the public around the CISF site
- Specific provisions precluding the release of liquid effluents from the facility
- An assessment of dose contributions to the local population from any other nuclear fuel cycle facilities within an 8-km (5-mi) radius of the CISF site
- An assessment that shows that the maximum dose to all individual organs (other than the thyroid) of a member of the public will be less than 25 mrem/yr
- An analysis that demonstrates that release to the general environment during normal operations and anticipated occurrences will be within the exposure limit given in 10 CFR 72.104

- A demonstration that the worker dose will not exceed 5 rem/yr if the cask processing rate exceeds 232 casks per year

11.5.4 Health Physics Program

- The staff has reviewed the information presented in Section 9.5, Radiation Protection During Operation, of the CISF TSAR, and found reasonable assurance that the program has been described adequately in accordance with 10 CFR 72.24. The staff found that there is reasonable assurance that the Health Physics Program is adequate to ensure that radiation exposures will be ALARA in accordance with 10 CFR 20.1101. The staff found that there is reasonable assurance that the Health Physics Program will minimize contamination in accordance with 10 CFR 20.1406. The staff found that there is reasonable assurance that the Health Physics Program will use controls as necessary to limit intakes of radionuclides in compliance with 10 CFR 20.1702. The staff found that there is reasonable assurance that the Health Physics Program provides acceptable means for demonstrating compliance with dose limits through surveys of radiation levels for workers and members of the public in accordance with 10 CFR 20.1302(a), 20.1501(a), and 72.126(c).

The site-specific CISF SAR must provide the following information about the equipment, instrumentation, and facilities at the CISF:

- Confirmation that the laboratory that processes the site dosimeters will be National Voluntary Laboratory Accreditation Program—accredited for that type of analysis

- Type, quantity, and locations of equipment and instrumentation for performing radiation and contamination surveys, sampling airborne radioactive material, area radiation monitoring, and personnel monitoring

The site-specific CISF SAR must provide the following information about the radiation protection program procedures:

- A commitment to review the program for content and implementation at least annually

- A detailed description of the radiation protection program procedures, or a citation of the guidance document that will be used to implement each procedure

- A description of the procedures that will be used for the respiratory protection program if airborne radioactivity makes the implementation of this program necessary

11.6 References

American National Standards Institute and American Nuclear Society. 1969. *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities.* ANSI/ANS N13.1–1969. Washington, DC: American National Standards Institute.

U.S. Department of Energy. 1998a. *Topical Safety Analysis Report of Centralized Interim Storage Facility*. Vols. I and II. Rev. 1. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

U.S. Department of Energy. 1998b. *CISF TSAR Response to RAIs*. Washington, DC: U.S. Department of Energy.

U.S. Nuclear Regulatory Commission. 1977. *Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable*. Regulatory Guide 8.10, Rev. 01. Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

U.S. Nuclear Regulatory Commission. 1978. *Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable*. Regulatory Guide 8.8, Rev. 03. Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

U.S. Nuclear Regulatory Commission. 1981. *Radiation Protection Plans for Nuclear Power Licensees*. NUREG–0761. Washington, DC: U.S. Nuclear Regulatory Commission.

U.S. Nuclear Regulatory Commission. 2000. *Standard Review Plan for Spent Fuel Dry Storage Facilities*. NUREG–1567, Final Report. Washington, DC: U.S. Nuclear Regulatory Commission.

VECTRA Technologies, Inc. 1995. *Safety Analysis Report for the NUHOMS® MP187 Multi-Purpose Cask*. NUH–05–151, Rev. 01. San Jose, CA: VECTRA Technologies, Inc.

PREDECISIONAL

12 QUALITY ASSURANCE EVALUATION

Information presented in Chapter 15, Quality Assurance, of the CISF TSAR, is not reviewed because it is beyond the scope of CNWRA work.

PREDECISIONAL

13 DECOMMISSIONING EVALUATION

Information presented in Chapter 16, Decommissioning, of the CISF TSAR, is not reviewed because it is beyond the scope of CNWRA work.

14 WASTE CONFINEMENT AND MANAGEMENT EVALUATION

14.1 Review Objective

The objective of this review is to ensure that the design and proposed operation of the CISF provide for safe confinement and management of any radioactive waste generated as a result of facility operations. This review specifically concerns radioactive wastes generated by site activities involving the handling and storage of SNF. These include (i) gaseous effluents from treatment and ventilation systems; (ii) liquid wastes from laboratory, cask washdown, and decontamination activities; and (iii) solid or solidified wastes. Neither the actual SNF being stored, nor the waste generated by eventual decommissioning of the facility, fall within the scope of this review. Radiation protection-related considerations for other waste management activities are addressed in Chapter 11, Radiation Protection Evaluation, and monitoring radioactivity in effluents is addressed in Chapter 9, Confinement Evaluation, of this AR.

14.2 Areas of Review

The following areas of review are addressed in Section 14.4, Conduct of Review:

Waste Sources

Off-Gas Treatment and Ventilation

Liquid Waste Treatment and Retention

Solid Wastes

Radiological Impact of Normal Operations

14.3 Regulatory Requirements

This section identifies the portions of 10 CFR Part 72 relevant to the review areas addressed by this chapter. The applicable regulatory requirements from 10 CFR Parts 20 and 72 for waste confinement and management are

- 20.1101(d)
- 20.1301(a) and (d)
- 20.1302(b)
- 20.2001(a)
- 20.2003(a)
- 72.24(f) and (l)
- 72.40(a)
- 72.104(a), (b), and (c)
- 72.122(b)(4) and (h)(3)
- 72.126(c)(1) and (d)
- 72.128(a)(5) and (b)

14.4 Conduct of Review

The review of Chapter 6, Waste Confinement and Management, of the TSAR (U.S. Department of Energy, 1998), included the description of the waste management systems to be installed at the

CISF and provided information about the waste confinement and disposal. The review objectives for this section are to establish that the CISF provides safe confinement and management of radioactive waste generated at the facility and that the generation of radioactive waste and release of the radioactive material to the environment meets the regulatory standards and is also ALARA. The review included consideration of guidance provided in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

14.4.1 Waste Sources

Review of this section of the CISF TSAR (Section 6.1, On-Site Waste Sources) included information on the on-site sources of gaseous, liquid, and solid wastes. This waste may contain mixed fission and activation products associated with LWR operations. CISF TSAR has identified two potential sources for gaseous wastes in terms of airborne radioactive contamination: aerosols of surface contamination from the exterior of transport cask or from the exterior of internal canister and cask leakage due to failed seal. Radioactive contamination due to these gaseous sources is expected to be within the regulatory limits, however HEPA filters will be provided for ALARA considerations.

The potential sources for liquid wastes include LLW water from the transfer facility decontamination booth, nonradioactive wastewater from the transfer facility wash-down station, other normal and off-normal operations, and sanitary wastes. The radioactive concentration may exceed limits as provided in 10 CFR Part 20, Appendix B, for unrestricted concentrations and, therefore, require radioactive waste processing. The nonradioactive liquid waste stream will be generated by fire protection operations, building and equipment leakage, fuel tank leakage, equipment and floor washing, transporter wash down, and general cleaning and equipment maintenance. This waste may contain small amounts of suspended and dissolved solids, nutrients, acids and alkalis, heavy metals, and fuel, oil, and grease. The sources of sanitary wastes include effluents from drinking water fountains, water closets, lavatories, mop sinks, and other similar fixtures.

The solid radioactive waste is generated as a result of cask contamination surveillance and decontamination activities. Solid waste will generally consist of paper or cloth swipes, paper towels, protective clothing, and other job control wastes. These wastes will be disposed in solid waste containers and will only be stored temporarily in the facility. These wastes will be taken off-site by contracted vendors for processing and disposal.

14.4.2 Off-Gas Treatment and Ventilation

Review of this section of the CISF TSAR (Section 6.2, Off-Gas Treatment and Ventilation) included information on the off-gas treatment and ventilation system that consisted of a conventional HVAC system in the transfer facility and a cask sampling system. The HVAC is designed to discharge facility exhaust to a common plant vent that would be monitored for radioactive ventilation. The transfer facility will be maintained at a negative pressure with respect to outside atmosphere to ensure that all leakage will be into the transfer facility. The system will also provide a capability for in-line HEPA filters that can be activated if the air activity monitor system detects any radioactive contamination of the facility air. The HEPA filters will remove almost all radioactive particulates from the facility effluent. The HEPA filters are protected from smoke, ash, and firewater generated in the event of a facility fire. The effluent radiation monitor will be capable of detecting fission product particulates/gases and activation products.

14.4.3 Liquid Waste Treatment and Retention

Review of this section of the CISF TSAR (Section 6.3, Liquid Waste Treatment and Retention) included descriptions of the liquid waste treatment and retention systems that consisted of a radioactive waste collection tank, nonradioactive wastewater collection systems, and sanitary waste systems. The transfer facility liquid radioactive waste collection tank consists of a stainless steel tank situated in a containment vault. The tank and vault are designed to withstand the DE. The waste will be directed to the collection tank from the decontamination booth basin and drain piping, collected in batches, and sampled for radiologic contamination. If the radioactive concentration of the waste exceeds the limits provided in Appendix B of 10 CFR Part 20, the waste will be transferred to the vendor-supplied, on-site processing facility. The waste will be treated to meet discharge limits and will be released to CISF outfall. The waste will be transferred to the conventional waste collection tank if the radioactive concentrations are within limits.

All nonradioactive or conventional wastewater generated at the CISF will be accumulated in a separate wastewater collection system consisting of underground high-density polyethylene tanks. This system will be designed to meet all safety requirements of various applicable building design codes. The contents of the conventional wastewater system will be sampled and analyzed to ensure compliance with the CISF water discharge permit. Wastewater in compliance with discharge limits will be released to CISF outfall. Wastewater not in compliance will be transferred to an off-site vendor for treatment and disposal. Sanitary waste is handled by septic tank and leach field systems.

14.4.4 Solid Wastes

Review of this section of the CISF TSAR (Section 6.4, Solid Wastes) included descriptions of collection, packaging, and storage of solid wastes. The solid waste at CISF will be generated as a result of contamination surveillance and decontamination activities. The solid waste will be collected in containers lined with polyvinyl chloride bags. After the container becomes full, it will be sealed and surveyed for external radiation and transferable contamination. The sealed containers will be temporarily stored in metallic containers at the site in an area specifically designed for that purpose. The metallic containers will be shipped off-site for disposal.

14.4.5 Radiological Impact of Normal Operations

Review of this section of the CISF TSAR (Section 6.5, Radiological Impact of Normal Operations) included a summary of radiological impact of normal operations. Because the CISF will only handle canistered SNF, surface contamination is the only likely source of radioactive material. The quantities of radioactive material released in facility effluents are expected to be small during normal operations. The annual dose beyond the controlled area is expected to be well below the limits provided in 10 CFR 72.104. The staff, however, expresses a general concern similar to one stated in Chapter 1, General Description, of this AR. The site-specific CISF SAR should discuss the potential impact of a 7,800-cask throughput of the facility on its waste confinement and management.

14.5 Evaluation Findings

14.5.1 Waste Sources

- The staff has reviewed the information presented in Section 6.1, On-Site Waste Sources, of the CISF TSAR, and found reasonable assurance that the information satisfies the requirements for on-site waste sources under 10 CFR 72.24, 72.104, 72.122, and 72.128.

14.5.2 Off-Gas Treatment and Ventilation

- The staff has reviewed the information presented in Section 6.2, Off-Gas Treatment and Ventilation, of the CISF TSAR, and found reasonable assurance that the design and performance of the off-gas treatment and ventilation systems satisfy the requirements of 10 CFR 20.2001, 72.24, 72.104, 72.122, 72.126, and 72.128.

14.5.3 Liquid Waste Treatment and Retention

- The staff has reviewed the information presented in Section 6.3, Liquid Waste Treatment and Retention, of the CISF TSAR, and found reasonable assurance that the design and performance of the liquid waste treatment and retention system satisfy the requirements of 10 CFR 20.2001, 20.2003, 72.24, 72.104, 72.122, 72.126, and 72.128.

14.5.4 Solid Wastes

- The staff has reviewed the information presented in Section 6.4, Solid Wastes, of the CISF TSAR, and found reasonable assurance that the design and performance of the solid waste collection, packaging, and storage system satisfy the requirements for solid wastes under 10 CFR 72.24, 72.104, 72.122, and 72.128.

14.5.5 Radiological Impact of Normal Operations

- The staff has reviewed the information presented in Section 6.5, Radiological Impact of Normal Operations Summary, of the CISF TSAR, and found reasonable assurance that the information satisfies the requirements for the radiological impact of normal operations under 10 CFR 20.1101, 20.1301, 20.1302, and 72.40(a); if information on the following issue is provided in the site-specific CISF SAR

The site-specific CISF SAR must provide the following information:

- An analysis to assess the potential impact on waste confinement and management from the postulated 7,800 casks to be handled by the facility.

14.6 References

U.S. Department of Energy. 1998. *Topical Safety Analysis Report of Centralized Interim Storage Facility*. Vols. I and II, Rev. 1. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

U.S. Nuclear Regulatory Commission. 2000. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG–1567, Final Report. Washington, DC: U.S. Nuclear Regulatory Commission.

15 ACCIDENT ANALYSIS

15.1 Review Objective

The objective of this chapter is to provide a systematic evaluation of the CISF identification and analysis of hazards for both off-normal and accident or design basis events involving SSC important to safety. Off-normal events are defined as those that are expected to occur with moderate frequency or no more than once per calendar year. ANSI/ANS 57.9-1992 (American National Standards Institute and American Nuclear Society, 1992) refers to these events as Design Event II. Accident events are considered to occur infrequently, if ever, during the lifetime of the facility. ANSI/ANS 57.9-1992 subdivides this class of accidents into Design Event III, a set of infrequent events that could be expected to occur no more than once during the lifetime of the CISF, and Design Event IV, events postulated because they establish a conservative design basis for SSC important to safety. For purposes of this chapter of the TSAR (U.S. Department of Energy, 1998a), no distinction is made between these two classes of events. Natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches are considered accident events.

15.2 Areas of Review

The following outline provides the list of off-normal events and accident scenarios reviewed. This list differs from the list given in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000) in that it includes accident scenarios not specifically identified in NUREG–1567.

Off-Normal Events

Cask Drop Less Than Design Allowable Height
Partial Vent Blockage (if applicable)
Operational Events
Off-Normal Ambient Temperature
Off-Normal Events Associated with Pool Facilities

Accidents

Cask Tipover/Overturning
Cask Drop
Flood
Fire and Explosion
Lightning
Earthquake
Loss of Shielding
Adiabatic Heatup/Full Blockage of Air Inlets and Outlets
Tornadoes and Missiles Generated by Natural Phenomena
Accidents at Nearby Sites
Accidents Associated with Pool Facilities
Building Structural Failure Onto Structures, Systems, and Components
Failure of Primary Confinement Boundary

Nonmechanistic Failure of the Confinement Boundary

Pressurization
Loss of Confinement
Other Nonspecified Accidents

15.3 Regulatory Requirements

This section identifies and presents a high-level summary of the regulatory requirements applicable to the review areas addressed by this chapter. The applicable regulatory requirements for 10 CFR Part 72 for the accident analysis are

- 72.24(a), (d)(2), and (m)
- 72.90(a), (b), and (c)
- 72.92(a), (b), and (c)
- 72.94(a), (b), and (c)
- 72.104(a), (b), and (c)
- 72.106(b)
- 72.122(b)(1–2), (c), (i), and (h)(2)
- 72.124(a)
- 72.126(c) and (d)
- 72.128(a)(2)
- 72.236(c), (d), (e), and (l)

15.4 Conduct of Review

This section provides the results of the review for each accident event evaluation. The review varied in complexity within each evaluation. In general, the staff reviewed the operating environment, the physical parameters, the methodology used, and the actual analysis performed by the licensee.

The initial review of the CISF TSAR generated several requests for information as described in the introduction of this AR. The responses to these requests and the proposed revisions to the CISF TSAR (U.S. Department of Energy, 1998a) text are included in this review. The descriptions presented in this section are from the revised documents.

A major issue raised in the response to NRC RAIs (U.S. Department of Energy, 1998b) was the definition of important to safety items and distinction between those credited in the analysis for mitigation or prevention. Table 15-1 was developed by the DOE, as a result of the RAIs, to identify those features defined as important to safety, as well as the defense-in-depth items. Information presented in Bader (1998) was also reviewed.

The effects of various accidents may be interrelated, and some degree of overlap is expected during the accident analysis review process. An example of such overlap is a tornado missile accident, reviewed according to section 15.4.2.9, that could lead to a loss of shielding, an accident reviewed according to section 15.4.2.7. If two or more accidents are interrelated, the probability of the event and the consequences were assessed qualitatively in determining the bounding event.

15.4.1 Off-Normal Events

This section discusses results from the review of off-normal conditions that may include malfunctions of systems, minor leakage, limited loss of external power, and operator error. The consequences of these events do not have a significant effect beyond the cask storage area. Each event includes: (i) a discussion of the cause of the event, (ii) the means of detection of the event, (iii) an analysis of the effects and consequences, and (iv) the actions required to return the system to a normal situation. Radiological impact from each of the off-normal events is assessed.

Table 15-1. Important to safety and defense-in-depth features required for each event (adopted from U.S. Department of Energy, 1998b)

Event	Important to Safety Features	Defense-In-Depth Features
Partial Blockage of Air Vents	Cask System*	Bird/Debris Screens*
		Cask Vent Surveillance
		Facility Fence
		Material Control
		Security Patrols
		Thermal Monitor*
		Thermal Monitor Surveillance
Canister Misalignment	Cask System*	Alignment System*
	Ram for Canister Transfer*	Crane Load Indicator
	Transfer Facility Cranes	Crane Load Indicator Surveillance
		Operator Surveillance
		Pre and Post transfer Inspection
		Ram Pressure Indicator*
		Ram Pressure Indicator Surveillance
		Remote Video & Audio System
Failure of Instrumentation	Cask System*	Alignment System*
	Transfer Facility Cranes	Crane Load Indicator
		Crane Load Indicator Surveillance
		Operator Surveillance
		Portable Survey Equipment
		Pressure Monitor*
		Pressure Monitor Surveillance
		Ram Pressure Indicator*
		Ram Pressure Indicator Surveillance
		Remote Video & Audio System
		Thermal Monitor*
		Thermal Monitor Surveillance
Failure of Secondary Confinement Boundary	Cask System*	Pressure Monitor*
		Pressure Monitor Surveillance
Handling Event	Cask System*	Clear Designation of Equipment
	Transfer Facility Cranes	Low Lift Height and Slow Speed Crane Operations
		Robotics
		Clearly Defined & Clear Travel Paths for Crane Loads
Lightning	Cask System*	Cask Vent Surveillance
	Transfer Facility Superstructure	Lightning Protection System
Loss of External Power	Cask System*	Backup Power to Fire System
	Transfer Facility Cranes	Backup Power to Security System
		Halt Operations Until Power Restored
		Portable Generator Hookup
		UPS for Cask Monitor System

Table 15-1. Important to safety and defense-in-depth features required for each event (adopted from U.S. Department of Energy, 1998b) (cont'd)

Events	Important to Safety Features	Defense-In-Depth Features
Off-Normal Ambient Temperature	Cask System*	
	Intermediate Lifting Device*	
	Rigging Equipment*	
	Transfer Facility Crane	
Vehicular Impact	Cask System*	Brakes Are Applied on Railcars
	Transfer Facility Superstructure	Casks Not Placed on Throughways
		Physical/Retractable Barrier
		Rail Line Switch Settings/Positions Are Controlled
		Vehicle Speed Limits
Full Blockage of Air Inlets and Outlets	Cask System*	Bird/Debris Screens*
	Thermal Monitor Surveillance	Cask Vent Surveillance
		Facility Fence
		Material Control
		Security Patrols
		Thermal Monitors*
Drop Accident	Cask System*	Clear Designation of Equipment
	Site Transporter*	Clearly Defined & Clear Travel Paths for Crane Loads
	Transfer Facility Crane	Crane Load Indicator
	Upenders/Downenders*	Intermediate Lifting Device*
		Remote Video & Audio System
		Restrict and Monitor Lift Heights
		Rigging Equipment*
Earthquake	Cask System*	All QA–3 and QA–5 SSC
	Cask Support Frame*	Cask Vent Surveillance
	Site Transfer Trailer*	
	Site Transporter*	
	Transfer Cradle*	
	Transfer Facility Caissons/Anchors	
	Transfer Facility Mounting Structures	
	Transfer Facility Crane	
	Transfer Facility Crane Rails	
	Transfer Facility Superstructure	
	Upenders/Downenders*	
Explosion	Cask System*	Cask Vent Surveillance
	Transfer Facility Superstructure	Control Amount & Location of Explosive Substances
		Security/Physical Protection System

Table 15-1. Important to safety and defense-in-depth features required for each event (adopted from U.S. Department of Energy, 1998b) (cont'd)

Events	Important to Safety Features	Defense-In-Depth Features
Extreme/Tornado Wind	Cask System*	Transfer Facility Blowout Panels Cask Vent Surveillance
	Transfer Facility Blowout Panels	Thermal Monitor*
	Transfer Facility Superstructure	Thermal Monitor Surveillance
Failure of Primary Confinement Boundary	Cask System*	Pressure Monitor*
	Pressure Monitor Surveillance	
Fire	Cask System*	Fire Detection System with UPS
	Fire Protection Program	Fire Hose/Standpipe System
		Fire System Diesel Backup Pump
		Portable Fire Extinguishers
		Radioactive Waste Management Program
Flood	All QA–1 SSC+	Cask System*
		Wastewater System
Loss of Confinement	Cask System*	HEPA in HVAC System
		Sampling of Cask Cavity Gases
Loss of Shielding	Cask System*	Transfer Facility Radiation Monitor Alarm System
Pressurization	Cask System*	
Tipover/Overturning	Cask System*	Clear Designation of Equipment
	Cask Support Frame*	Clearly Defined & Clear Travel Paths for Crane Loads
	Rigging Equipment*	Low Lift Height and Slow Speed Crane Operations
	Site Transfer Trailer*	Storage Pads
	Site Transporter*	Vehicle Speed Limit
	Transfer Cradle*	
	Transfer Facility Crane	
	Transfer Facility Mounting Structures	
	Upender/Downender*	
Tornado Missile	Cask System*	
	Site Transfer Trailer*	
	Site Transporter*	
	Transfer Facility Missile Walls	
	Transfer Facility Superstructure	

* Vendor-supplied equipment
+ Includes vendor-supplied equipment

15.4.1.1 Cask Drop Less than Design Allowable Height

The drop of the confinement cask at less than design allowable height is one of the hypothetical off-normal scenarios for the CISF. The evaluation seeks to determine that the cask integrity and fuel spacing geometry are not compromised if the cask is dropped from a relatively low height and that the cask may continue to store SNF safely after such a drop. Analysis of this event is bounded by the cask drop accident described in section 15.4.2.2 of the AR where drop of a cask from the design allowable height has been considered. Therefore, the review concentrated on the drop accident. No further review of a cask drop less than design allowable height has been conducted.

15.4.1.2 Partial Vent Blockage

Subsection 12.1.1, Partial Blockage of Air Vents, of the CISF TSAR (U.S. Department of Energy, 1998a), evaluates a 50-percent blockage of the storage casks air inlet vents while the cask is in the storage area. In addition to the information provided in the CISF TSAR, information provided in response to RAIs (U.S. Department of Energy, 1998b) and Bader (1998) were also reviewed. This off-normal event is applicable only to storage casks having air vents, namely, TranStor™ (Sierra Nuclear Corporation, 1995), NUHOMS® MP187 (VECTRA Technologies, Inc., 1995), and Westinghouse Large and Small MPCs (Westinghouse Government and Environmental Services Co., 1996a,b). This review was conducted in accordance with the criteria specified in Subsection 15.5.1.2 of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

The purpose in evaluating this off-normal event is to establish that no critical temperature limits will be exceeded for an extended time period. The CISF TSAR states that the expected duration of this event is the interval between successive inspections. The partial blockage causes temperature throughout a storage cask to rise initially, because of partial loss of the natural circulation used to cool the canister containing the SNF, and to eventually reach a steady state. This off-normal event may be initiated by blowing winds; a sand, snow, or ice storm; an avalanche; a flood; animal activities; or a landslide. Each of these events may build up debris near the bottom of a cask. Because air inlets are located near the bottom of a storage cask, this accumulation of debris may cause a partial blockage of the air flow into the cask. A blockage can be detected by an abnormal reading from a thermocouple measuring the temperature near the storage system exhaust vent, through cask vent surveillance, or security patrol.

Subsection 12.1.1, Partial Blockage of Air Vents, of the CISF TSAR, states there is no adverse effect on important to safety functions from a 50-percent air vent blockage event. All thermally vented storage cask systems are designed for mitigating any consequences associated with a 50-percent blockage of inlet vents so that their steady-state temperature levels do not exceed the levels required to maintain the fuel cladding or concrete integrity. Because the thermal design of the cask system mitigates any consequences associated with partial blockage of air inlets, no facility design features are required for detection or mitigation of this off-normal event. Moreover, the defense-in-depth design features (Table 15-2 of this AR) and administrative controls will reduce the likelihood of the event occurrence or allow early detection. The defense-in-depth features, as listed in Table 15-1 of this AR, include

- Facility Fence: to minimize debris intrusion into storage area under high wind conditions
- Material Control Program: to minimize material brought into or left in the storage area

- Thermal Monitor Surveillance: to check daily for elevated temperatures indicative of blocked vent conditions and for detection of malfunctions in thermal monitoring systems as a part of the LCO surveillance requirements

- Security Patrol: to periodically patrol controlled areas to provide capability to detect conditions conducive to blocking vents

- Cask Vent Surveillance: to visually inspect the cask vents following meteorological or other phenomena conducive to blocking vents for prompt detection of a blocked vent condition

- Bird/Debris Screen: to minimize debris buildup

Both thermal monitors and bird/debris screens are features of the cask systems and will not be relied on in the analysis (U.S. Department of Energy, 1998a). Thermal monitors will detect elevated temperatures indicative of blocked vent conditions but are not required for detection or mitigation of the event. Similarly, bird/debris screens will minimize the amount of debris entering the vented casks, but may get clogged by the debris. Therefore, this bird/debris screen is not relied on to prevent this event.

The CISF TSAR does not provide any analysis methodology of this event because the cask systems are designed to mitigate any consequence from this event. Review of SARs of respective cask systems should confirm the following information:

- The vent flow area and revised vent flow loss coefficients associated with a blockage of one-half the normal air inlet vent flow area

- The air outlet temperature and all key CISF unit internal material maximum temperatures with the flow areas and flow loss coefficients calculated assuming a normal ambient air temperature [usually assumed to be 21° C (70 °F)], maximum design basis decay heat, and identical thermal models and computer codes used in the normal conditions thermal analysis of the CISF

- The analysis compared the calculated maximum material temperatures with respective short-term temperature limits

The CISF TSAR (U.S. Department of Energy, 1998a) states that there is no immediate radiation exposure associated with this event. A small dose, however, may be received by the facility workers while removing debris from a storage cask vent. Because of the expected frequency of the event, the relatively short period of time to remove the debris, and the low radiation field, the DOE expects the radiation exposure will be small in comparison to the normal operating exposures.

15.4.1.3 Operational Events

The CISF TSAR examines a set of events including canister misalignment (Subsection 12.1.2, Canister Misalignment); instrumentation failure (Subsection 12.1.3, Failure of Instrumentation); failure of the secondary confinement boundary (Subsection 12.1.4, Failure of Secondary Confinement Boundary), loss of external power (Subsection 12.1.7, Loss of External Power); vehicular impact (Subsection 12.1.9, Vehicular Impact); and handling event (Subsection 12.1.5,

Handling Event). In addition, responses to RAIs 12-3, 12-7, and 12-8 (U.S. Department of Energy, 1998b) were also reviewed. This review was conducted in accordance with Subsection 15.5.1.3 of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

Canister Misalignment

Reviews of the canister misalignment event included Subsection 12.1.2, Canister Misalignment, of the CISF TSAR (U.S. Department of Energy, 1998a) and Bader (1998) and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b).

This off-normal event involves misalignment or interference of a cask or canister during insertion or removal from a transportation, transfer, or storage cask in both horizontal and vertical transfer operations. This event is applicable only to those systems requiring on-site transfer operations, namely Sierra TranStor™ (Sierra Nuclear Corporation, 1995), NUHOMS® MP187 (VECTRA Technologies, Inc., 1995), and Westinghouse Large and Small MPCs (Westinghouse Government and Environmental Services Co., 1996a, b). Canister transfer operations occur in the transfer facility or storage area. Therefore, this event may occur at either location.

Misalignment may occur during canister transfer operations through improper alignment and mating between the casks or storage module surfaces, interference caused by foreign material present, or a combination of such conditions. A canister misalignment event can be detected from excessive jamming forces, unusual audible noises during horizontal pushing or pulling of a cask/canister, or both. Ram pressures during horizontal transfer operations also will provide an indication of any misalignment and interference. Remote video and audio capabilities will assist in monitoring operations during vertical canister transfer. Unusual audible noises or slackening of the crane wire slings supporting the cask/canister load during vertical loading will be detected. Crane load sensors will also provide an indication of excessive forces during vertical canister transfer operations.

Important to safety features for a canister misalignment event include cask system, ram for canister transfer, and transfer facility cranes. The structural designs of the canisters and casks involved in a canister transfer and the pressure applied by a ram must mitigate any consequences associated with a canister misalignment, including maximum pressure of the ram in horizontal canister transfer or impacts caused by a crane during lifting or lowering operations in vertical transfer. Transfer facility cranes are designed to support cask system loads during vertical transfer including misalignment and misalignment recovery operations.

Because the structural design of the cask system should mitigate consequences associated with a misalignment event, no facility design features are necessary for either detection or mitigation of this event. Several defense-in-depth features and administrative controls, however, will reduce the likelihood of event occurrence or provide prompt detection capabilities.

- Remote Video and Audio System: uses CCTV monitors to assist with remote operations by providing unobstructed views and audio capability to remote operations allowing detection, prevention, or both cask or canister misalignment

- Crane Load Indicator: provides crane operator with indication of weight raised or lowered and, thereby, load hang-up during canister transfer operations

- Crane Load Indicator Surveillance: provides continuous monitoring of the indicator during vertical canister transfer for detecting load hang-ups and malfunctions in the crane load indicator system as an LCO surveillance requirement

- Operator Surveillance: allows surveillance of canister transfer operations from floor of canister transfer area and crane operating room, if needed, to ensure proper canister transfers

- Pre and Post Transfer Inspection: permits inspection of empty casks prior to canister transfer operations to ensure casks do not contain debris that may interfere with transfer; inspection after canister transfer ensures that canisters have been properly and completely transferred into a cask

- Ram Pressure Indicator Surveillance: provides continuous monitoring for LCO surveillance requirements during horizontal canister transfers for detecting a canister misalignment and malfunctions in ram pressure indicator system

Recovery from this event takes place immediately once the misalignment, interference, or both are detected. Specific recovery operations will depend on the vendor design of the canister transfer operations. Generally, the immediate recovery actions include reversing the canister insertion or withdrawal operations to lessen the load and visually inspecting the alignment with necessary adjustments. If the operator is unable to satisfactorily correct the alignment, the operator will return the canister and casks to the initial positions and visually inspect for foreign objects.

Failure of Instrumentation

Reviews of potential impact from failure of instruments and control systems included Subsection 12.1.3, Failure of Instrumentation, of the CISF TSAR (U.S. Department of Energy, 1998a), Bader (1998), and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b). This review was conducted in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

A failure of instrumentation event is postulated to occur when an instrument either is not operational or yields a false reading. Instrument failure does not lead to an accident directly. An instrument failure may contribute to or delay detection of another event, however.

The CISF instrument and control systems are grouped into three categories for analyzing this event: (i) transfer facility process instrumentation and control components, (ii) storage system monitoring equipment, and (iii) radiation monitoring. Transfer facility process instrumentation and control components include cameras, CCTV monitors, crane load sensors, hydraulic ram pressure indicators, and building pressure and temperature instrumentation. The transfer facility also includes crane and robot remote control operating consoles. Robotic equipment is expected to include sensitive motion control, force detection, and device positioning capabilities. Storage monitoring equipment consists of pressure transducers or thermocouples, with associated computer data readouts in the cask monitoring room in the personnel building. Radiation monitoring instrumentation includes fixed area radiation monitors, the transfer facility unit vent monitor, and radiation detectors at the site boundary.

Loss of power, faulty instrument component/sensor, malfunction of sensor/component, or wiring discontinuity may lead to failure of instrumentation. Failures of instruments may also result from age or exposure to a harsh environment.

Failure of instrumentation or the control system can usually be directly observed and detected by equipment operators. Additionally, instrumentation failure or calibration problems will be detected as a result of periodic inspection, calibration, and testing. Monitoring instruments will generally fail in two modes: (i) system fails at some indication that can be detected by comparing trends with other monitors or with change in environmental conditions, or through surveillance testing; and (ii) system fails to zero or full scale.

Important to safety features associated with this event include the cask system and the transfer facility. The confinement and shielding design of the cask system should mitigate any consequences associated with this event. Additionally, the transfer facility cranes will be designed in such a way that, with administrative controls, any drop of casks from unqualified heights will be prevented.

Failure of instrumentation and control systems that are immediately obvious to facility operators will result in discontinued operations or taking appropriate actions to maintain the safety of the CISF. Failure that results in erroneous readings of monitored parameters not immediately obvious to operators can be postulated.

Transfer facility cranes are designed to support cask system loads during handling operations including during failure of instrumentation and control system events. Failures of control systems that result in the ability to limit lift height are mitigated by crane design features that prevent "two-blocking" and cable failures (U.S. Department of Energy, 1998a). A fail-safe automatic cable brake feature on line crane prevents uncontrolled load drops.

Because the cask systems are designed so they do not require any important to safety instrumentation and control systems, and cask handling operations will be monitored continuously by trained personnel, no other facility design features are required for detection or mitigation of this event. Moreover, the transfer facility instruments are tested and maintained on a regular frequency so that the probability of failure decreases. Additionally, several defense-in-depth facility design features and administrative controls are provided, as listed in Table 15-1 of this AR, to detect and mitigate the consequences of instrumentation and control system failures.

- Remote Video and Audio System: CCTV monitors will assist with remote operations by providing unobstructed views and audio capability to remote operators that allows them to prevent or to detect a canister or cask misalignment

- Crane Load Indicators: LCO augments surveillance of the operator by indicating loads raised or lowered by crane are within limits; failure of this indicator will be detected by the crane load indicator surveillance and potentially from visual and audio surveillance of the lifting operation

- Crane Load Indicator Surveillance: continuous monitoring of load indications during vertical canister transfers provides capability of detecting load hang-ups and malfunctions of the indicator system as a part of LCO surveillance requirements

- Portable Survey Equipment: provided in case area radiation monitors fail and for various surveys required during cask receipt and handling operations

- Operator Surveillance: visual and audio surveillance of operations are provided to assist in operator actions

- Pressure Monitor Surveillance: daily checks of the interseal pressure monitors and remote alarms of each bolted storage unit for detection of malfunctions in confinement monitoring systems as a part of LCO surveillance requirements

- Ram Pressure Indicator Surveillance: continuous monitoring during horizontal canister transfers of the pressure indicator for detecting canister misalignments and malfunctions in the ram pressure indicator system as a part of LCO surveillance requirements

- Thermal Monitor Surveillance: daily check of thermal monitoring system indicators for detecting elevated temperatures indicative of blocked vent conditions and malfunctions in the thermal monitoring system as a part of LCO surveillance requirements

Any cask system certified for use in the CISF is designed to perform without any important to safety instrumentation and control system (U.S. Department of Energy, 1998a). Although the cask systems may include provisions for seal pressure or outlet vent thermal monitoring, failure of these systems does not affect important to safety functions. Required operational surveillance of monitoring systems will ensure storage monitoring system failures are detected and malfunctions of the monitoring systems are corrected in a timely manner.

Certified cask systems may also include alignment systems and ram transfer pressure monitors. As the alignment and ram pressure monitoring systems are not relied on in the analysis of a canister misalignment, failure of these systems is not considered to affect the important to safety function, rather, alignment and ram pressure monitoring systems are provided as defense-in-depth features.

Failure of Secondary Confinement Boundary

Reviews of the failure of secondary confinement boundary event included Subsection 12.1.4, Failure of Secondary Confinement Boundary, of the CISF TSAR (U.S. Department of Energy, 1998a), Bader (1998), and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b). This event is postulated to occur for bolted cask closure systems of the NAC STC (Nuclear Assurance Corporation International Services, Inc., 1994) in the storage area or transfer facility when the single seal (metallic o-ring) associated with the outer lid fails. The NAC STC system has a dual lid design. The primary confinement boundary is the inner lid and its penetrations, which are protected by two metallic o-rings. The outer lid and single o-ring provide the secondary confinement boundary.

Failure of one of the o-ring seals may be caused by mishandling during transfer, transport, or storage operations resulting in possible material fracture of the mechanical seal of the outer lid. Leakage through the o-ring of the outer lid during storage will be detected by monitoring the pressure in the region between the inner and outer lids. Pressure in this region will be set higher than the cask SNF cavity and surrounding environment so that any leak will be from the inter lid region. An alarm signal will be sent to a computer data monitor in the cask monitoring room once the pressure in this inter lid region drops to a preset level. This preset alarm level will consider normal variations in pressure because of seasonal temperature variations, diurnal variations, and normal radioactive decay processes.

The cask system is the only important to safety feature required to function during this off-normal event. The NAC STC cask system will provide redundant sealing of the confinement system per 10 CFR 72.236(e). The primary confinement boundary of the cask should mitigate any consequences associated with a failure of the secondary confinement boundary. No facility design features are required for detection or mitigation of this event. The CISF, however, includes a defense-in-depth administrative control for prompt detection of this event

- Pressure Monitor Surveillance: LCO surveillance requires daily check of seal pressure monitors and remote alarms for each bolted storage unit and for detection of pressure monitoring system malfunctions.

The DOE does not consider the continuous seal monitoring system an important to safety SSC following Section 7.V.2 of NUREG–1536 (U.S. Nuclear Regulatory Commission, 1997). NUREG–1536 establishes that although the function of this system is to monitor the confinement seal integrity, failure of the monitoring system does not release radioactive materials. Consequently, the monitoring system for bolted storage units need not be designed to the same requirements as the confinement boundary (i.e., American Society of Mechanical Engineers, 1995, Section III, Subsection NB or NC).

Although there are no radiological consequences associated with this event, a recovery action must be initiated within the time frame specified in the cask vendor SAR once an alarm is indicated to comply with the requirements of 10 CFR 72.236(e). Recovery action includes replacement of the outer seal and restoration of the secondary confinement boundary. CISF personnel will investigate the cause of the low pressure alarm. If the pressure indicator is determined to be functioning properly, the cask will be returned to the transfer facility and the source of the leak investigated. If the leak is determined to be caused by failure of the secondary confinement boundary, the outer lid will be removed and the o-ring replaced. After reinstalling the outer lid, the inter lid region will be pressurized again and tested. The cask will then be returned to the storage area.

Loss of External Power

Reviews of the potential effect from loss of external power at the CISF included Subsection 12.1.7, Loss of External Power, of the CISF TSAR (U.S. Department of Energy, 1998a) and Bader (1998), along with responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b). This off-normal event involves a total loss of external AC power. Duration of the power loss depends largely on the initiating event and the time necessary to restore the power supply.

Loss of external power can result from an external event (e.g., lightning or extreme wind) or an internal event (e.g., fire) causing an open or a short circuit. Many possible causes can be postulated for this event, including off-site failure of the power transmission system as well as failures owing to local site conditions.

A loss of power event in the transfer facility will be detected immediately by facility workers through the loss of interior lighting, HVAC system shutdown, and loss of crane and robotics operations. In the storage area, this event will be detected by the momentary loss of security lightning and startup of the backup security diesel generator.

Important to safety features of the CISF that should perform their intended functions during a loss of power event include both the transfer facility cranes and the cask system. Transfer facility cranes are designed to support cask system loads under all conditions, including loss of power. Drum brakes of these cranes will lock into position to prevent a load drop in the event of power loss. The primary effect on the CISF operations will be inoperability of the cranes, which delays cask loading, unloading, or both. No facility design features are required for detection or mitigation of the event. However, several defense-in-depth features of the facility and administrative controls, as listed in Table 15-1 of this AR, are provided for recovery from these events:

- Backup Power to Fire and Security Systems: ensures fire and security systems remain functional during a loss of power event
- Portable Generator Hookup: ensures, in case of a long-term (more than 24 hr) power outage, storage cask monitoring systems and other CISF features can receive power
- UPS for Cask Monitoring System: provides for an orderly shutdown of the cask monitoring system and minimizes potential loss of monitoring data
- Halt Further Operations Until Power Restored: prevents operations when radiation monitoring may not be functioning

All of the important to safety design features of cask systems, including shielding, confinement, thermal, and criticality control, are designed to operate passively, that is, without power (U.S. Department of Energy, 1998a). The thermal and pressure monitoring systems of some storage cask systems are provided with an UPS system and the transfer facility is equipped with provisions for a portable generator hookup. These features provide for continuous monitoring of the SNF confinement and heat removal systems for these storage casks. Failure of the lighting system at the transfer facility and cask storage area will not affect visual monitoring.

Vehicular Impact

Reviews of potential consequences from a vehicular impact event included Subsection 12.1.9, Vehicular Impact, of the CISF TSAR (U.S. Department of Energy, 1998a), Bader (1998), and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b). Vehicular impact is postulated to occur either in the transfer facility or in the storage area as a result of an interaction between a transportation cask, a storage cask, the transfer facility, a storage pad, or an on-site vehicle, and a site locomotive, a site tractor, a flatbed trailer, a flatbed rail car, a cask transporter, or a vehicle used by site personnel. Equipment failure, operator error, or a natural event

(e.g., earthquake) may lead to this off-normal event. Occurrence of this event is easily identifiable from visual evidence, such as dents or scratches on casks, on-site vehicles, and other CISF SSC.

In the transfer facility, vehicular impacts are limited to site locomotives, site cask transporters, site tractors, flatbed trailers, site transfer trailers, and flatbed rail cars, which enter and exit only through the receiving bay, except site cask transporters. Site cask transporters enter and exit through either the receiving or the transporter bays. Potential vehicular impacts in the storage area are limited to site cask transporters, site tractors, site transfers, and vehicles used by site personnel.

Important to safety features that may be affected by vehicular impact include the cask system and the transfer facility superstructure. Protective barriers and administrative procedures will minimize the consequences of a vehicular impact and, in many cases, prevent the event from occurring. In addition, limited stretches of straight paths at the CISF minimize the potential for traveling beyond the posted speed limits.

CISF facilities are designed so damage caused by a vehicular impact is conservatively bounded by the damage caused by the large tornado missile. A physical/retractable barrier is placed on both ends of the track leading into and out of the active bay to prevent potential interactions between the site locomotive and a flatbed rail car or trailer in an active receiving bay. Administrative procedures will prevent any activities along the track. Administrative procedures and physical barriers prevent operations from occurring in adjacent receiving bays in the transfer facility when a cask must pass through the bay. Conservatively low speed limits for site locomotives and other site vehicles prevent most vehicular impact events and minimize the damage in the adjacent receiving bays.

A flatbed or transfer trailer may impact the transfer facility if the trailer is misaligned as it is pulled into the transfer facility. Impact of either of these trailers on the transfer facility will produce minimal damage and is quickly recognized, preventing further damage. An impact with the transfer facility does not cause any damage to a cask because the casks on these trailers do not hang over the trailer sides.

As a part of the recovery action, a cask impacted by an on-site vehicle must be externally inspected after a vehicular impact event. Damage is expected in the external shield or to the outer cask surface. Temporary shielding of the casks may be required until the external shield can be permanently replaced or repaired. Repair of these casks may require moving to the off-normal cask holding area for repair by a contractor. In some cases, casks containing transferable canisters may be transferred to another storage unit and the damaged unit will be either sent for repair or decommissioned.

The following are defense-in-depth features, as identified also in Table 15-1 of this AR, that will minimize the damage from vehicular impact:

- Brakes applied on rail cars
- Casks not placed on throughways
- Physical/retractable barriers
- Controllable rail line switch settings/positions
- Conservative speed limits established for on-site vehicles to minimize damage from a vehicular impact

Bader (1998) has presented a chart to determine either the mass or the maximum speed of a vehicle within the facility based on momentum balance equation assuming that the postulated massive tornado missile (an automobile weighing 3,968 lb traveling at a speed of 126 mph) will be imparting an impact to the storage casks that would be bounding for any vehicular impact at the proposed facility. The storage casks are designed to withstand an impact from this postulated missile. However, it is not clear from the presented information whether the characteristics of the missile do in fact bound all possible cases of vehicular impact at the facility. For example, a locomotive or a rail car will be significantly more massive than the automobile postulated in the tornado missile characterization. Consequently, there is a possibility that the momentum imparted by the massive tornado missile (i.e., the automobile) may not be bounding for some cases. The site-specific CISF SAR must provide additional information and analyses to demonstrate that an analysis with the massive missile is indeed bounding for the facility.

Handling Event

The CISF TSAR provides information about a handling event in Subsection 12.1.5, Handling Event, (U.S. Department of Energy, 1998a). Reviews of this section also included Chapter 4 of the TSAR, Bader (1998), and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b).

A handling event is postulated to occur when a storage, transfer, or transportation cask collides with part of the transfer facility as a result of operator error, any equipment failure, improper use of equipment, or a natural event. Equipment in the transfer facility includes robotics and other storage, transfer, and transportation casks. This event should be detected either through inspection or audibly.

Both the transfer facility cranes and the cask system are important to safety features of the CISF potentially affected by a handling event. The transfer facility cranes should ensure that casks and canisters handled do not drop from heights greater than these specified and analyzed. Additionally, these cranes have been designed to be swing free and single-failure-proof. The crane configuration precludes any potential interaction between the loads.

The storage casks certified for use at the CISF should be designed to withstand the impact of a tornado missile. Additionally, any transportation cask used at the CISF must withstand a 30-ft drop to an unyielding surface to satisfy the regulatory requirements of 10 CFR 71.73(c)(1). Consequently, no important to safety facility features are required for detection and mitigation of a handling event.

Several defense-in-depth facility design features and administrative controls, as identified in Table 15-1 of this AR, are provided that will reduce the possibility of occurrence of a handling event:

- Low Lift Height and Slow Speed Crane Operations: crane operations that lift and move casks will be done at minimal heights and minimal speeds, to minimize impacts
- Robotics: lightweight and will operate at slow speeds so potential impact forces onto a cask are minimized
- Clearly Defined and Clear Travel Paths for Crane Loads: travel paths of loads moved by cranes will be clearly defined and kept as clear as possible to minimize potential interactions with other equipment and prevent damage to the tornado missile protection partitions

- Clear Designation of Equipment: minimizes possibility of mixing vendor equipment during cask handling operations

Expected damage from this off-normal event is superficial (e.g., chipping or spalling) because of slow speed operations and robustness of the casks. No cask tipover events will occur due to lift height restrictions, limited speed of operations, and design of the cask system to prevent tipover. A partial loss of shielding is possible. Radiological consequences from this event are bounded by those criteria associated with a tornado missile event.

A recovery action after a handling event includes inspection of the cask involved. Casks not suffering external damage or elevated dose rates do not require any further action. Casks containing transferable canisters may require transfer of the canister to another unit. The damaged unit will either be sent off-site for repair or decommissioned. For cask systems without a transferable canister, damage from this event may cause a loss of shielding. Consequently, these casks will require temporary shielding until the external shield can be replaced permanently. The repair may be conducted in the off-normal cask holding area by a contractor.

15.4.1.4 Off-Normal Ambient Temperature

Reviews of the off-normal ambient temperature event included Subsection 12.1.8, Off-Normal Ambient Temperature, and Chapter 3, Principal Design Criteria, of the CISF TSAR (U.S. Department of Energy, 1998a), Bader (1998), and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b). This review was conducted in accordance with Subsections 15.5.1.4 and 15.5.28 of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). This event consists of two possible scenarios at the CISF: (i) extremely low ambient temperatures with no solar insolation and (ii) extremely high ambient temperatures with full solar insolation. Values of low and high temperatures along with solar insolation are site-specific. Although the site for the CISF is not selected yet, values for these parameters have been selected in the CISF TSAR to encompass most of the potential sites in the 48 contiguous United States. The bounding temperature range selected for the CISF is -40 °F to 125 °F. The solar insolation values are 800 g-cal/day-cm^2 for a horizontal flat surface and 400 g-cal/day-cm^2 for a curved surface. This event only affects external SSC at the CISF.

This off-normal ambient temperature event is a natural phenomenon expected to occur less than once per year. Although it is unlikely that these loadings would be sustained for more than a few hours, the CISF TSAR assumed 12 hr for a conservative steady-state analysis. Regional meteorological data should indicate when this event has occurred.

CISF TSAR (U.S. Department of Energy, 1998a) identified the important to safety features of the CISF that will be affected by this off-normal event: (i) cask system, (ii) intermediate lifting device, (iii) rigging equipment, and (iv) transfer facility crane. Thermal design of cask systems and associated rigging and lifting SSC should ensure that all important to safety features withstand extreme ambient temperatures specified in Table 3.3-8 of the CISF TSAR for 12 hr. The HI-STAR 100 and VECTRA NUHOMS® cask systems currently do not meet the temperature range specified as the design criterion for the CISF. Lifting devices, which include the cranes, intermediate lifting devices, and rigging associated with the cask systems, must be qualified for operation under the extreme temperatures specified in Table 3.3-8 of the CISF TSAR. Transfer

facility cranes will be designed to be functional over the entire temperature range associated with this event.

There are no defense-in-depth facility features for prevention or mitigation of this event. The transfer facility, however, is equipped with heating, ventilation, and air conditioning for personal comfort. Because there are no radiological releases or adverse consequences from this event, no corrective actions are necessary.

15.4.1.5 Off-Normal Events Associated with Pool Facilities

There is no pool facility at the CISF. Therefore, this section does not apply.

15.4.2 Accidents

The CISF TSAR includes a discussion of accident potential, both external natural events and human-induced events, at the CISF. Natural phenomena events to be considered are presented in Chapter 2, Site Characteristics, of the CISF TSAR and the review is discussed in Site Characteristics, of this AR. The accident analysis review focused on the effects of the natural phenomena and human-induced events on SSC important to safety. Analytical techniques, uncertainties, and assumptions were examined.

Each event was examined to ensure that it includes (i) a discussion of the cause of the event, (ii) the means of detection of the event, (iii) an analysis of the consequences (particularly any radiological consequences) and the protection provided by devices or systems designed to limit the extent of the consequences, and (iv) any actions required of the operator.

15.4.2.1 Cask Tipover/Overturning

Review of cask tipover accident and potential consequences at the CISF included Subsection 12.2.12, Tipover/Overturning, of the CISF TSAR (U.S. Department of Energy, 1998a) and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b). This review was conducted in accordance with section 15.5.2.1 of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). This accident event involves tipover of a transportation or a storage cask from a vertical to a horizontal orientation and also overturning of a transportation cask in the horizontal position on a transfer skid in the transfer facility, storage area, or path to the storage area from the transfer facility.

A tipover is postulated to be caused by an earthquake, a tornado missile impact, a cask to cask impact owing to motion of the cranes, a rigging or crane failure, a flood, or a vehicle impact. An overturning event is postulated to occur through failure of a site transfer trailer or a transfer skid to support its load. An overturning event is generally initiated by another event (e.g., a seismic event or a tornado missile impact).

Tipover and overturning events at the CISF are mitigated by cask system design, facility design features, and administrative controls on operating procedures. Several important to safety features of the facility that will prevent or mitigate the consequences of a tipover or overturning event have been identified. These safety features, as identified in Table 15-1 of this AR, include (i) cask system, (ii) cask support frame, (iii) rigging equipment, (iv) site transfer trailer, (v) site transporter,

(vi) transfer cradle, (vii) transfer facility crane, (viii) transfer facility mounting structures, and (ix) upender/downender. Cask systems are designed to prevent any tipover from a credible earthquake, extreme/tornado wind, explosion, handling event, tornado missile, or a vehicular impact at the CISF. Cask systems may be restrained to equipment that prevents tipovers. Cask support frames are designed to prevent significant movement of the cask/canister and tipover in a credible earthquake or a handling event. Rigging equipment is designed with appropriate lifting safety margins to ensure it will not partially fail, causing a tipover. Site transporters, transfer trailers, transfer cradles, and upenders/downenders associated with the cask system are designed not to overturn as a result of a design basis earthquake, tornado missile, handling event, or vehicle impact.

Transfer facility cranes and mounting structures are designed to prevent the cask support frame and other connected structures from tipping over because of a DBE and potential handling events. No other facility design features are required for detection or mitigation of this event. Several defense-in-depth features, however, have been provided in the design of the CISF, along with administrative controls to reduce the possibility of occurrence of a tipover/overturning event. These features, as listed in Table 15-1 of this AR, are

- Clear Designation of Equipment: minimizes possibility of mixing different vendor equipment during cask handling operations
- Clearly Defined and Clear Travel Paths for Crane Loads: travel paths of loads moved by cranes are clearly defined and kept as clear as possible to minimize potential interactions that may result in a tipover event
- Low Lift Height and Slow Speed Crane Operations: crane operations for lifting and moving casks will be done at minimal heights and speeds to minimize impact forces that may lead to a tipover event
- Storage Pads: large in size to minimize potential of tipping over the edge in a seismic event and not to fail or crack apart during a seismic event so as not to adversely affect the stability of a cask system
- Vehicle Speed Limit: conservatively established for on-site vehicles to minimize damage from a vehicle impact

Response to RAI 12-8 (U.S. Department of Energy, 1998b) and information presented in Table 4-13 of this AR show that only the HI-STAR 100 cask system (Holtec International, 1994) currently satisfies the CISF criterion for tipover. The CISF design-basis earthquake, flood, tornado, and tornado missile spectrum are bounded by the values used in evaluating the HI-STAR 100 cask system (Bader, 1998). For five other proposed cask systems, additional analyses are needed to demonstrate that they can withstand the design-basis tipover accident at the CISF without affecting their safety functions.

Additionally, no information is available to evaluate whether the site transporters, the transporter cradles, or the upenders/downenders can withstand a design-basis tipover event. Consequently, the site-specific CISF SAR should provide analyses to demonstrate that a loaded site transfer trailer or a loaded transfer skid will not overturn during a design-basis seismic event (with peak ground

acceleration of 0.75 g, as defined in Chapter 2, Site Characteristics, of the CISF TSAR) or a design-basis tornado missile impact.

15.4.2.2 Cask Drop

Review of the cask drop accident analysis was conducted in accordance with section 15.5.2.2 of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000) and included the information presented in Subsection 12.2.2, Drop Accident, of the CISF TSAR; response to RAIs 12-3, 12-5, and 12-8 (U.S. Department of Energy, 1998b); and information given in the report Drop Accident-ISF TSAR Design Basis Event Analysis (Bader, 1997). This event involves dropping a loaded transportation cask, transfer cask, canister, storage cask, or cask lid in the transfer facility, storage area, or path from the transfer facility to the storage area.

The CISF TSAR (U.S. Department of Energy, 1998a) identifies the important to safety and defense-in-depth features associated with the drop accident. The important to safety features, as identified in Table 15-1 of this AR, include (i) cask system, (ii) site transporter, (iii) transfer facility crane, and (iv) upender/downender. The defense-in-depth facility features are provided to reduce the likelihood of event occurrence and to prevent drops from heights in excess of maximum handling heights. These features, as indicated in Table 15-1 of this AR, include the following:

- Clear Designation of Equipment: minimizes the probability of mixing vendor equipment during cask handling operations that may lead to a drop event
- Clearly Defined and Clear Travel Paths for Crane Loads: minimizes potential interactions that may result in a drop event
- Crane Load Indicator: informs the crane operator, as part of the LCO requirement, the weight of load on the crane, significant load changes caused by hang-ups, or excessive raising of a canister into a transfer cask
- Remote Video and Audio System: uses CCTV monitors for assisting remote operation and unobstructed views together with providing audio capability to remote operators
- Monitor and Restrict Lift Heights: provides operational controls to monitor lift heights, verifies clearances during lifts, and restricts lift heights
- Intermediate Lifting Device: provided by cask vendors
- Rigging Equipment: provided by cask vendors

A drop event may occur during any lifting or lowering operation at the CISF as a result of operational or mechanical failure of a transfer facility crane, a site transfer trailer (vendor-supplied), a site transporter (vendor-supplied), a yoke/rigging, or a storage unit upender/downender (vendor-supplied). In addition, failure to use the appropriate vendor equipment may also lead to a cask, canister, or lid drop event. The cask lid drop accident can only occur during vertical canister transfer when the lid is removed from the loaded transportation cask or when the lid is replaced on the loaded storage cask.

All casks certified for use in the CISF are designed to withstand a drop from the maximum vertical and horizontal lift/drop heights for each component of the cask systems without significant impact to the important to safety design functions. Maximum handling heights from which the system components could potentially be dropped are determined from system-specific features (e.g., maximum lift heights of site transporters and upenders/downenders) of six vendor technologies proposed for use at the CISF and CISF operational sequences. Maximum handling heights for the proposed cask systems are given in Table 3.3-9 of the CISF TSAR and Tables 7.1 and 7.2 of Bader (1997). In addition, the cask lids will be raised a maximum of 6 in. above a cask and moved laterally.

The design of the crane and the rigging minimizes the probability of a cask or a lid drop by meeting the suggested safety margins in NUREG–0612 (U.S. Nuclear Regulatory Commission, 1980) and the guidelines of ANSI–N14.6 (American National Standards Institute, 1986) for lifting heavy loads. Other lifting equipment has provisions for straps or other devices to secure casks both during and after lifting or lowering operations. Because many of the lifting devices are unique to each vendor system, the equipment will be clearly labeled and easily identifiable to the crane operator. Operational controls will also be used to monitor and restrict the lift height, as well as verify clearance and load paths.

In addition to controlling the lift heights, the crane is equipped with a load sensor. This sensor will alert the crane operator if significant load changes occur because of canister hangup during vertical transfer while raising a canister to a height that causes the transfer cask to become slightly lifted during vertical transfer.

The robotics and video system of the transfer facility will be used to remotely inspect a dropped cask before recovery. Temporary shielding can be provided, if necessary because of some loss of shielding. Additionally, canisters can be transferred out of dropped casks for all canistered systems.

The site transporters, site transfer trailers, upender/downenders, intermediate lifting devices, and yokes/rigging will be designed to minimize the probability of a drop event and restrict lift heights to design conditions. Intermediate lifting devices and rigging equipment provided by the cask vendors are considered defense-in-depth features because the cask systems themselves are designed to withstand a drop event. The role of the lifting devices is to prevent drops from excessive heights.

Bader (1997) provides an analysis methodology of potential consequences of drop accidents at the CISF. The analysis includes casks or canisters with maximum design weight (including SNF) dropped onto the transfer facility floor, a storage pad, or the path from the transfer facility to the storage area. Drop of a transportation cask is not considered in the analysis. These casks must satisfy a 30-ft free drop test, as specified in 10 CFR 71.73. Any potential drop of a transportation cask will be bounded by the 30-ft drop test. Because drop of casks without SNF will have no radiological consequence on the CISF, provided a dropped empty cask is not used again before a thorough inspection is completed and an empty cask is not dropped on a loaded cask, these casks are not included in the analysis. The hardness of the transfer facility floor and the storage pads are bounded by the following concrete characteristics: (i) a thickness of 3 ft (91.4 cm), (ii) a Young's Modulus of 3.6×10^6 psi (2.5×10^4 MPa), and (iii) an ultimate strength of 4,000 psi (28 MPa). The potential heights from which a cask or canister may be dropped depend on the type of cask system:

- NUHOMS®—Exterior Horizontal Transfer System
- Hi-STAR 100—Transportable Storage Cask System

- TranStor™—Vertical Transfer System
- Large MPC—Interior Horizontal Transfer System
- Small MPC—Interior Horizontal Transfer System
- STC—Transportable Storage Cask System

Although the transfer facility cranes and rigging are designed to meet the guidelines of ANSI–# N14.6-1986 (American National Standards Institute, 1986) and NUREG–0612 (U.S. Nuclear Regulatory Commission, 1980), the fault tree analysis presented in Bader (1997) for the failure of a handling system shows that the probability of dropping a loaded cask during the lifetime of the CISF is still credible. Therefore, each cask system certified for use at the CISF must be designed so that a credible drop has no significant effect on important to safety functions: confinement, thermal, criticality, retrievability, and radiation protection. The worst potential radiological consequences of a drop event are bounded by the consequences of a loss of confinement event, which assumes complete failure of all the fuel rods in a cask/canister. Based on the design features and defense-in-depth features, this review indicates that a small loss of shielding is a more likely result from a drop event, provided the cask systems are certified for the maximum design drop height of the CISF. The loss of shielding caused by a tornado missile impact will bound any loss of shielding resulting from a drop of the casks without a separate outer layer of neutron shielding.

Each cask must be thoroughly inspected after any drop regardless of the drop height. Because each cask to be used in the CISF must be designed and certified for drop from the maximum credible heights, there is no significant effect on the important to safety functions. Undamaged casks do not require any corrective action and may be returned to service. The robotics, cranes, and video systems of the transfer facility, however, can be used to perform a majority of the recovery operations if damage to the cask is detected. Casks containing transferable canisters may transfer the canister to another unit (preferably a storage unit) and the damaged unit will be either sent off-site for repair or decommissioned. For systems without a canister, the units will be moved to the off-normal cask holding area and repaired by site personnel or a contractor.

Simple repairs of dropped casks may be made by site personnel. Site personnel may accumulate some additional dose beyond that which is normally received while making the repairs to a dropped cask. The occupational exposure associated with this activity should be small given the expected frequency of the event, relatively short time required for repair, and expected radiation field. Exposures expected to be greater will require more extensive ALARA techniques including the use of long-handled tools and temporary shielding.

It should be noted here that any repair or modification of the dropped storage casks must be done under a 10 CFR Part 72 quality assurance program, which has been reviewed in Chapter 12, Quality Assurance Evaluation, of this AR. Any repair or modification of a dropped transportation cask, however, must be done under a 10 CFR Part 71 quality assurance program. The site-specific CISF SAR must provide information on the quality assurance program under 10 CFR Part 71.

Tables 15-2 and 15-3 provide the information presented in Tables 8-1 and 8-2, respectively, of Bader (1997). These tables summarize the maximum drop heights at the CISF and compare these with the qualified drop heights for various components of all six cask systems being considered at the CISF as submitted in the various SARs. Some components of each of the cask systems have not been analyzed for their maximum drop height at the CISF or require recovery operations not possible at the CISF. Therefore, these cask systems cannot be used currently at the CISF.

Table 15-2. Summary of cask system component end drop heights (adopted from Bader, 1997)

End Drop Height (in.)								
Component	Transportation Cask		Storage Cask		Transfer Cask		Canister/Basket	
Cask System	CISF Criterion	Qual-ified	CISF Criterion	Qual-ified	CISF Criterion	Qual-ified	CISF Criterion	Qual-ified
Holtec HI-STAR 100	80	36	80	36	NA	NA	NA	NA
NAC STC System	80	12	80	12	NA	NA	NA	NA
Sierra TranStor™	80	80	12	18	218.25	None	209.25	209.25
VECTRA NUHOMS®	80	80	NA	NA	NA	NA	NA	NA
Westinghouse Large MPC	114	None	30	30	NA	NA	NA	NA
Westinghouse Small MPC	114	None	30	30	NA	NA	NA	NA

NA–Not Applicable

Table 15-3. Summary of cask system component side drop heights (adopted from Bader, 1997)

Side Drop Height (in.)								
Component	Transportation Cask		Storage Cask		Transfer Cask		Canister/Basket	
Cask System	CISF Criterion	Qual-ified	CISF Criterion	Qual-ified	CISF Criterion	Qual-ified	CISF Criterion	Qual-ified
Holtec HI-STAR 100	None	60	None	60	NA	NA	NA	NA
NAC STC System	None	60	None	60	NA	NA	NA	NA
Sierra TranStor™	None	80	None	60	None	None	None	None
VECTRA NUHOMS®	60	80	NA	NA	NA	NA	NA	NA
Westinghouse Large MPC	108	None	70	70	NA	NA	NA	NA
Westinghouse Small MPC	108	None	70	70	NA	NA	NA	NA

NA–Not Applicable

15.4.2.3 Flood

Information provided in Subsection 12.2.8, Flood; Chapters 2, Site Characteristics, and 3, Principal Design Criteria, of the CISF TSAR (U.S. Department of Energy, 1998a); and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b), have been reviewed in accordance with Subsection 15.5.2.3 of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000) to determine compliance with the requirements of 10 CFR 72.122(b)(2). Water from the facility and natural hazards may affect the operations at the CISF and present a hazard to personnel. There is a variety of potential site-specific sources for flooding external to the CISF including (i) dam break upstream of a nearby river or lake, (ii) seiche, (iii) tsunami, (iv) hurricane, (v) high river stage, (vi) high lake level, (vii) high tide, (viii) landslide, (ix) avalanche, (x) snow melt, (xi) intense precipitation, or (xii) storm surge. On-site water from the decontamination tank and the fire protection system can cause an uncontrollable release of water. A breach in the piping of the fire protection system or the decontamination tank inside the transfer facility can cause a localized flood. An earthquake, an impact into the pipes or tanks by a transporter vehicle, or a piece of cask handling equipment moved by an overhead crane can develop the breach.

All QA–1 SSC, listed in Table 3.2-1 of the CISF TSAR, are important to safety features that will be affected by a flooding event. CISF design dictates that all important to safety features will be placed

above the postulated design basis flood level. Consequently, no other facility design features are required for mitigation or detection of this event, and there is no need to consider the external sources of flooding. The CISF design does not preclude floods produced by internal events. The volume of water available from on-site sources, however, is not sufficient to cause significant concern with regard to radiological safety. A defense-in-depth facility design feature is provided for an internal flood caused by a breach of the fire protection system piping. This feature is a wastewater system that is sized to handle potential design flow produced by an internal flood event. This collected water will be sampled and tested before it is released to a vendor for disposal. Additionally, all certified cask systems have been analyzed for tipover/overturning and hydrostatic pressurization because of a flood event. Cask vendor SARs will provide the information that demonstrates all casks are able to withstand the maximum static pressure exerted on the cask when completely submerged in water.

15.4.2.4 Fire and Explosion

Analyses of accident scenarios involving potential fire and explosion at the proposed CISF were evaluated as required by 10 CFR 72.122(c). The CISF TSAR presents the information on fire in Subsection 12.2.7, Fire, and on explosion in Subsection 12.2.4, Explosion. In addition, information presented in Chapter 4, Operating Systems, of the CISF TSAR, and responses to RAIs 4-7 through 4-14, 12-3, 12-8, and 12-11 (U.S. Department of Energy, 1998b) were also reviewed. This review was conducted in accordance with the criteria given in Subsection 15.5.2.4 of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). Protection against fire and explosion for SSC important to safety was also reviewed in Subsection 6.4.5, Fire and Explosion Protection, of this AR.

Fire

Subsection 12.2.7, Fire, of the CISF TSAR (U.S. Department of Energy, 1998a) provided information on fire analysis. Additional information presented in Chapter 4, Operating Systems, of the CISF TSAR and responses to RAIs 4-7 through 4-14, 12-3, and 12-8 (U.S. Department of Energy, 1998b) were also used in this review. This review was conducted in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

A credible fire accident exposing SSC important to safety at the CISF is possible either during handling at the transfer facility or during cask transporting. A credible fire at the CISF may be initiated by the ignition of oil leaking from the diesel fuel storage tank, trash, hydraulic fluid, solid radwaste, vehicle diesel fuel, or electrical insulation/equipment. Fires from other site-specific sources such as forest fire, accidents on nearby highways, or highly flammable industrial complexes have not been considered. Analysis incorporating these sources will be submitted in the site-specific CISF SAR.

The cask system is an important to safety SSC that should continue to function in this design basis event. All cask systems are designed of noncombustible materials (heavy-section concrete and highs temperature metal sections) so that small credible fires at the CISF installation will not affect the important to safety design features. These heavy section structures will have high heat capacity and will dissipate heat rather quickly, minimizing significant localized rise of temperature. Response to RAI 12-8 shows that all six cask systems proposed for use in the CISF satisfy the fire criteria. Although no consequences are expected from a credible fire event at the CISF, the DOE has committed to conduct radiological surveys followed by visual inspections and instrument testing to ensure that neither any damage to the structures nor any radiological release occurred

(U.S. Department of Energy, 1998a,b). Necessary reporting of the accident will be done in accordance with 10 CFR 72.75 requirements.

The fire protection program, described in Chapter 4, Operating Systems, of the CISF TSAR, is an important to safety facility feature and will limit and control the amount of combustible materials stored in and around the CISF site or otherwise allowed to accumulate in contaminated or noncontaminated trash receptacles. Therefore, important to safety SSC will not be adversely affected by the credible potential fires at the CISF, according to the fire hazard analysis presented in Appendix 4A, Fire Hazards Analysis Summary and System Evaluation, of the CISF TSAR.

Several defense-in-depth facility design features and administrative controls, however, are provided to reduce the possibility of event occurrence and allow for prompt detection of the event. These features, as indicated in Table 15-1 of this AR, include

- Fire Detection System with UPS: provides fire detection capability for 24-hr service because of the dedicated UPS
- Fire Hose and Stand Pipes: provide capability for extinguishing credible fire at the CISF
- Fire Protection System with a Diesel Backup Pump: provides fire extinguishing capability even in cases of a power outage
- Portable Fire Extinguishers: provide capability to extinguish potential fires
- Radioactive Waste Management Program: ensures that small amounts of low-concentration contaminated waste will accumulate at the CISF and will be stored in steel cover containers to limit the potential direct airborne releases from credible fires

There are two diesel fuel storage tanks located on the CISF (U.S. Department of Energy, 1998a, Subsection 4.1.2.18, Storage Tanks). One tank is located in the security complex and stores enough fuel for 24-hr operation at a full load of a 500 kVA diesel generator. The capacity of this tank is 1,000 gal. The second tank is located in the fire protection pump building and stores diesel for the fire protection pump.

There is no QA–1 SSC in the security complex. The administration areas and areas containing mechanical and electrical equipment within the security complex will be provided with automatic water-based sprinklers. The central computer area will be provided with an inert dry-gas system.

The CISF TSAR (Subsection 3.7.4 of Appendix 4A) states that the size of the diesel fuel storage tank in the fire protection pump building will be no larger than 400 gal. The walls will be 8-in. thick, 3-hr fire-rated with associated double doors.

The inspection gatehouse will receive the SNF in transportation casks by heavy haul trucks and by rail. The shipments will be inspected here before proceeding to the transporter wash-down station. Additionally, rail cars and heavy haul trucks can wait in the queuing space provided in the transportation cask queuing areas.

Heavy haul SNF transporters will park in a paved area next to the rail tracks. It is expected that locomotives will be moving the rail cars with loaded SNF. Any rupture of the diesel storage tanks of

the locomotives with subsequent spillage and ignition can generate a large pool fire. This fire may affect the SNF in transportation casks on the heavy haul trucks or in storage casks placed on the cask storage pads. An analysis is needed demonstrating the SNF will be safe from any postulated fire in the CISF.

Subsection 3.2.4 of Appendix A of the CISF TSAR states that fire severity near the cask storage pads is "low" due to a lack of combustible material, layout of the casks, and construction of the canister and casks. The Fire Hazard Analysis has concluded the canisters and casks would be able to withstand any brush fire or trash fire occurring in the vicinity and the probability of spillage of fuel from portable electrical generators and storage cask transporters is too low for further evaluation. However, no basis for either assumption has been provided. There is no discussion of any program to maintain the area in the vicinity of the storage pads free of any combustible material. Additionally, the site-specific CISF SAR must demonstrate that any postulated fire in the vicinity of the storage pads will not affect the safety functions of the canisters and casks, in accordance with 10 CFR 72.122(c).

Potential major sources of fuel for a fire in the transfer facility are the tanks of heavy haul trucks/transporters and rail locomotives. The storage capacity of the fuel tanks in the heavy haul transporters can be several hundred gallons. It is not clear from the discussion of operating procedures whether the locomotives will be allowed to enter the transfer facility. The capacity of the fuel storage tanks in the locomotives can be several thousand gallons. Depending on the number of locomotives and heavy haul transporters allowed at any time inside the transfer facility, substantial amounts of diesel fuel would be available. If for any reason the diesel is spilled and later ignited, there will be a substantial pool fire, which will affect QA 1 SSC in the transfer facility.

A fire analysis is necessary in the site-specific CISF SAR, which takes into consideration the maximum amount of diesel available from the fuel tanks of the locomotives and the heavy haul transporters including tires. This analysis should provide the flame height, duration, and temperature at different levels of the transfer facility. Based on the results of this analysis, the site-specific CISF SAR must demonstrate all QA1 SSC will not be affected from the maximum postulated fire in the transfer facility. Additionally, the site-specific CISF SAR must demonstrate the HVAC system in the transfer facility will be capable of dispersing the smoke generated from this fire. All these demonstrations are necessary to satisfy the requirements of 10 CFR 72.122(c).

Explosion

Reviews of explosion event included Subsections 7.4.1.3.1, Loads, and 12.2.4, Explosion, of the CISF TSAR (U.S. Department of Energy, 1998a), responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b), and Bader (1998). This review was conducted in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

This accident event involves an off-site or on-site explosion that may damage important to safety SSC of the CISF, namely the casks and transfer facility superstructure. The effects produced by an explosion may be an incident or reflected overpressure, dynamic pressure, blast-induced ground motion, or blast-generated missiles.

The potential scenarios that can result in an off-site explosion include

- A transportation accident involving a tractor trailer, rail car, or barge shipping explosives on a nearby transportation route
- Leakage or rupture of a pipeline containing an explosive fuel (e.g., natural gas) and its subsequent ignition
- An accident involving explosive chemicals at a nearby industrial facility

Scenarios that can result in an on-site explosion include

- A transportation accident resulting in the rupture of a fuel line/tank and its subsequent ignition on-site. At the CISF, these accidents may involve a security vehicle, a site locomotive, a site cask transporter, a site tractor, or a tanker truck used to refill the CISF fuel tank(s).
- Leakage or rupture and subsequent ignition of on-site fuel tank(s) required for the diesel backup generator(s) and for any on-site refueling operations.
- Leakage or rupture (and subsequent ignition) of on-site welding gas canister.

Both cask systems and transfer facility superstructures are required to function after this event. Regulatory Guide 1.91 (U.S. Nuclear Regulatory Commission, 1978) prescribes a methodology for evaluating the risk of damage from explosions. For explosions of magnitudes considered in the TSAR and SSC that must be protected, overpressure effects are the controlling factors. Regulatory Guide 1.91 sets 1 psi (6.9 kPa) as the peak positive incident overpressure below which no significant damage would be expected to occur to structures. Because the transfer facility superstructure is designed for a design basis tornado with a wind speed of 360 mph, this superstructure is adequate for a 1-psi (6.9 kPa) explosion overpressure. Therefore, explosion pressures or loads are bounded by the tornado wind criteria provided adequate distances between QA–1 SSC and explosion sources are maintained to keep the peak positive incident overpressure below 1 psi (6.9 kPa). Blast-induced ground motions are bounded by the earthquake criteria and blast-generated missiles are bounded by the tornado missile criteria established for the CISF.

Subsection 12.2.4.2, Accident Analysis, of the CISF TSAR and response to RAI 12-11 provide an acceptable methodology for estimating the minimum distance between QA–1 SSC and explosion sources following Regulatory Guide 1.91 (U.S. Nuclear Regulatory Commission, 1978). This distance R has been estimated using the trinitrotoluene (TNT) equivalent weight W of a potential solid explosive and cube-root scaling technique

$$R \geq kW^{\frac{1}{3}} \tag{15-1}$$

where k is an empirically measured coefficient and is equal to 45 (U.S. Nuclear Regulatory Commission, 1978). Because some materials are more explosive in the vapor phase (e.g., diesel fuel), the minimum distance necessary for vapor phase explosions may be more critical. Regulatory Guide 1.91 suggests a 240 percent TNT mass equivalency is an acceptable upper bound for vapor phase explosions. Therefore, the minimum distance R from a vapor phase explosion is

$$R \geq 45(2.4W)^{\frac{1}{3}} \tag{15-2}$$

Figure 12.2-1 (corrected) of the CISF TSAR is used for estimating the minimum distance required between a potential explosion source and the transfer facility or the storage area.

The potential impact to the transfer facility and storage area from explosions at on-site tanker trucks and fuel tank(s) depends on the amount of fuel demonstrated in these tanks (or, equivalent amount of TNT). The Ideal gas law has been used to determine the diesel fuel vapor density at different temperatures. This diesel vapor density has been used to convert to equivalent TNT to estimate the minimum distance necessary. Figure 12.2-2 (corrected) of the CISF TSAR shows the minimum required distance from diesel fuel at room temperatures, and at maximum and minimum temperatures allowed at the CISF.

There are four areas at the CISF where a potentially explosive agent can be found (i) backup security power generator diesel fuel tank and day tank, (ii) backup fire pump power generator day tank, (iii) on-site vehicle refueling area, and (iv) and areas containing on-site welding gas. A small size of 2-day tanks and a limited amount of welding gas will be allowed on-site to preclude them from being significant explosive sources. However, the backup security fuel tank holds 1,000-gal. of diesel and the on-site vehicle area is serviced by a 2,000-gal. tanker truck. The 1,000-gal. diesel tank is located at a minimum distance of 150 ft from the transfer facility and 700 ft from the storage area. Similarly, the on-site refueling area serviced by the 2,000-gal. tanker truck is located a minimum of 200 ft from the transfer facility and the storage area. These distances satisfy the minimum required distances determined from Figure 12.2-2 (corrected) as specified by Regulatory Guide 1.91. Additionally, each cask system is designed for a pressure drop of 3 psi caused by the tornado wind, which provides an extra margin of protection against an explosion. Specific cask vendor SARs should provide the required analysis showing that the certified cask systems can structurally withstand a 1-psi (6.9 kPa) pressure wave associated with a design basis explosion. The CISF TSAR identifies the following dense-in-depth features at the CISF.

- Cask Vent Surveillance: visual inspection following meteorological or other phenomena conducive to blocking vents provides capability to promptly detect blocked vent conditions and potential explosion damage

- Controlled Amount and Location of Explosive Substances: amount and location of explosive is controlled so that explosive materials cannot produce an overpressure larger than 1 psi to important to safety SSC

- Security/Physical Protection System: controlled access to the CISF will limit/prevent the amount of explosive materials entering the CISF

- Transfer Facility Blowout Panels: roll-up doors will blow out to limit the building internal pressure to 1 psi

As this is a non-site-specific TSAR, the analysis does not include potential explosions from off-site transportation, industrial, and pipeline. Response to RAI 12-3, however, indicates the revisions proposed by the DOE to Wagstaff (1998). These revisions include estimation of minimum distances between the site and transportation routes from hypothetical explosions involving high explosives. Using 1-psi peak positive incident overpressure below which no significant damage would be expected to occur to structures designed for a design basis tornado [following Regulatory Guide 1.91 (U.S. Nuclear Regulatory Commission, 1978)], explosion loads are bounded by the tornado wind load

criteria (a wind speed of 360 mph) provided that the following minimum distances between the site and transportation routes are satisfied:

- 1,700 ft for a truck carrying the maximum probable hazardous solid cargo of 50,000 lb of TNT equivalent
- 2,300 ft for a single railroad car containing 132,000 lb of TNT equivalent
- 10,000 ft for a ship holding 10,000,000 lb of TNT equivalent

The minimum distances between the site and the transportation routes must be verified in the site-specific CISF SAR.

15.4.2.5 Lightning

Information presented in Subsection 12.1.6, Lightning, and Chapter 4, Operating Systems, of the CISF TSAR (U.S. Department of Energy, 1998a) along with the responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b) and Bader (1998) were reviewed, in accordance with Subsection 15.5.2.5 of NUREG–1567 (U.S. Nuclear Regulatory Commission 2000), to determine the potential effect of lightning on the CISF and compliance with the requirements of 10 CFR 72.122(b)(2). Lightning is a large-scale high-tension natural electrical discharge in the atmosphere. It is a natural event associated with thunderstorms in which one or more cloud-to-ground strikes affect CISF SSC exposed to the environment.

A lightning accident event is expected to occur once per year in the course of normal operations of the CISF. Consequently, the CISF TSAR categorizes lightning as a Design Event II or an off-normal event following ANSI/ANS-57.9-1992 (American National Standards Institute and American Nuclear Society, 1992). The Standard Review Plan NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000), however, classifies lightning as an accident event. The CISF TSAR has categorized both Type III and Type IV ANSI/ANS-57.9 design events as accidents. Consequently, the CISF TSAR excludes lightning from the list of accident events.

Although a lightning event is expected to occur once per year, its frequency is dependent on the frequency of thunderstorms. The frequency of thunderstorms is a function of time of day, geographic location, and elevation. Typically, most of the thunderstorms occur during late afternoon and evening of summer. Certain areas of the country are also prone to greater occurrences of thunderstorms, particularly the warmer and more humid locations.

The analysis of a lightning event is generally site-specific. The DOE (1998a,b) has acknowledged this and committed to address this again once a site has been selected. The general effects of lightning strike depend on the structures affected and the number of lightning strikes. Specific effects may include a localized temperature increase, a loss of power, or a short circuit of electrical components. A lightning strike on the transfer facility or a storage cask may be detected visually at the location of the strike by discoloration, typically a blackened area at the point of impact. The occurrence of the lightning strike may be observed by individuals at the time of event, or it may not be observed until a later time during routine surveillance inspection.

Both transfer facility superstructure and the cask system are important to safety features of the CISF that may be affected by lightning strike. The transfer facility superstructure is designed in accordance with NFPA 780 (National Fire Protection Association, 1997) to protect the important to safety features found inside the transfer facility from a direct lightning strike (excluding cask systems). Air terminals or other lightning protection devices specified by NFPA 780 will intercept the lightning discharge and provide a low-impedance path to ground terminals. All the cask systems certified for use in the CISF must be designed to thermally withstand a lightning strike, that is, only a localized temperature increase at the cask surface will take place as a result of a lightning strike, without degrading the thermal performance of the casks. Arrangement of storage casks in the storage area and any required structures will be designed to comply with the requirements of NFPA 780 for lightning protection.

Because storage cask systems must be designed to mitigate any thermal consequences associated with a lightning strike, no facility design features are necessary for detection and mitigation of this event. The CISF design, however, includes a defense-in-depth facility design feature and an administrative control that will reduce the likelihood of effects from this event and provide for prompt detection. These features, as listed in Table 15-1 of the AR, include

- Lightning Protection System: designed in accordance with NFPA 780
- Cask Vent Surveillance: visual inspection of cask vents following meteorological or other phenomena conducive to blocking vents provides capability for prompt detection of blocked vent conditions potentially caused by lightning or associated meteorological conditions

Because no radiological consequences or other effects on the important to safety functions are associated with this event, no recovery action is required.

15.4.2.6 Earthquake

The CISF TSAR has presented in Subsection 12.2.3, Earthquake, the details of accident analysis from an earthquake event. In addition, the reviewer has taken into consideration relevant information from Chapters 2, Site Characteristics, and 7, Installation Design and Structural Evaluation, of the CISF TSAR, (U.S. Department of Energy, 1998a); responses to RAIs 4-7, 12-3, 12-8, and 12-14 (U.S. Department of Energy, 1998b); and Bader (1998). This review was conducted in accordance with Subsection 15.5.2.6 of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000), in compliance with the requirements of 10 CFR 72.122(b)(2).

The CISF TSAR states that the CISF is designed to endure consequences of a design basis earthquake with a response spectra anchored at a horizontal acceleration of 0.75 g applied at the structure foundation. All QA–1, QA–3, and QA–5 SSC are designed for this ground motion. The effect of a seismic event on all other SSC has no impact on important to safety SSC. A seismic event can occur at any time during any stage of a transfer or storage operation involving a cask or a canister.

The CISF TSAR identifies both important to safety and defense-in-depth features at the CISF for an earthquake event. The important to safety features, as given in Table 15-1, include (i) cask system, (ii) cask support frame, (iii) site transfer trailer, (iv) site transporter, (v) transfer cradle, (vi) transfer facility caissons/anchors, (vii) transfer facility mounting structures, (viii) transfer facility crane, (ix) transfer facility crane rails, (x) transfer facility superstructure, and (xi) upenders/downenders. The

transfer facility superstructure, mounting structures, and caissons/anchors are designed to withstand the effects of the design basis earthquake, as reviewed in Chapter 5, Operating Procedures, of this AR. The transfer facility cranes and crane rails are designed to accommodate the design basis seismic load while loaded with the heaviest cask. Additionally, the CISF TSAR has assured that the cranes will remain on their rails during this event. Design of the cranes will be made during the site-specific design. Prevention of uplift from the crane rails under all loading conditions will be checked and shown to meet all applicable safety factors in the design guidelines during the site-specific design (see the response to RAI 4-1).

The CISF design excludes locating the facility near a surface fault (Subsection 2.6.3, Subsurface Faulting, of the CISF TSAR). Therefore, it is unlikely that lift and settlement of the soil will be significant. Consequently, significant lifting and/or settlement of a storage pad is unlikely if liquefaction of the material underneath the pad and associated settlement do not occur. As discussed in Chapter 2 of this AR, the site-specific SAR for the CISF should provide assessment of the liquefaction potential at the proposed site. Additionally, the storage pads are designed to prevent failure or crack apart and impact a cask as a result of the seismic event. The pads are also designed to be large in size to reduce the possibility of casks sliding off the edge of the pad and into one another.

As discussed in Section 5.4.3.4, Structural Analysis, of this AR, some cask vendors have taken credit for the deformation and crushing of the concrete storage pads in a tipover accident. EPRI NR–7551 (Electric Power Research Institute, 1993) points out that the subgrade is much more important than the pad itself in establishing the hardness of the tipover target. Final evaluation of this issue is site-specific and requires information of *insitu* material properties.

The cask system, cask support frame, site transfer trailer, site transporter, transfer cradle, and upenders/downenders are vendor-supplied important to safety SSC that are required to function during a seismic event. All storage, transportation, and transfer casks loaded with SNF should be designed not to tipover due to a design basis earthquake or should be restrained to seismically designed equipment at all times. Review of cask-specific vendor SARs or the site-specific CISF SAR should confirm this assumption before certification for use in the CISF. In the transfer facility, the seismically designed equipment includes cask support frames, upenders/downenders, transfer cradles, transfer facility cranes, transfer facility mounting structures, and the transfer facility superstructure.

The upenders/downenders and transfer cradles to be used for horizontal canister transfers together with the cask support frames to be used for vertical canister transfers should be designed not to collapse or significantly move during a seismic event. Additionally, casks or modules should be mated and either bolted or restrained to one another during a canister transfer operation. This seismic design prevents damage to a canister being horizontally or vertically transferred during a seismic event. Cask-specific vendor SARs or the site-specific CISF SAR must show with reasonable assurance that the design of these features will perform the intended safety functions in a design basis seismic event.

Site transporters and transfer trailers are vendor-supplied important to safety SSC and will be used for transporting casks from the transfer facility to the storage area. They should be designed in such a way that they will not overturn during a CISF design basis seismic event. Similarly, storage casks and modules should be designed to prevent tipover during a seismic event. Cask-specific vendor

SARs must demonstrate with reasonable assurance that these important to safety features will be able to continue performing during tipover a design basis earthquake.

In addition to the important to safety facility features and the design of the cask system, the following defense-in-depth facility design and administrative control features are provided to reduce the potential effects of design basis earthquake:

- All QA–5 SSC: SSC classified as important to potential interaction include those items whose function is not required, but whose consequential failure during a seismic event can impair the capability of other items to perform their intended important to safety function, such as a storage pad, have been designed not to interact with important to safety SSC as a result of this event.

- QA–3 Liquid Retention Structures: SSC classified as important to radioactive waste control and management of site-generated liquid radioactive waste, such as Liquid Waste Tank Vault, are designed following guidance given in Regulatory Guide 1.143 (U.S. Nuclear Regulatory Commission, 1979).

- Cask Vent Surveillance: visual inspection of cask system vents following any meteorological or other phenomena conducive to blocking of vents provides a capability for prompt detection of blocked vent conditions as well as an opportunity to inspect for any damage to storage pads or cask systems from a seismic event.

15.4.2.7 Loss of Shielding

Reviews of the loss of shielding accident event are included in Subsection 12.2.10, Loss of Shielding, of the CISF TSAR (U.S. Department of Energy, 1998a) and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b). This review was conducted in accordance with Subsection 15.5.2.7 of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

A loss of shielding event can have potential effects on the radiation properties of the transport, transfer, and storage casks because of partial loss of the casks shielding capability. This loss is limited to the nonstructural shield on the outside of the cask, a small surface loss, or cracking of the concrete shield. Partial shielding loss can take place from a vehicular impact, a cask drop, a tornado missile, or misalignment of transfer, transport, or storage casks during a canister transfer.

Analysis of this accident event is specific to each cask system. HI-STAR 100 (Holtec International, 1994) and NAC STC (Nuclear Assurance Corporation International Services, Inc., 1994) systems have a separate neutron shield on the outer surface. This shield can be removed or dislodged by this event. Other cask systems only consider small surface losses or cracking of a concrete shield while analyzing this event.

A radiation monitor alarm may indicate a possible loss of shielding of the cask. CISF personnel are assumed to follow emergency procedures associated with this alarm. The procedures include placing the cask into a safe position to prevent additional damage, defining the extent of damage by taking radiation field measurements with remote fixed and movable detectors, and visually observing with CCTV monitors. Emergency recovery operations include either repairing or replacing the damaged shield, or transferring the canister for a canister-based system to an undamaged cask.

The cask system is the only SSC required to function in the analysis of this accident event. Design of the cask systems should minimize the effect of the loss of shielding from this accident. The CISF TSAR shows that all six proposed cask systems to be used in the CISF satisfy this requirement.

There is no important to safety facility feature for this event. However, defense-in-depth facility feature assists prompt detection of this event.

- Transfer Facility Radiation Monitoring Alarm System: will alarm locally and in the remote operation room indicating a high dose rate.

The CISF TSAR has not performed any additional shielding analysis for the loss of shielding event. Potential consequences are limited to a small increase in dose rates as defined in the vendor SARs. The CISF TSAR states that these small increases will not significantly affect occupational radiation exposures because of the use of temporary shielding. The CISF TSAR also takes credit for remoteness of facilities to minimize the occupational radiation exposures, but this argument cannot be supported because the CISF site is yet to be selected. The CISF TSAR estimates no off-site dose consequences from this event because of limited event duration and the distance to the controlled area boundary. The staff agrees with this argument based on additional discussion given in Chapter 7, Shielding Evaluation, of this AR.

15.4.2.8 Adiabatic Heatup/Full Blockage of Air Inlets and Outlets

Reviews of the full blockage of air inlets/outlets of a storage cask included Subsection 12.2.1, Full Blockage of Air Inlets/Outlets, of the CISF TSAR (U.S. Department of Energy, 1998a) and responses to RAIs 12-7 and 12-8 (U.S. Department of Energy, 1998b). This review was conducted in accordance with Subsection 15.5.2.8, Adiabatic Heating, of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). Adiabatic heating is a key assumption for an evaluated accident as it ensures the most conservative thermal transient response of the cask components has been evaluated. NUREG–1567 specifies that all casks relying on natural air convection through internal labyrinthine passages are required to assume that all air inlet passages are completely blocked. The thermal response must be calculated assuming no heat loss to the environment. Subsection 12.2.1 of the CISF TSAR, Full Blockage of Air Inlets/Outlets, has made these assumption while analyzing this accident event.

This event is considered a design-basis accident for cask systems with inlets and outlets for natural air circulation while the cask is in the storage area. Four of the six proposed cask systems have these features: TranStor™ (Sierra Nuclear Corporation, 1995), NUHOMS® MP187 (VECTRA Technologies, Inc., 1995), and Large and Small MPC (Westinghouse Government and Environmental Services, 1996a,b). The event is expected to last for the duration between successive monitoring intervals, which is dependent on the expected temperature characteristics of each cask system. A buildup of debris from strong blowing winds; a large sand, snow, or ice storm; an avalanche; a flood; or a landslide may initiate this event.

The cask system is an important to safety SSC required to function during this event. The thermal design of ventilated cask systems should withstand a complete blockage of the air inlets and outlets over the duration between cask surveillance; the impact should be mitigated within a specified time period. This requirement necessitates scheduled surveillance of the performance of storage system vents using thermal monitor readings. Thermal monitors are located near the outlet vents. The proposed interval between temperature surveillance at the CISF is 24 hr (U.S. Department of Energy,

1998a). The thermal monitor itself, however, is not an important to safety item because its failure will be easily detected through output data surveillance and trending. For example, the vented air temperatures should trend consistently with the changes in ambient temperature and between storage units. Moreover, failure of the monitoring system is unlikely to coincide with a blockage event.

The bird/debris screen is provided for all cask vents to prevent most debris from entering into the air cavity. These screens may themselves become blocked by debris. Hence, this cask feature is not relied on to prevent this event.

Thermal monitor surveillance is a LCO surveillance requirement to ensure successful detection and mitigation of a blocked vent condition within vendor analysis assumptions for this event. Daily checks of thermal monitoring system indications will provide the capability for detecting elevated temperatures indicative of blocked vent conditions and malfunctions of the thermal monitoring system. No other facility design features, besides the thermal design of the cask system along with the LCO, are required for detection or mitigation of this event. Several defense-in-depth facility design features and administrative controls, however, are provided that reduce the likelihood of occurrence of this event or allow prompt detection of the event. These features, as identified in Table 15-1 of this AR, are

- Bird/Debris screen: provides a barrier to prevent most debris from entering the air cavity
- Facility Fence: provides a barrier to minimize off-site debris intrusion into the storage area under high wind condition
- Material Control Program: minimizes material brought into or left in the storage area that could potentially block the vents
- Security Patrols: provide detection of conditions conducive to blocking of vents
- Cask Vent Surveillance: provides prompt detection of blocked vents after a meteorological or other phenomena through visual inspection

It should be noted here that the TranStor™ storage casks currently do not meet the CISF criterion for full blockage of air inlets and outlets (Bader 1998). A thermal evaluation of this cask system is necessary involving a complete loss of natural circulation initiated by strong blowing winds; a very large sand, snow, or ice storm; an avalanche; a flood; or a landslide.

15.4.2.9 Tornadoes and Missiles Generated by Natural Phenomena

Reviews of potential consequences from design basis tornados and missiles generated by natural phenomena on the CISF important to safety SSC included Subsections 12.2.5, Extreme/Tornado Winds, and 12.2.13, Tornado Missiles, of the CISF TSAR (U.S. Department of Energy, 1998a) and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b) to verify conformance with 10 CFR 72.122(b)(2). In addition, information presented in Wagstaff (1998) and Bader (1998) was also reviewed in analyzing potential consequences from this event. This review was conducted in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). It was presumed that the site personnel will not have prior warning before the CISF SSC are impacted by a potential design basis tornado missile.

Characteristics of the design basis tornado and missiles are given in Chapter 3 [Subsections 3.3.1.1, Tornado (Wind Load) and 3.3.1.2, Tornado (Missile Spectrum)] of the CISF TSAR. Because the site for locating the CISF is yet to be selected, the TSAR developed the characteristics of the tornado and missiles from worst-case conditions. Design basis tornado characteristics were based on Regulatory Guide 1.76 (U.S. Nuclear Regulatory Commission, 1974). Three design basis tornado missiles are based on Spectrum I missiles of Subsection 3.5.1.4, Missiles Generated by Natural Phenomena, of NUREG–0800 (U.S. Nuclear Regulatory Commission, 1987). These missiles include an automobile (a massive high kinetic energy missile that will deform on impact), an armor piercing artillery shell (a rigid missile to test penetration resistance), and a 1-in. solid steel sphere (a small rigid missile of a size sufficient to pass through openings in protective barriers). The first two missiles are assumed to impact at normal incidence. The last missile impinges on the barrier openings in the most damaging directions. These objects are postulated to be picked up and transported by the winds of a design basis tornado. These objects may impact on the CISF structures, storage casks, and other SSC exposed to the environment.

Important to safety SSC that may be impacted by tornado wind are (i) cask system, (ii) transfer facility blowout panels, and (iii) transfer facility superstructure.

The cask system is required to function in the analysis of this event. Storage cask systems to be used in the CISF should be designed to structurally withstand the pressure drop and wind loads associated with this event. The wind load associated with the design basis events should not be capable of tipping over or overturning storage casks. Additionally, the associated pressure drop should not adversely affect the storage casks. Thermal monitors for ventilated storage systems are defense-in-depth features for detecting elevated temperatures near the outlets indicating a blocked vent condition as a result of high wind at the CISF site. These monitors are not considered important to safety features as failure of a monitor will be easily detected from the trend in the output data.

After an extreme wind or a tornado event, all storage casks and the outlets of all ventilated storage systems will be inspected and cleared of debris. Additionally, the operability of the inter lid pressure monitoring system and alarm board panel will be examined. Necessary repairs to damaged pressure transducers or alarm boards will be performed.

The superstructure of the transfer facility and blow out panels are important to safety events required to function during an extreme wind event. The wind load from a design basis extreme wind and tornado, given in Tables 3.4-3 and 3.4-1 of the CISF TSAR, is not capable of overturning the CISF transfer facility. Section 7.4, Reinforced Concrete Structures-Important to Radiological Safety, QA–1 of the CISF TSAR examined the overturning moments and pressure drop for the transfer facility from the wind loads. The rollup doors of the transfer facility are designed to blow out at 1 psi to limit the internal pressure of the building. Two defense-in-depth administrative controls have been imposed to allow prompt detection of blocked vents as a result of this event.

- Thermal Monitor Surveillance: limiting condition for surveillance requires daily check of thermal monitors for detecting elevated temperatures indicating blocked vents and malfunctions of the monitoring system as part of LCO surveillance

- Cask Vent Surveillance: requires visual inspection of cask vents following meteorological or other phenomena conducive to blocking the vents to promptly detect blocked vents and potential explosion damage

Important to safety SSC vulnerable to tornado missile impact are (i) cask system, (ii) site transfer trailer, (iii) site transporter, (iv) transfer facility missile walls, and (v) transfer facility superstructure. These SSC are required to function during this design basis event. Cask systems should be designed to prevent tipover or significant shielding damage as a result of a credible tornado missile. Site transporters and transfer trailers associated with the cask systems must be designed not to overturn on impact with a design basis tornado missile.

The transfer facility missile walls and superstructure are designed to structurally withstand the impact of the spectrum of tornado missiles. The transfer facility superstructure provides tornado missile protection for the entire transfer facility through reinforced concrete walls and roof. Tornado missiles that enter the facility through the exterior doors are prevented from impacting the canister transfer area by a labyrinth of missile protection walls. Additionally, openings in the roof and walls are provided with missile protection barriers where necessary. No defense-in-depth features have been identified for this event.

After a tornado missile event, radiological surveys and visual inspections will be performed in the storage area to identify potentially damaged storage casks. If high local dose rates or substantially damaged storage casks are discovered, the damages will be repaired in accordance with approved procedures identified in vendors SARs. A functional verification of operability of the containment (inter lid pressure) monitoring system and alarm board panels will be performed. Necessary repairs to damages will be performed.

There is no radiological release or adverse effect important to safety functions of the cask systems in the transfer facility. In the storage area, however, a tornado missile can locally penetrate or crush the gamma-neutron shielding overpack, or locally reduce the structural thickness of the concrete cask. By design of the storage casks, the consequences from this event should be limited to a local increase in dose rate. Inspections following a tornado event will identify the casks with shielding damage and recovery operations will be implemented on an emergency basis. These recovery operations include minimizing occupational radiation exposure and potential for off-site releases. Temporary and alternative shieldings will be provided, if needed, without significant occupational exposures.

Review of the response to RAI 12-8 and Bader (1998) shows that all six cask systems proposed for CISF currently satisfy the criteria for tornadoes and missiles generated by natural phenomena.

15.4.2.10 Accidents at Nearby Sites

The site for the CISF has not been determined, so specific accidents at nearby sites are left for the site-specific safety analysis. Transportation and other general events that might affect the CISF however, are considered in the accident scenarios presented in the CISF TSAR.

15.4.2.11 Accidents Associated with Pool Facilities

There is not a pool facility at the CISF. Therefore, this section is not applicable to the AR.

15.4.2.12 Building Structural Failure on to Structures, Systems, and Components

Section 7.4, Reinforced Concrete Structures-Important to Radiological Safety, QA–1, of the CISF TSAR (U.S. Department of Energy, 1998a) evaluates the transfer facility structure for response to overpressure, seismic events, tornadic winds, and tornadic missiles. The facility structure is designed to survive these events. Therefore, the structure will protect the SNF during these events and prevent the release of hazardous materials. No further review was completed for this event.

15.4.2.13 Failure of Primary Confinement Boundary

Reviews of the failure of primary confinement boundary accident event at the CISF included Subsection 12.2.6, Failure of Primary Confinement Boundary, of the CISF TSAR (U.S. Department of Energy, 1998a) and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b). This review was conducted in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

This event is postulated to occur for a bolted cask closure system, such as the NAC STC system (Nuclear Assurance Corporation International Services, Inc., 1994), in the storage area of the transfer facility when radioactive gases leak from the fuel basket past failed primary confinement boundary seals through a single outer lid seal to the environment. The primary confinement boundary of the dual-lid NAC STC system is the inner lid and its penetrations, which are protected by two metallic o-rings. Failures of both o-ring seals and storage cask confinement monitoring system are necessary for this event to take place.

Failure of both o-rings may be caused by mishandling during handling, transfer, transport, storage operations, or by other severe accident events, (e.g., cask drop, earthquake, and others). Probability of occurrence of this event is low, as it requires failure of two redundant o-rings and the pressure transducer in the inter lid cavity.

The effects and consequences of this accident event are bounded by the hypothetical loss-of-confinement event. The design of the cask includes features that limit the leakage to an established maximum on single failure of a confinement boundary seal and provide a continuous seal monitoring capability. Following the allowed leakage during normal conditions of transport under 10 CFR Part 71, the leakage rate test criterion for each seal of the NAC STC cask system is not to exceed 2.2×10^{-5} std-cm^3/sec. To ensure that radioactive fission gases from the cask cavity do not escape to the outside environment during storage, the inter lid region is pressurized to 7.7 psig (53 kPa) and a pressure transducer in the inter lid region monitors the pressure. An alarm will be activated if the pressure drops below the set point (U.S. Department of Energy, 1998a).

Pressure monitor surveillance is a LCO surveillance requirement for this event. Daily checks of the interseal pressure monitoring system indications provide the capability for detecting pressure changes indicative of a seal failure as well as malfunctions in the monitoring system.

10 CFR 72.236(e) includes provisions for continuous seal monitoring capability. This pressure monitoring system, however, has been considered as a defense-in-depth feature instead of an important to safety SSC, in accordance with Section 7.V.2 of NUREG–1536 (U.S. Nuclear Regulatory Commission, 1997).

The dose resulting from this accident event has been analyzed by the cask vendor (Nuclear Assurance Corporation International Services, Inc., 1994) and is beyond the scope of this review. Important to safety functions that may be affected by this event are the limited loss of SNF confinement, radiation protection, and SNF retrievability (U.S. Department of Energy, 1998). NAC (1994) had combined the doses from krypton-85 and tritium to obtain the total dose rate from gaseous release from the postulated leaking cask. The total dose from this small loss of confinement event was several orders of magnitude lower than the limit established in 10 CFR 72.106(b) for design basis accident events. Therefore, the CISF TSAR concluded that the effect on the radiation protection function is insignificant. Recovery action at the CISF, however, must be undertaken to replace the damaged seals or restore the SNF confinement.

Recovery action should be initiated within the time frame specified by the vendor to ensure restoration of SNF confinement (U.S. Department of Energy, 1998). When a seal leakage alarm activates, the site personnel will assess the function of the inter lid pressure monitoring system. If the system is functioning correctly, the suspect NAC STC cask will be moved from the storage area to the transfer facility for leak assessment. If the inner lid seals are determined to have failed, the options for recovery would depend on the severity of the leak. If the leak is small, it may be possible to simply repressurize the inter lid region. For larger leaks involving gross failure of the inner lid confinement system, it may be necessary to seal-weld the inner lid and the vent and drain port covers closed (Bader, 1998; U.S. Department of Energy, 1998). After successful leak tests of welds, the inter lid region should again be tested for leakage.

15.4.3 Nonmechanistic Failure of the Confinement Boundary

Accidents involving nonmechanistic failure of the confinement boundary at the proposed CISF are reviewed in this section. The postulated accidents are required to demonstrate that the regulatory dose limits are not exceeded even for a direct release of fission products and crud from the stored SNF.

15.4.3.1 Pressurization

Reviews of the pressurization event in the CISF TSAR included Subsection 12.2.11, Pressurization, of the CISF TSAR (U.S. Department of Energy, 1998a) and responses to RAIs 12-3 and 12-8 (U.S. Department of Energy, 1998b). This review was conducted in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

The pressurization event is postulated to occur to SNF storage systems when 100 percent of the fuel rod cladding ruptures releasing all fuel rod fill gases (primarily helium) and 30 percent of the fission product gases. There is a potential for breach of the canister or cask confinement system from the internal pressure from fuel rod fill and fission product gases if the structural integrity of the cask/canister is compromised.

There is no known mechanism that will result in complete failure of all fuel rod cladding. This nonmechanistic event is postulated to establish a conservative design maximum internal pressure resulting from this improbable event. This event is applicable only to the storage systems.

The structural consequences from a pressurization event are evaluated in storage cask vendor SARs. All cask systems certified for use in the CISF should be structurally designed to withstand the

internal pressures produced by this hypothetical event. The CISF TSAR states that all proposed cask systems proposed for CISF meet the structural requirements except HI-STAR 100 (Holtec International, 1994). Additional analyses are necessary to demonstrate that the HI-STAR 100 cask will meet the structural requirements.

15.4.3.2 Loss of Confinement

Reviews of loss of confinement accident event included Subsection 12.2.9, Loss of Confinement, of the CISF TSAR (U.S. Department of Energy, 1998a) and responses to RAIs 12-3, 12-8, and 12-13 (U.S. Department of Energy, 1998b). This review was conducted in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

The loss of confinement event can take place when redundant seals or welds of one canister/basket containing SNF fail, releasing radioactivity. Only the gaseous fission product has been considered in the analysis because solid particles will not escape in significant amounts and generally will be deposited close to the release point. To determine the maximum radiological consequences on the immediate environment, this bounding design basis accident involving a nonmechanistic failure of all fuel rods has been analyzed. There is no credible mechanism resulting in a complete failure of all fuel rod cladding and failure of the confinement boundary. Failure of the confinement boundary can only be caused by a cask drop. NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000), however, requires that the accident analysis should take into account not only the gaseous nuclides but also radioactivity from other radionuclides. The site-specific CISF SAR must provide an analysis for the loss of confinement accident event taking into account all types of radioactive material.

Analysis of this hypothetical loss of confinement accident is specific to each storage cask system. On complete failure of the confinement boundary with failure of all fuel rods, all fission products that have migrated to the fuel-cladding gap are assumed released to the environment. The storage cask system is the only important to safety SSC required to function during this event. In accordance with 10 CFR 72.106, each cask system to be used in the CISF must satisfy the dose criteria of 5 rem TEDE to the whole body, a total of the deep-dose equivalent and committed dose equivalent to an individual organ or tissue, other than the lens of the eye of 50 rem, 15 rem lens dose equivalent, and 50 rem shallow dose equivalent to skin or extremity, received by a member of the public at the controlled area boundary by this loss of confinement event. In addition, all cask systems certified for CISF should be designed and analyzed to withstand all credible design basis event with no significant loss in confinement capability. The consequences from a loss of confinement event depend on the type of fuel assemblies (PWR or BWR), quantity of fuel in the canisters/cask with its burn-up characteristics, and time elapsed since the fuel assemblies have been removed from the reactor core. The CISF TSAR shows that five proposed cask systems currently satisfy the criterion. The NUHOMS® MP187 system (VECTRA Technologies, Inc., 1995) is approved only under 10 CFR Part 71 and will require additional analyses under 10 CFR Part 72 to demonstrate that it satisfies the confinement criterion.

No CISF facility features are identified as important to safety for this accident event. Two defense-in-depth facility features, however, are provided that allow prompt detection of the event and mitigate the consequences:

- HEPA in HVAC System: provides for continuous HEPA filtration of the exhaust from transfer facility for ALARA

- Sampling of Cask Cavity Gases: provides for sampling the cask annular space prior to removal of the cask lids of the canistered system and filtering effluent prior to discharge to the HVAC system

Recovery of a suspect cask/canister for canister-based cask systems begins with retrieving the suspect cask/canister from the storage area and taking it to the transfer facility for necessary corrective action. The suspect canister will be transferred to a transportation cask for shipment to a facility capable of further recovery actions or other storage over-pack approved for storage confinement system recovery. The canister can be returned to storage subject to the monitoring requirements of the recovery system. These operations may involve transferring the SNF assemblies to another canister or repairing the suspect canister.

Recovery operations for a suspected cask system without a canister involve transferring it from storage to the transfer facility. Confinement of individual SNF assemblies is provided by a redundant welded seal or a mechanical closure system.

Systems with redundant welded seals will be inspected for the source of leakage and then repaired using approved procedures and original manufacturer fabrication standards. Repairs will reestablish the original design features including redundant seal welds.

Casks with a mechanical closure system, such as NAC STC (Nuclear Assurance Corporation International Services, Inc., 1994), will be inspected and faulty seals repaired. If the cask monitoring system detects the leak of the lid seal, the suspect NAC STC will be taken to the transfer facility for further evaluation and necessary recovery actions once the function of the inter lid pressure monitoring system is established. After confirming the leakage from the inter lid region, the faulty seal will be replaced followed by reestablishing the closure, repressurizing the inter lid region with helium, and retesting the inter lid for leakage. When a leak at the outer lid closure system is corrected, no further recovery actions are necessary. After reconnecting and testing the inter lid pressure monitoring system, the cask will be returned to storage.

If leakage through the secondary outer lid of the cask cannot be confirmed, primary closure systems associated with the inner lid will be tested. If the leakage rate into the cask cavity is sufficiently slow, allowing an appreciable amount of storage before pressure equilibrium between the cavity and the inter lid region, the recovery operations will include (i) reinstalling the outer lid of the cask, (ii) reestablishing the inter lid region design pressure by filling with more helium, (iii) determining the leakage rate into the cask cavity through periodic measurements of the inter lid cavity pressure, and (iv) verifying that the leakage rate is sufficiently low so as to allow continued storage and monitoring of the cask before undertaking additional recovery actions.

If the rate of leak is sufficiently large to preclude returning to a normal storage condition with enhanced monitoring and maintenance, the actions taken depend on the leak rate. If the leak rate allows sufficient time, necessary facilities will be acquired and the inner lid seals replaced. If sufficient time is not available to provide necessary facilities to replace the seals, the recovery operations will include (i) seal-weld inner lid, (ii) perform helium leak tests of seal welds using the seal test ports, (iii) reinstall the lid after successful completion of the test, (iv) fill inter lid region with helium, and (v) retest inter lid region for leaks. After reconnecting and testing the inter lid pressure monitoring system, the cask will be returned to the storage area for normal storage operation.

However, whether a damaged canister can be shipped to another facility for further recovery actions after transferring in the currently approved transportation cask is still an issue that needs to be resolved. The site-specific CISF SAR must develop and discuss a contingency plan for handling and recovery of damaged canisters.

15.4.4 Other Nonspecified Accidents

This category of accidents is intended to cover all other accident scenarios that do not fall into the categories identified in Subsections 15.4.1, Off-Normal Events, 15.4.2, Accidents, and 15.4.3, Nonmechanistic Failure of the Confinement Boundary, as described previously. There are no nonspecified accidents evaluated in the CISF TSAR.

15.5 Evaluation Findings

The staff has reviewed the information presented in Chapter 12, Accident Analysis, of the CISF TSAR (U.S. Department of Energy, 1998a) along with responses to RAIs (U.S. Department of Energy, 1998b) and other supplementary documents provided by the DOE. The staff assumed that information specific to one of the proposed cask storage systems will be available in vendors SARs. Demonstration of compliance with applicable regulatory requirements will be given in these vendor SARs. The cask vendor interface criteria for each of the off-normal and accident events have been identified, however. As the location for the CISF is not selected yet, the CISF TSAR does not contain site-specific information. In addition to the DBEs for the generically sited CISF, the site-specific CISF SAR will include, at a minimum, analysis of aircraft impact, avalanche, cooling tower collapse, landslide, natural gas power plant events and pipeline accidents, soil shrinkage/swelling, and associated consolidation and coastal erosion events. (U.S. Department of Energy, 1998a).

15.5.1 Off-Normal Events

The staff has reviewed the information presented in the Off-Normal Events section of the CISF TSAR and found reasonable assurance that the design of SSC and analysis satisfy the requirements for off-normal events as far as possible for this non-site-specific CISF installation under 10 CFR 72.24, 72.90, 72.92, 72.94, 72.104, 72.106, 72.122, 72.124, 72.126, 72.128, and 72.236. The following evaluation findings were made.

15.5.1.1 Cask Drop Less Than Design Allowable Height

- The staff has reviewed the information presented in the CISF TSAR, responses to the NRC RAIs, and the referenced documents, and has reasonable assurance that the analysis of cask drop less than design allowable height is bounded by the drop accident in conformance with the requirements of 10 CFR 72.128(a)(2).

15.5.1.2 Partial Vent Blockage

- The staff has reviewed the information regarding partial vent blockage presented in the CISF TSAR and the referenced documents and has reasonable assurance that the radiological consequences from the partial vent blockage event will be well below the normal operating exposures, in accordance with the requirements of 10 CFR 72.122(b)(2).

15.5.1.3 Operational Events

Canister Misalignment

The staff has reviewed the information presented with regard to canister misalignment and found reasonable assurance that the important to safety functions at the CISF will not be affected as a result of a canister misalignment provided the site-specific CISF SAR presents the following information, either directly or by reference to the vendor SARs or CoCs to satisfy the requirements of 10 CFR 72.122(h)(5), 72.124(a), and 72.236(c):

- Maximum ram pressure applied during pushing/pulling action of a horizontal canister transfer operation will not cause significant structural damage or a loss of confinement.
- No significant structural damage or loss of confinement will occur as a result of an impact during the lowering or raising of the canister by a crane with a vertical canister transfer.

Failure of Instrumentation

- The staff has reviewed the information presented in the CISF TSAR, responses to the NRC RAIs and the referenced documents and found reasonable assurance that important to safety functions at the CISF will not be affected by failure of instrumentation, in accordance with 10 CFR 72.122(h)(4) and 72.122(i).

Failure of Secondary Confinement Boundary

- The staff has reviewed the information presented on failure of the secondary confinement boundary and its potential effects. The staff has reasonable assurance that the NAC STC cask system will mitigate consequences associated with a failure of the secondary confinement boundary, in accordance with the requirements of 10 CFR 72.236(e).

Loss of External Power

- The staff has reviewed the information presented with respect to potential effect of a loss of electrical power event and determined that all the important to safety functions of the CISF will not be compromised by this event if the cask systems to be used are designed to operate passively.

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- All important to safety design functions of a cask system (e.g., shielding, confinement, thermal, and criticality control) operate passively (i.e., without power) to satisfy the requirements of 10 CFR 72.122(b)(2).

Vehicular Impact

- The staff has reviewed the information presented with respect to potential hazards from a vehicular impact to the proposed CISF and determined that the information presented does

not satisfy the requirements of 10 CFR 72.122(b)(2)(ii), 72.122(h)(5), 72.124(a), and 72.236(c).

The site-specific CISF SAR must provide the following information:

- Demonstration that the massive tornado missile is indeed the bounding load for a vehicular impact for the CISF.

Handling Event

- The staff has reviewed the information presented on potential impacts of handling event and found reasonable assurance that the consequences from this event can be mitigated by the design of the transfer facility, the transfer facility cranes, and cask/canister systems and administrative controls, in accordance with 10 CFR 72.122(h)(5), 72.124(a), and 72.236(c).

The site-specific CISF SAR should provide the following information, either directly or by reference to vendor SARs or CoCs:

- Rigging equipment is designed with the proper safety margins so that a partial failure during a cask lifting operation does not occur.

15.5.1.4 Off-Normal Ambient Temperature

- The staff has reviewed the information presented in the CISF TSAR and other referenced documents. The staff has found that not all of the six proposed cask systems currently meet the temperature range requirement specified for the CISF. Additionally, the transfer facility cranes and rigging and lifting SSC associated with the cask systems are not designed yet. Therefore, no evaluation findings could be made about the applicability of these systems at the CISF based on the specified temperature range.

The site-specific CISF SAR must provide the following information:

- Design temperature differential for the concrete components should not be exceeded in extremely cold temperatures to satisfy the requirements of 10 CFR 72.90(c) and 72.122(b)(1).

- The transfer facility cranes should be designed to withstand the expected temperature range to satisfy the requirements, of 10 CFR 72.90(c) and 72.122(b)(1).

- The minimum service temperature for all lifting equipment associated with the cask systems should be at least 40 °F above the nil ductility temperature (i.e., the transition temperature from ductile to brittle behavior) of the materials of construction, according to ANSI–N14.6-1986, to satisfy the requirements of 10 CFR 72.90(c) and 72.122(b)(1).

The site-specific CISF SAR must provide the following information, either directly or by reference to the vendor SARs or CoCs:

- All cask systems to be used at the CISF should be able to structurally and thermally withstand the extreme ambient temperatures as specified in Table 3.3-8 of the CISF TSAR, in accordance with 10 CFR 72.90(c) and 72.122(b)(1).

15.5.1.5 Off-Normal Events Associated with Pool Facilities

There is no pool facility at the CISF. Therefore, this section is not applicable.

15.5.2 Accidents

The staff has reviewed the information presented in the Accidents section of the TSAR and found reasonable assurance that the design of the SSC and consequence analysis satisfy the requirements for accidents as far as possible for this non-site-specific CISF installation under 10 CFR 72.24, 72.90, 72.92, 72.94, 72.106, 72.122, 72.124, 72.128, and 72.236. The following specific evaluation findings are made.

15.5.2.1 Cask Tipover/Overturning

- The staff has reviewed the information presented in the CISF TSAR and responses to RAIs and found reasonable assurance that a tipover of a cask system will have no adverse consequences to important to safety functions, provided only NRC-certified storage cask systems are used.

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Analyses demonstrating that the casks systems will not tipover as a result of a credible CISF earthquake, explosion, handling event, tornado missile, tornado/extreme wind, or vehicular impact.

- Analyses demonstrating that the cask support frames will prevent cask/canister movements and tipovers as a result of the design basis earthquake or handling event.

- Analyses demonstrating that the rigging equipment is designed with the proper safety margins so that a partial failure during a cask lifting operation does not occur.

- Analyses demonstrating that site transporters, transfer trailers, and upenders/downenders associated with these cask systems will not overturn as a result of a design-basis earthquake, tornado missile, handling event, or a vehicular impact.

15.5.2.2 Cask Drop

- The staff has reviewed the information presented in the CISF TSAR and Bader (1997), and found that not all six proposed cask systems can currently withstand a drop from the maximum drop height established for the CISF.

The site-specific CISF SAR must provide the following information to demonstrate compliance with 10 CFR 72.128(a)(2).

- Information on the QA program under 10 CFR Part 71 for any repair or modification of a dropped transportation cask by the site personnel.

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to demonstrate compliance with 10 CFR 72.128(a)(2):

- Analyses demonstrating that the site transporters and upenders/downenders associated with the cask systems are designed to restrict the lift heights to those established for each cask system, which should be no less than the maximum handling height established for the proposed CISF.

- Analyses demonstrating that all of the cask systems proposed to be used in the CISF can withstand drops from their maximum handling height at the proposed facility without any significant effect to their important to safety design functions.

15.5.2.3 Flood

- The staff has reviewed the information presented with respect to flood hazard to the proposed CISF and found reasonable assurance that flooding will not pose a credible hazard to the proposed CISF. The selected site will be flood-dry. Additionally, the amount of available water at the CISF is insufficient to cause a tipover and total submersion of the casks.

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to demonstrate compliance with 10 CFR 72.122(b)(2):

- Analyses demonstrating that all of the cask systems proposed to be used in the CISF can withstand the maximum static pressure exerted on the cask when completely submerged in water.

15.5.2.4 Fire and Explosion

- The staff has reviewed the information presented in the CISF TSAR for fire hazard and found that it does not demonstrate compliance with the requirements of 10 CFR 72.122(c).

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.122(c):

- A fire analysis for the transfer facility using the maximum amount of diesel available from the fuel tanks of the locomotives and the heavy haul transporters, including tires, demonstrating that all QA1 SSC will continue their safety function in the event of a worst fire scenario without any assistance from the fire suppression system.

- An analysis of the potential heat load from a postulated fire of diesel spilled from the fuel tanks of the locomotives on the transportation casks, placed on heavy haul transporters that are parked in the cask queuing areas, and on the storage casks, placed on the concrete storage pads, demonstrating that the casks will be able to continue their safety functions.

- Analyses demonstrating that all of the casks proposed to be used in the CISF can continue their safety functions in the case of a fire in the vicinity of the storage pads from the postulated fire from fuel of portable electrical generators and storage cask transporters, including any brush or trash fire.

- Minimum distances between the SSC important to safety and the transportation should be based on the criterion in Regulatory Guide 1.91 (U.S. Nuclear Regulatory Commission, 1978).

15.5.2.5 Lightning

- The staff has reviewed the information presented with respect to lightning hazard of the proposed CISF and found reasonable assurance that the transfer facility would be able to withstand a lightning strike without affecting any safety functions, in accordance with 10 CFR 72.122(b)(2). However, lightning is a site-specific natural phenomenon and the DOE has committed to address this event again once the site for the CISF is selected.

The site-specific CISF SAR must provide the following information to demonstrate compliance with 10 CFR 72.122(b)(2):

- An analysis of design information showing that site-specific lightning hazard will not affect any safety function of the CISF.

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to demonstrate compliance with 10 CFR 72.122(b)(2):

- Documentation that all of the storage casks proposed to be used can withstand any thermal excursion from a lightning strike with only a localized temperature increase at the surface of the cask and still continue their intended safety functions.

15.5.2.6 Earthquake

- The staff has reviewed the information presented regarding the earthquake hazard for the proposed CISF and found reasonable assurance that the CISF can safely withstand a design-basis earthquake in accordance with the requirements of 10 CFR 72.122(b)(2). However, not all cask systems currently meet the CISF seismic load criterion.

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.90(c); 72.92; 72.122(b); and 72.128(a):

- Site-specific studies should confirm that site characteristics are acceptable and the design values of acceleration are not exceeded.

- Adequate factor of safety for cask storage pad response has been provided under seismic loads.

- Analysis and design details have been provided demonstrating that the transfer facility cranes will remain on their rails during a site-specific design earthquake.

- Storage pads are designed to prevent the casks impacting other casks or sliding from the pad as a result of the CISF design-basis earthquake.

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to satisfy the requirements of 10 CFR 72.90(c), 72.92, and 72.128(a):

- Documentation that the upenders/downenders and transfer cradles to be used for horizontal canister transfers, and cask support frames to be used for vertical canister transfers can withstand a design earthquake without affecting any safety functions.

- Documentation that the site transporters and site transfer trailers for transporting casks from the transfer facility are designed not to overturn due to a CISF design-basis earthquake.

- Analyses demonstrating that the proposed cask systems are designed to prevent a tipover during the CISF design-basis earthquake or, alternatively, can withstand a tipover event.

15.5.2.7 Loss of Shielding

- The staff has reviewed the information presented about loss of shielding event and found reasonable assurance that dose requirements at the controlled area boundary will be met if the cask systems are able to minimize the damage to structural shielding caused by credible CISF design-basis events, in accordance with 10 CFR 72.104, 72.106, and 72.236(d).

15.5.2.8 Adiabatic Heatup/Full Blockage of Air Inlets and Outlets

- The staff has reviewed the information regarding the hazards associated with full blockage of air inlets and outlets of the storage casks at the proposed CISF and found reasonable assurance all proposed storage cask systems except the TranStor™ cask systems meet the CISF criterion in accordance with 10 CFR 72.122(b).

The site-specific CISF SAR must provide the following information:

- Site characteristic that may directly affect the blockage of the vents of the storage casks should be assessed in accordance with 10 CFR 72.90(a).

- Frequency and severity of external natural and man-induced events that can block the vents of the storage casks should be assessed in accordance with 10 CFR 90(b).

- The facility should be properly cited so as to avoid any possible long-term and short-term adverse effects caused by blockage of vents of the storage casks associated with the modification of flood plains, in accordance with 10 CFR 72.90(f).

- Natural phenomena that may exist or that can occur in the region of a proposed site be identified and assessed according to their potential effects on vent blockage of the storage casks, in accordance with 10 CFR 72.92(a).

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- A thermal evaluation of the TranStor storage cask assuming a complete loss of circulation in accordance with 10 CFR 72.236(d) and (l).

15.5.2.9 Tornadoes and Missiles Generated by Natural Phenomena

- The staff has reviewed the information presented regarding the hazards associated with tornadoes and missiles generated by natural phenomena and found reasonable assurance that the CISF transfer facility superstructures and the proposed cask systems can withstand a design-basis tornado and associated design-basis tornado missiles in accordance with the requirements of 10 CFR 72.90(a), (b), (c) and (d); 72.92(a), (b), and (c); and 72.122(b)(2).

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Analyses demonstrating that the site transporters to be used for transferring a loaded cask from the transfer building to the storage pads will not overturn when carrying a loaded storage cask when struck by a design-basis tornado in accordance with 10 CFR 72.128(a)(2).

15.5.2.10 Accidents at Nearby Sites

The staff could not assess the potential for accidents at nearby facilities affecting the CISF, as the site for the CISF is yet to be selected.

The site-specific CISF SAR must analyze and provide information about any potential accidents that may affect the proposed CISF:

- Descriptions and operations at other facilities near the proposed CISF
- Analysis of any potential accidents at these facilities impact the CISF

15.5.2.11 Accidents Associated with Pool Facilities

As the CISF does not have a pool facility, accidents associated with pool facilities are not applicable.

15.5.2.12 Building Structural Failure onto Structures, Systems, and Components

Consequences from building structural failure onto SSC are bounded by other accident events.

15.5.2.13 Failure of Primary Confinement Boundary

- The staff has reviewed the information presented on failure of primary confinement boundary event and found reasonable assurance that the cask design features along with surveillance of the inter lid pressure monitoring system on a daily basis will limit the occurrence of this event.

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Analyses demonstrating that the cask systems will not tipover or overturn as a result of a credible CISF earthquake, explosion, handling event, tornado missile, tornado/extreme wind, or vehicular impact.
- Analyses demonstrating that the cask support frames will prevent cask/canister movements and tipovers as a result of the design basis earthquake or handling event.
- Analyses demonstrating that the site transporters, transfer trailers, transfer cradles, and upenders/downenders associated with these cask systems will not overturn as a result of the design basis earthquake, tornado missile, handling event, or vehicular impact.
- Analyses demonstrating that the cask systems are designed to minimize the impact to structural shielding caused by credible CISF design basis events.

15.5.3 Nonmechanistic Failure of the Confinement Boundary

- The staff has reviewed the information presented in the Nonmechanistic Failure of the Confinement Boundary section of the CISF TSAR and found reasonable assurance that the design of the SSC and analysis satisfy the requirements for nonmechanistic failure of the confinement boundary as far as possible for this non-site-specific CISF installation under 10 CFR 72.24, 72.106, 72.122, 72.126, and 72.236. The following specific evaluation findings are made.

15.5.3.1 Pressurization

- The staff reviewed the information presented on the pressurization event and found that not all of the proposed cask systems are currently designed to withstand the internal pressure postulated in this hypothetical accident.

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Analyses demonstrating that the cask systems are designed to structurally withstand the internal pressures produced when 100 percent of the fuel rod cladding has ruptured, subsequently releasing all of the fuel rod fill gases and 30 percent of the fission product gases, in accordance with 10 CFR 72.236(d).

15.5.3.2 Loss of Confinement

- The staff has reviewed the information presented on loss of confinement accident event and found that only the gaseous fission products dose requirements at the controlled area boundary will be met.

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.106:

- A verification that the closest distance from the storage area to the controlled area boundary is greater than or equal to that analyzed in the cask SARs
- An analysis of loss of confinement event including all types of radioactive materials
- A discussion of a contingency plan for handling and recovery of damaged canisters, including shipping them to an off-site facility capable of further recovery actions, in currently approved transportation casks

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to satisfy the requirements of 10 CFR 72.106:

- Doses at the site boundary caused by the loss of confinement event for all cask systems to be used at the CISF

15.5.4 Other Nonspecified Accidents

There were no nonspecified accidents to be evaluated.

15.6 References

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16 TECHNICAL SPECIFICATIONS

16.1 Review Objective

The objective of this review is to evaluate applicant proposed technical specifications, including justifications, to ensure they are completely and appropriately defined and supported. The review also determined if the AR should incorporate any additional technical specifications.

The technical specifications define the conditions deemed necessary and sufficient for safe CISF operations. The technical specifications include functional and operating limits, monitoring instruments and limiting control settings, limiting conditions, surveillance requirements, design features, and administrative controls that ensure safe operation of the facility. Each specification was reviewed for clear documentation and justification in the technical review sections of the CISF TSAR (U.S. Department of Energy, 1998a) and was documented in the associated section of this AR as necessary for safe facility operation. These technical specifications should be included in the site-specific CISF SAR. Because this was not a site-specific TSAR, a complete evaluation of all technical specifications was not possible. It was assumed that compliance with appropriate regulations by any reference to cask-specific information would be evaluated in the cask vendor SAR review.

16.2 Areas of Review

The following areas of review are addressed in Section 16.4, Conduct of Review:

Functional/Operating Limits, Monitoring Instruments, and Limiting Control Settings

Limiting Conditions

Surveillance Requirements

Design Features

Administrative Controls

16.3 Regulatory Requirements

This section identifies the portions of 10 CFR Part 72 relevant to the review areas addressed by this chapter. The applicable regulatory requirements from 10 CFR Part 72 for Technical Specifications are

- 72.24(g)
- 72.26
- 72.44(a), (c)(1-5), (d)(3), (e), (f), and (g)(1-4)

16.4 Conduct of Review

The review of Technical Specifications was accomplished using the guidelines NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). Information provided in Chapters 13, Conduct of Operations, and 14, Technical Specifications, of the CISF TSAR (U.S. Department of Energy, 1998a), responses to RAIs (U.S. Department of Energy. 1998b), and documents cited in the CISF TSAR were considered in the review.

Chapter 14, Technical Specifications, of the CISF TSAR presents the technical specifications (conditions of operation) for the five areas of review identified in Section 16.2, Areas of Review, of this AR. As noted in the CISF TSAR, the technical specifications define the necessary and sufficient conditions for safe operation of the CISF. It is also noted in the CISF TSAR that the operating controls and conditions of individual storage cask systems proposed to be used at the CISF installation must satisfy the applicable CISF limiting conditions for operation.

16.4.1 Functional/Operating Limits, Monitoring Instruments, and Limiting Control Settings

Review of this section consisted of evaluating the proposed functional and operational limits for the CISF. These limits apply to fuel and waste handling and storage conditions. These limits are necessary to (i) protect the integrity of the stored fuel or waste container, (ii) protect employees against occupational exposures, and (iii) guard against the uncontrolled releases of radioactive materials that may affect the health and safety of the public [Section 14.1, Functional/Operating Limits and Monitoring Limits/Limiting Control Settings, of the CISF TSAR (U.S. Department of Energy, 1998a)].

The operating controls or conditions that are derived from the respective cask vendor SARs are summarized in Table 16-1. Regardless of cask type, the radiation dose limit is 10 mrem/hr at 2 m from any vertical surface and the maximum removable surface contamination, prior to transfer to the storage area, is 30,000 dpm/100 cm^2 gamma-beta and 3,000 dpm/100 cm^2 alpha.

Table 16-1. Cask-specific controls and conditions (based on Table 14.1-1 of the CISF TSAR)

Control or Condition	Applicable System(s)
Maximum temperature limits for storage casks/modules	• Westinghouse Large/Small MPC Systems • Vectra NUHOMS® System • Sierra TranStor™ System
Storage cask cavity pressure maintenance requirements	• NAC STC System
Hydraulic ram maximum pressure limits	• Westinghouse Large/Small MPC Systems • Vectra NUHOMS® System
Crane lift load limitation for lifting a loaded spent nuclear fuel canister	• Sierra TranStor™ System

16.4.2 Limiting Conditions

Review of this section consisted of evaluating the LCOs, which are the lowest functional capability or performance levels for (i) equipment required for safe operation and (ii) technical conditions and

characteristics of the CISF installation required for continued operation. LCOs, as identified in Section 14.2, Limiting Conditions for Operation, of the CISF TSAR have been, or will be, developed for the (i) storage unit temperature monitors, (ii) storage unit air temperature rise, (iii) storage cask pressure monitors and remote alarms, (iv) storage cask pressure maintenance, (v) hydraulic ram system pressure monitor, (vi) hydraulic ram system pressure, (vii) crane lift load indicator, (viii) crane lift load, (ix) storage system radiation dose rate limits, and (x) cask surface contamination limits prior to storage. The transportation cask surface contamination limits prior to transport off-site are identified in Subsection 14.5.8.2.7, Radiation Protection Program, of the CISF TSAR. The transportation cask surface contamination limits prior to transport off-site satisfy the regulatory requirements of 10 CFR 71.87.

16.4.3 Surveillance Requirements

Review of this section consisted of evaluating the surveillance requirements, including frequency and scope, described in Section 14.3, Surveillance Requirements, of the CISF TSAR. The surveillance requirements have been imposed to ensure compliance with the LCOs defined in Section 14.2, Limiting Conditions for Operation, of the CISF TSAR. In addition, DOE has committed to performing visual surveillance of the cask inlet/outlet vents following (i) any temperature readings indicating vent blockage, (ii) any indication of failure of temperature monitoring system, or (iii) any meteorological or other event that can result in blockage of vents by debris or other material. Visual surveillance of the cask vents is a defense-in-depth feature used in conjunction with temperature monitoring.

16.4.4 Design Features

Review of this section consisted of evaluating Section 14.4, Design Features, of the CISF TSAR. The design features and bases for classifying the various CISF SSC were provided in Chapter 3, Principal Design Criteria, of the CISF TSAR. See Chapter 4, Structures, Systems, and Components and Design Criteria Evaluation, of this AR for an evaluation of these design criteria. The configuration control program [Subsection 14.5.8, Procedures, Programs and Manuals, of the CISF TSAR (U.S. Department of Energy, 1998a)] will be implemented to ensure proper maintenance of the CISF SSC.

16.4.5 Administrative Controls

Review of this section included the technical specifications on Administrative Controls provided in Section 14.5, Administrative Controls, of the CISF TSAR. The DOE indicated that these conditions are necessary for the safe operation of the CISF. This section was reviewed in conjunction with Chapter 13, Conduct of Operations, of the CISF TSAR to ensure that they are completely and appropriately defined and justified. Topics reviewed included Subsections 14.5.1, Responsibility; 14.5.2, Organization; 14.5.3, Qualification; 14.5.4, Training; 14.5.5, Response Plans; 14.5.6, Reviews and Assessments; 14.5.7, Technical Specification and Technical Specification Bases Control; 14.5.8, Procedures, Programs, and Manuals; 14.5.9, Reporting Requirements; and 14.5.10, Record Retention, of the CISF TSAR.

The staff has determined during the review that the technical specifications for the Facility Safety Review Committee annual audits pertaining to (i) radiation protection, (ii) nuclear safety, (iii) industrial safety including fire protection, (iv) environmental protection, (v) ALARA policy implementation, and (vi) changes in facility design or operation were not adequately defined.

The records that will be maintained, as identified in Subsection 14.5.10, Record Retention, of the CISF TSAR, must include, either directly or by reference, the list of facility records presented in Subsection 13.4.2, Facility Records, of the CISF TSAR.

Technical specifications that address the minimum facility audit frequencies were not given in the CISF TSAR.

Technical specifications that are consistent with the derived CISF shielding requirements, [i.e., storage cask systems will have peak contact dose rates (gamma plus neutron) less than 650 mrem/hr at any point on the top of the cask and the average dose rate over the entire top of the cask will not exceed 5.1 mrem/hr] were not identified.

The specific delegation of stop-work authority at the CISF was not identified in the TSAR.

16.5 Evaluation Findings

16.5.1 Functional/Operating Limits, Monitoring Instruments, and Limiting Control Settings

- The staff has reviewed the information presented in the Functional/Operating Limits, Monitoring Instruments, and Limiting Control Settings section of the CISF TSAR and found reasonable assurance that the information satisfies the requirements for the general description under 10 CFR 72.24, 72.26 and 72.44. The proposed technical specifications for functional/operating limits, monitoring instruments, and limiting control settings provide reasonable assurance that the CISF will allow safe storage of SNF provided the various cask systems are appropriately licensed and the operation control or conditions identified are properly monitored and limited.

16.5.2 Limiting Conditions

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.24(g) and 72.26:

- A summary of the overhead bridge crane lift load limits for all of the applicable storage systems proposed to be used

- A summary of the overhead bridge crane lift load limits during different stages of the canister transfer process for all of the applicable storage systems proposed to be used

The site-specific CISF SAR must provide the following information, either directly or by reference to the vendor SAR or COC, to satisfy the requirements of 10 CFR 72.24(g) and 72.26:

- A summary of the maximum allowable temperatures for all of the applicable storage systems proposed to be used

- A summary of the maximum allowable storage cask inter lid pressures for all of the applicable storage systems proposed to be used

- A summary of the maximum allowable hydraulic ram pressures for the applicable canister transfer systems

16.5.3 Surveillance Requirements

- The staff has reviewed the information presented in the Surveillance Requirements section of the CISF TSAR and found reasonable assurance that the information satisfies the requirements for the general description under 10 CFR 72.24 and 72.44. The proposed surveillance requirements provide reasonable assurance that the CISF will allow safe storage of SNF.

16.5.4 Design Features

- The staff has reviewed the information presented in the Design Features section of the CISF TSAR and found reasonable assurance that the information satisfies the requirements for the general description of SSC under 10 CFR 72.24 and 72.44.

16.5.5 Administrative Controls

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.44(c)(5):

- Technical specifications that address the Facility Safety Review Committee annual audits pertaining to (i) radiation protection, (ii) nuclear safety, (iii) industrial safety including fire protection, (iv) environmental protection, (v) ALARA policy implementation, and (vi) changes in facility design or operation

- Documentation that the records that will be maintained, as identified in Subsection 14.5.10, Record Retention, of the CISF TSAR, include the list of facility records presented in Subsection 13.4.2, Facility Records, of the CISF TSAR

- Technical specifications that address minimum facility audit frequencies

- Technical specifications consistent with the derived CISF shielding requirements, [i.e., storage cask systems will have peak contact dose rates (gamma plus neutron) less than 650 mrem/hr at any point on the top of the cask and the average dose rate over the entire top of the cask will not exceed 5.1 mrem/hr]

- Identification of the specific delegation of stop-work authority at the CISF.

16.6 References

U.S. Department of Energy. 1998a. *Topical Safety Analysis Report of Centralized Interim Storage Facility.* Vols. I and II, Rev. 1. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

U.S. Department of Energy. 1998b. *CISF TSAR Response to RAIs.* Washington, DC: U.S. Department of Energy.

U.S. Nuclear Regulatory Commission. 2000. *Standard Review Plan for Spent Fuel Dry Storage Facilities*. NUREG–1567, Final Report. Washington, DC: U.S. Nuclear Regulatory Commission.

APPENDIX A

REQUIRED SCOPE OF SITE-SPECIFIC SAFETY ANALYSIS REPORT

APPENDIX A

REQUIRED SCOPE OF SITE-SPECIFIC SAFETY ANALYSIS REPORT

The site-specific safety analysis report (SAR) must include at least the following information to satisfy the requirements of the regulations.

A. 1.5.4 Identification of Agents and Contractors

The site-specific Centralized Interim Storage Facility (CISF) SAR must provide the following information to satisfy the requirements of 10 CFR 72.22, and 72.24:

- Identification of prime agent for construction and operation.

A.2.5.1 Geography and Demography

The site-specific Centralized Interim Storage Facility SAR must provide the following information to demonstrate compliance with 10 CFR 72.24, 72.90, 72.94, 72.96, 72.98, 72.100, and 72.122:

- Information on site location including site host state and county; site latitude, longitude, and Universal Mercator coordinates; and map and aerial photographs with radial coverage extending a minimum of 8 km (5 mi) from the site
- A detailed site description indicating the site boundary and the controlled area, controlled area access points, and the distances from the boundary to significant features of the installation
- Topographic maps showing the site topography and surface drainage patterns as well as roads, railroads, transmission lines, wet lands, and surface water bodies of the site
- A description of the vegetative cover and surface soil characteristics
- Demographic information, such as current population data and projections
- A sector map of population dividing the area within an 8-km radius of the site by concentric circles with radii of 1.5, 3.0, 5.0, 6.5, and 8.0 km and by 22.5-degree segments, each segment centered on one of the 16 compass points
- Population data overlaid on a base map showing the nearby cities or towns
- Maximally exposed individual(s) identified including the rationale for selection
- A description of the land and water use within an 8-km radius from the site

A.2.5.2 Nearby Industrial, Transportation, and Military Facilities

The site-specific CISF SAR must provide the following information to demonstrate compliance with 10 CFR 72.24, 72.90, 72.94, 72.96, 72.98, 72.100, and 72.122:

- A detailed description of industrial, transportation, and military installations within the 8-km radius from the selected site, and all relevant facilities at greater distances, should be included

- A description of the products or materials produced, stored, or transported at each facility should be described along with any potential hazards to the CISF from activities or materials at the facilities

- Confirmation that there will not be a uranium fuel cycle operation near the site selected for the CISF installation so as to pose any potential hazards to the proposed CISF, the CISF design assumed no nearby fuel cycle operations

A.2.5.3 Meteorology

The site-specific CISF SAR must provide the following information to demonstrate compliance with 10 CFR 72.24, 72.90, 72.92, 72.98, and 72.122:

- Summarized data on temperature, wind speed and direction, and relative humidity collected on-site as well as at nearby weather stations

- One topographic map showing the detailed topographic features, as modified by the facility, within an 8-km radius

- Another topographic map showing profiles of maximum elevation over distance from the center of the installation out to 16 km for each of the 22.5-degree compass-point sectors

- Descriptions of the on-site measurements made, locations and elevations of the measurements, instruments used, instrument performance specifications, calibration and maintenance procedures, and data analysis procedures

A.2.5.4 Surface Hydrology

The site-specific CISF SAR must contain the following information to demonstrate compliance with 10 CFR 72.24, 72.90, 72.92, 72.98, and 72.122 :

- Characterization of the surface hydrological features of the region, area, and site including location, size, and hydrological characteristics of all streams, rivers, lakes, adjacent shore regions, and any proposed changes to site drainage features, identification of the sources of the hydrological information, types of data collected, and methods and frequency of collection

- Identification of the structures important to safety and equipment and systems that may be affected by hydrologic features

- A description of surface waters that could potentially be affected by normal or accidental effluents from the site and a list of population groups that use such surface waters as potable water supply as well as the size of these population groups, location, and water-use rates

- An adequate supporting documentation to claim the selected site is flood-dry, as indicated in ANSI/ANS 2.8–1992, taking into account probable maximum flood on adjacent streams and rivers

- A discussion of the effects of potential seismically induced dam failures on water levels of streams and rivers, if potential dam failures are necessary to identify flood design bases

- A description of potential risk of inundation from surge and seiche flooding (including the frequency and magnitudes of potential causes, wave runup, erosion, sedimentation) and any site facilities designed to guard against these processes

- An analysis of the potential hazards posed by tsunami if the selected site abuts a coastal area

- An analysis of the potential hazard caused by ice-jam flooding and a description of the history and location of ice-generating mechanisms, and any facility structures designed to protect against flooding from ice-jams

- A description of the ability of the surface and groundwater environment to disperse, dilute, or concentrate normal and inadvertent liquid releases of radioactive effluents for the full range of anticipated operating conditions, including accident scenarios

A.2.5.5 Subsurface Hydrology

The site-specific CISF SAR must provide the following information to demonstrate compliance with 10 CFR 72.24, 72.98, and 72.122:

- A description of the groundwater aquifer(s) beneath the site, the associated hydrological units, and their recharges and discharges

- A description of the results of a survey of groundwater users, well locations, source aquifers, water uses, static water levels, pumping rates, and drawdowns

- A water table contour map showing surface water bodies, recharge and discharge areas, and locations of monitoring wells to detect leakage from storage structures

- Information on monitoring wells including well head elevation, screened interval, installation methods, and representative hydrochemical analyses

- A discussion of the results of an analysis bounding the potential groundwater contamination from site operations

A.2.5.6 Geology and Seismology

The site-specific CISF SAR must provide the following information to demonstrate compliance with 10 CFR 72.24, 72.90, 72.92, 72.98, 72.102, and 72.122:

- Geologic history of the area describing its lithologic, stratigraphic, and structural conditions
- A large-scale map of the site showing surface geology and the location of major facilities
- Stratigraphic columns and cross sections of the site
- Planar and linear features such as folds, faults, synclines, anticlines, basins, and domes identified on a geologic map showing bedrock surface contours
- A description of the site morphology including areas of potential landslide or subsidence along with a topographic map showing geomorphic features and principal site facilities
- A small-scale map showing major features of the installation and the locations of all borings, trenches, and excavations with small-scale cross sections illustrating relationships among major foundations and subsurface materials, structures, and the water table
- Any physical evidence of behavior of surficial site materials during previous earthquakes
- Maps showing all potentially significant faults or parts of faults within 161 km of the site and epicenters of historical earthquakes with all capable faults (as defined in 10 CFR Part 100, Appendix A) identified
- A description of any mapped faults 300 m or longer within an 8-km area of the site
- A description of the stability of the rock (defined as having a shear velocity of at least 1,166 m/s) and soil beneath the foundations of the CISF structures
- A description of the geologic features, such as areas of potential uplift or collapse, or zones of deformation, alteration, structural weakness, or irregular weathering
- A description of the static and dynamic engineering properties of the materials underlying the site as well as physical properties of foundation materials
- A plot plan showing the locations of all borings, trenches, seismic lines, piezometers, geologic cross sections, and excavations with all CISF structures superimposed
- Plans and profiles of any excavation and backfill with compaction criteria
- A description of the water table history and anticipated groundwater conditions beneath the site during CISF construction and operation
- An analysis of rock and soil responses to dynamic loading along with estimation calculations of the liquefaction potential and safety factors

- A contour map to demonstrate that the selected site is flat without potential for slope stability problems

- A discussion of the potential effects of erosion and deposition

- A detailed discussion of potential hazards to the site from nearby volcanoes

- A description of any dissolution feature or karst deposit

- The 0.75-g peak horizontal acceleration should be the upper bounding value for the selected site. If the predicted value exceeds this limit, all analyses of the CISF installation, including storage and transportation casks affected by the acceleration, should be carried out to demonstrate safety of the installation

- The selected site should be sufficiently away from any capable fault, as defined in 10 CFR Part 100, Appendix A IV(b)(4), so that the near-surface tectonic deformation is within the range analyzed for the SSCs important to safety

- The selected site should be reasonably flat so that any issues related to instability of slopes or water channel formation may be assumed negligible. Alternatively, slope stability, water channel formation, and other related issues must be analyzed

- If the site is located in an active volcanic region, then site-specific investigations should be performed once the site for the CISF is selected to determine whether significant ash fall from volcanic eruptions is a credible loading condition. The selected site should be at sufficient distance from any potential volcanic center so that ash fall load can be eliminated from license consideration or the design of the CISF should include volcanic ash loads

A.3.5.1 Operation Description

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.11(a); 72.40(a)(5 and 13); 72.44(c)(1); 72.122(g); and 72.128:

- Confirmation that the off-normal holding area satisfies the minimum 2,300-ft distance from the site boundary criterion

- Confirmation that the CISF off-normal holding area will be equipped to monitor the outlet ventilation port temperatures and interlid pressures of the storage casks placed in this area

- Confirmation that the CISF installation and equipment are accessible to available off-site emergency facilities and services such as hospitals, fire and police departments, ambulance service, and other emergency agencies

- Clarification that the temporary site facilities will not be used to perform cask repair and maintenance operations.

- Confirmation that the CISF installation is capable of processing the anticipated number of incoming SNF shipments by considering (i) the different types of casks expected to be used and the anticipated number of each type, (ii) the time required to process a given cask type

(i.e., from the time it arrives at the CISF to the time it can be placed on the storage pad), and (iii) the limit on the number of casks that can be processed concurrently within the transfer facility building in terms of the number of available overhead bridge cranes

- A new preliminary hazards assessment that takes site-specific characteristics into consideration

- Confirmation that a CISF installation testing and maintenance program has been established for the site-specific equipment and facilities

A.3.5.3 Other Operating Systems

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.11(a); 72.24(b); 72.40(a)(13); 72.44(c)(1 and 4); 72.122(f), (g), and (k); 72.128(a); and 72.150:

- The details as to how off-site sources will be used to supplement the potable water well pump when refilling the fire protection water storage tanks

- Confirmation that sufficient redundancy, testing, and monitoring of the fire protection system water pressure sensor used to automatically engage the fire protection pumps exists

- Confirmation that the fire protection water distribution system can withstand a design basis earthquake

- Confirmation that sufficient redundancy, testing, and monitoring of the fire protection water distribution system sectional valve used to isolate breaks or valve failures exists

A.3.5.4 Operation Support Systems

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.11(a); 72.40(a)(13); 72.126(a)–(c); and 72.128:

- The level of effluent in the transfer facility building required to reroute the exhaust through the high efficiency particulate air filters.

- The anticipated length and rate of scheduled maintenance periods for the CISF installation.

- The technical basis for the percentage of casks that are anticipated to require surface decontamination.

- Clarification of how the area radiation monitor is to be used for cask transporters.

- Clarification of which areas within the transfer facility building will be equipped with the area radiation monitoring system.

A.3.5.5 Control Room and Control Area

The site-specific CISF SAR must include the following information to satisfy the requirements of 10 CFR 72.11(a):

- Clarification that the overhead bridge crane operators can adequately view operations being performed in the site transporter area from the control room

A.4.5.2 Classification of Structures, Systems, and Components

The site-specific CISF SAR must provide the following information:

- Confirmation that the concrete storage pads have been classified as important to safety structures, systems, and components (SSCs) and the analyses perform necessary to demonstrate their ability to withstand applicable design basis events to fully satisfy the requirements of 10 CFR 72.24(n) and 72.144(a) and (c).

- Confirmation that the concrete pad of the off-normal holding area has been classified as an important to safety SSC and perform the analyses necessary to demonstrate its ability to withstand applicable design basis events commensurate with the concrete storage pads to fully satisfy the requirements of 10 CFR 72.24(n) and 72.144(a) and (c)

A.4.5.3.2 Structural

The site-specific CISF SAR must provide the following information:

- Consideration of volcanic ash fall loads, if warranted by the site-specific characteristics, to satisfy the requirements of 10 CFR 72.92

- Confirmation that the potential air overpressure from all off-site and on-site explosions does not exceed 1.0 psi. If the air overpressure is shown to exceed this value, the ability of SSCs important to safety to withstand this loading condition without affecting their ability to perform their safety function will have to be demonstrated to satisfy the requirements of 10 CFR 72.94 and 72.122(c)

- An analysis to determine the site-specific potential of an aircraft impact event. An assessment of the consequences of an aircraft impact event will have to be performed if a sufficiently high probability of occurrence is determined to exist to satisfy the requirements of 10 CFR 72.94 and 72.122(c) and (h)(1)

A.4.5.3.4 Shielding, Confinement, Radiation Protection

The site-specific CISF SAR must provide the following information:

- Modified allowable accident dose limits for controlled areas that address the current regulatory requirements of 10 CFR 72.106

A.4.5.4 Design Criteria for Other Structures, Systems, and Components

The site-specific CISF SAR must provide the following information:

- Descriptions of the other SSCs subject to U.S. Nuclear Regulatory Commission approval in sufficient detail to determine the adequacy of these SSCs to perform their function and/or to ensure that they do not adversely influence important to safety SSCs to satisfy the requirements of 10 CFR 72.24(c)

A.5.5 Evaluation Findings

The site-specific CISF SARs must provide the following information:

- The criteria for inspection, maintenance, and testing as required in 10 CFR 72.122(f)
- CISF design details sufficient to assess the emergency capabilities as required by 10 CFR 72.122(g)
- Design criteria for fabrication, construction, testing, maintenance, and performance requirements in sufficient detail to show compliance with the requirements of 10 CFR 72.120(a)

A.5.5.3 Reinforced Concrete Structures

The site-specific CISF SAR must provide the following information:

- A description of the off-normal holding area in sufficient detail to satisfy the requirements of 10 CFR 72.24(b) and (c)(4). This includes the specific design criteria, material properties, and supporting structural analyses
- Margins of safety for the various structural SSCs for full compliance with the requirements of 10 CFR 72.24(d)
- Analyses of the local penetration, perforation, and spalling of tornado-generated missile impacts as required by 10 CFR 72.122(b)

A.5.5.4 Other Structures, Systems, and Components Important to Safety

The site-specific CISF SAR must provide the following information:

- Descriptions of the other SSCs important to safety in sufficient detail to fully satisfy the requirements of 10 CFR 72.24 (b) and (c)(4)
- Detailed information on the material properties and descriptions for other SSCs important to safety in sufficient detail to satisfy the requirements of 10 CFR 72.24(c)(3)
- Details of the applicable codes and standards used in the design and analysis of the other SSCs important to safety to satisfy the requirements of 10 CFR 72.24(c)(4)

- Analyses demonstrating the adequacy and margins of safety of the other SSCs important to safety to satisfy the requirements of 10 CFR 72.24(d) and (i)

A.5.5.5 Other Structures, Systems, and Components

The site-specific CISF SAR must provide the following information:

- Description of the other SSCs in sufficient detail to satisfy the requirements of 10 CFR 72.24(b) and (c)(4)
- The applicable codes and standards used in the analysis of the other SSCs as required by 10 CFR 72.24(c)(4)
- Analyses demonstrating the adequacy and margins of safety of the other SSCs in sufficient detail to satisfy the requirements of 10 CFR 72.24(d) and (i)
- Design details and analyses demonstrating that other SSCs can withstand the site-specific environmental conditions and natural phenomena sufficient to show compliance with the requirements of 10 CFR 72.122(b)(1 and 2)
- Design details of the radioactive waste handling and storage SSCs sufficient to show compliance with the requirements of 10 CFR 72.128

A.6.5.2 Material Temperature Limits

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.128(a)(4) and 72.236(g):

- An analysis demonstrating that the potential for embrittlement of ferritic steels used in SSCs important to safety from the minimum temperature expected at the selected site, as defined in the site characteristics chapter of the CISF TSAR, is negligible

A.6.5.5 Fire and Explosions

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.122(c):

- A discussion of the site vegetative cover and soil characteristics to facilitate evaluation of potential fire hazards and any interaction with the CISF operation
- A discussion of potential fire hazards from nearby facilities
- A discussion of fire brigade proximity and proposed response times of the brigades to a CISF fire event
- Availability of local water supply (if any) other than the dedicated aboveground storage tanks, to serve as a backup supply for automatic sprinkler systems or manual firefighting efforts
- Fire rating of the walls, doors, and other barriers for the transfer facility, the Security

Complex, and the Water Utilities and Fire Protection structures is commensurate with the classification based on combustibility and the fire resistance rating

- A demonstration of application of National Fire Protection Association 801 Standard (National Fire Protection, 1998c)
- Fuel capacities of locomotives and trucks that bring the transportation casks to the shipping/receiving area
- Maximum number of locomotives and/or trucks that can be in the shipping and receiving area at any time
- Number of tires in the trucks and amount of fuel that they may contribute to a fire already burning in the shipping/receiving area
- A discussion on building design that contains any diesel fuel spill to prevent a large pool fire
- Use latest revisions of all applicable standards and codes
- Fire suppression system(s) for fighting any postulated fire in the transfer cells and analysis demonstrating that there will be a criticality hazard from any firefighting attempts

A.7.5.4 Analysis of Shielding Effectiveness

The site-specific CISF SAR must provide the following information to satisfy the regulatory requirements of 10 CFR 20.1201(a)(1); 72.24(c)(3) and (e); 72.104(a); 72.126(a)(6); and 72.128(a)(2), 10 CFR 20.1301(a); and 20.1302(b):

- Justification for neglecting the radial contribution for all casks beyond the third row in the shielding calculations
- Justification for neglecting the center end casks in the shielding calculation
- Justification for neglecting the effects of ground scatter in the shielding calculations
- Additional justification for neglecting the bottom air inlet vents in the shielding calculations
- An analysis of the dose contribution from on-site casks waiting to be transferred to the storage area
- An analysis of the off-site dose from transfer operations inside the transfer facility

A.9.5.1 Radionuclide Confinement Analysis

The site-specific SAR must provide the following information:

- Documentation that the dose consequences from the design events are within the regulatory limits, as prescribed by 10 CFR 72.24(k). Further evaluation findings on dose assessments are presented in Subsection 11.4.3, Dose Assessment, of this AR
- Documentation that the data sources used to estimate the quantities of radionuclides released are reliable

A.10.5.1 Organizational Structure

The site-specific CISF SAR must provide the following information:

- Specific delegation of the stop-work authority at the CISF should be defined to demonstrate compliance with 10 CFR 72.28(c)
- Specific audit frequency for the site by the U.S. Department of Energy headquarters to evaluate the application and effectiveness of management controls, plant procedures, and other activities affecting safety to demonstrate compliance with 10 CFR 72.24(h)
- Minimum audit frequency for Operational Quality Assurance of the CISF should be specified in Subsection 13.4.3, Facility Review and Audit Program, and should also be included in Section 14.5, Technical Specifications, to demonstrate compliance with 10 CFR 72.24(n)

A.10.5.3 Normal Operations

The site-specific CISF SAR must provide the following information:

- A consistent discussion of response plans and technical specifications in Subsections 13.4.1, Facility Procedures, and 14.5.5, Response Plans

A.10.5.5 Personnel Selection, Training, and Certification

The site-specific CISF SAR must provide the following information:

- A consistent discussion of transfer facility staff requirements and technical specifications in Section 13.3, Training Program, and Subsection 14.5.2.1, Transfer Facility Staff.

A.11.5.1 As Low As Reasonably Achievable Policies and Programs

The site-specific CISF SAR must provide the following information about the As Low as Is Reasonably Achievable (ALARA) policy and program:

- A description of the organizational structure of the ALARA program and the responsibilities and activities of ALARA personnel
- How ALARA principles will be achieved by minimizing contamination in accordance with 10 CFR 20.1406, through the use of proper surveys in accordance with 10 CFR 20.1701, 20.1702, and 72.126(a).

A.11.5.2 Radiation Protection Design Features

The site-specific CISF SAR must provide the following information about the installation design features:

- The site of the facility with respect to population centers and a description of the attempts that are made to locate the site away from population centers to the extent feasible

- The location of transfer routes for CISF containers and a discussion of the attempts that are made to maintain distance from the site perimeter and minimize the length of the route and interaction with other traffic

The site-specific CISF SAR must provide the following information related to access control:

- A site layout showing the CISF-controlled area and any traversing right-of-way
- A description of provisions for routing of potentially contaminated water from showers and decontamination stations to avoid unacceptable releases from the site

The site-specific SAR must provide the following information about the area radiation monitoring system and the radioactive airborne effluent monitoring system:

- The locations and types of fixed area radiation monitors and continuous airborne monitoring instrumentation should be detailed in drawings and specifications defining the CISF design

A.11.5.3 Dose Assessment

The site-specific CISF SAR must provide the following information:

- An evaluation of off-site collective radiation dose to members of the public around the CISF site
- Specific provisions precluding the release of liquid effluents from the facility
- An assessment of dose contributions to the local population from any other nuclear fuel cycle facilities within an 8-km (5-mi) radius of the CISF site
- An assessment that shows that the maximum dose to all individual organs (other than the thyroid) of a member of the public will be less than 25 mrem/yr
- An analysis that demonstrates that release to the general environment during normal operations and anticipated occurrences will be within the exposure limit given in 10 CFR 72.104
- A demonstration that the worker dose will not exceed 5 rem/yr if the cask processing rate exceeds 232 casks per year.

A.11.5.4 Health Physics Program

The site-specific CISF SAR must provide the following information about the equipment, instrumentation, and facilities at the CISF facility:

- Confirmation that the laboratory that processes the site dosimeters will be National Voluntary Laboratory Accreditation Program-accredited for that type of analysis
- Type, quantity, and locations of equipment and instrumentation for performing radiation and contamination surveys, sampling airborne radioactive material, area radiation monitoring, and personnel monitoring

The site-specific CISF SAR must provide the following information about the radiation protection program procedures:

- A commitment to review the program for content and implementation at least annually
- A detailed description of the radiation protection program procedures, or a citation of the guidance document that will be used to implement each procedure
- A description of the procedures that will be used for the respiratory protection program if airborne radioactivity makes the implementation of this program necessary

A.14.5.5 Radiological Impact of Normal Operations

The site-specific CISF SAR must provide the following information:

- An analysis to assess the potential impact on waste confinement and management from the postulated 7,800 casks to be handled by the facility.

A.15.5.1.3 Operational Events

Vehicular Impact

The site-specific CISF SAR must provide the following information:

- Demonstration that the massive tornado missile is indeed the bounding load for a vehicular impact for the CISF

A.15.5.1.4 Off-Normal Ambient Temperature

The site-specific CISF SAR must provide the following information:

- Design temperature differential for the concrete components should not be exceeded in extremely cold temperatures to satisfy the requirements of 10 CFR 72.90(c) and 72.122(b)(1).
- The transfer facility cranes should be designed to withstand the expected temperature range to satisfy the requirements of 10 CFR 72.90(c) and 72.122(b)(1).
- The minimum service temperature for all lifting equipment associated with the cask systems should be at least 40 °F above the nil ductility temperature (i.e., the transition temperature from ductile to brittle behavior) of the materials of construction, according to ANSI N14.6–1986, to satisfy the requirements of 10 CFR 72.90(c) and 72.122(b)(1).

A.15.5.2.2 Cask Drop

The site-specific CISF SAR must provide the following information to demonstrate compliance with 10 CFR 72.128(a)(2)

- Information on the quality assurance program under 10 CFR Part 71 for any repair or modification of a dropped transportation cask by the site personnel

A.15.5.2.4 Fire and Explosion

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.122(c):

- A fire analysis for the transfer facility using the maximum amount of diesel available from the fuel tanks of the locomotives and the heavy haul transporters, including tires, demonstrating that all QA–1 SSCs will continue their safety function in the event of a worst fire scenario without any assistance from the fire suppression system
- An analysis of the potential heat load from a postulated fire of diesel spilled from the fuel tanks of the locomotives on the transportation casks, placed on heavy haul transporters that are parked in the cask queuing areas, and on the storage casks placed on the concrete storage pads, demonstrating that the casks will be able to continue their safety functions
- Analyses demonstrating that all of the casks proposed to be used in the CISF can continue their safety functions in the case of a fire in the vicinity of the storage pads from the postulated fire from fuel of portable electrical generators and storage cask transporters, including any brush or trash fire
- Minimum distances between the SSCs important to safety and the transportation should be based on the criterion in Regulatory Guide 1.91 (U.S. Nuclear Regulatory Commission, 1978)

A.15.5.2.5 Lightning

The site-specific CISF SAR must provide the following information to demonstrate compliance with 10 CFR 72.122(b)(2):

- An analysis or design information showing that site-specific lightning hazard will not affect any safety function of the CISF.

A.15.5.2.6 Earthquake

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.90(c); 72.92; 72.122(b); and 72.128(a):

- Site-specific studies should confirm that site characteristics are acceptable and the design values of acceleration are not exceeded
- Adequate factor of safety for cask storage pad response has been provided under seismic loads
- Analysis and design details has been provided demonstrating that the transfer facility cranes will remain on their rails during a site-specific design earthquake
- Storage pads are designed to prevent the casks impacting other casks or slide from the pad as a result of the CISF design-basis earthquake.

A.15.5.2.8 Adiabetic Heatup/Full Blockage of Air Inlets and Outlets

The site-specific CISF SAR must provide the following information:

- Site characteristic that may directly affect the blockage of the vents of the storage casks should be assessed in accordance with 10 CFR 72.90(a)
- Frequency and severity of external natural and human-induced events that can block the vents of the storage casks should be assessed in accordance with 10 CFR 90(b)
- The facility should be properly sited so as to avoid any possible long-term and short-term adverse effects caused by blockage of vents of the storage casks associated with the modification of flood plains, in accordance with 10 CFR 72.90(f)
- Natural phenomena that may exist or that can occur in the region of a proposed site be identified and assessed according to their potential effects on vent blockage of the storage casks, in accordance with 10 CFR 72.92(a)

A.15.5.2.10 Accidents at Nearby Sites

The site-specific CISF SAR must analyze and provide information about any potential accidents that may affect the proposed CISF:

- Descriptions and operations at other facilities near the proposed CISF
- Analysis of any potential accidents at these facilities impacting the CISF

A.15.5.3.2 Loss of Confinement

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.106:

- A verification that the closest distance from the storage area to the controlled area boundary is greater than or equal to that analyzed in the cask SARs
- An analysis of loss of confinement event including all types of radioactive materials
- A discussion of a contingency plan for handling and recovery of damaged canisters, including shipping them to an off-site facility capable of further recovery actions, in currently approved transportation casks

A.16.5.2 Limiting Conditions

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.24(g) and 72.26:

- A summary of the overhead bridge crane lift load limits for all of the applicable storage systems proposed to be used
- A summary of the overhead bridge crane lift load limits during different stages of the canister transfer process for all of the applicable storage systems proposed to be used

A.16.5.5 Administrative Controls

The site-specific CISF SAR must provide the following information to satisfy the requirements of 10 CFR 72.44(c)(5):

- Technical specifications that address the Facility Safety Review Committee annual audits pertaining to (i) radiation protection, (ii) nuclear safety, (iii) industrial safety including fire protection, (iv) environmental protection, (v) ALARA policy implementation, and (vi) changes in facility design or operation

- Documentation that the records that will be maintained, as identified in Subsection 14.5.10, Record Retention, of the CISF TSAR, includes the list of facility records presented in Subsection 13.4.2, Facility Records, of the CISF TSAR

- Technical specifications that address minimum facility audit frequencies

- Technical specifications consistent with the derived CISF shielding requirements, [i.e., storage cask systems will have peak contact dose rates (gamma plus neutron) less than 650 mrem/hr at any point on the top of the cask and the average dose rate over the entire top of the cask will not exceed 5.1 mrem/hr]

- Identification of the specific delegation of stop-work authority at the CISF

REFERENCES

U.S. Nuclear Regulatory Commission. 1978. *Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants.* Regulatory Guide 1.91, Rev. 01. Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

APPENDIX B

REQUIRED SCOPE OF CASK-SPECIFIC ISSUES IN SITE-SPECIFIC SAFETY ANALYSIS REPORT

APPENDIX B

REQUIRED SCOPE OF CASK-SPECIFIC ISSUES IN SITE-SPECIFIC SAFETY ANALYSIS REPORT

The site-specific safety analysis report (SAR) must include at least the following information on the selected casks to satisfy the requirements of the regulations.

B1.5.1 Introduction

The site-specific SAR must contain the following information, either directly or by reference to cask SARs or Certificate of Compliance (CoCs), to satisfy the requirements of 10 CFR 72.22 and 72.24:

- For each vendor cask system, appropriate information must be submitted to the U.S. Nuclear Regulatory Commission (NRC) to show that the cask design criteria envelopes the site characteristics.

B. 1.5.5 Material Incorporated by Reference

The site-specific Centralized Interim Storage Facility (CISF) SAR must provide the following information, either directly or by reference to the vendor SARs or COCs, to satisfy the requirements of 10 CFR 72.44:

- Reference, in table 1.6-1 of the Topical Safety Analysis Report (TSAR), of the SAR for the Small On-site Transfer and On-site Storage Segment–Westinghouse (Westinghouse Government and Environmental Services Co., 1996b).

B.3.5.2 Spent Nuclear Fuel Handling Systems

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to satisfy the requirements of 10 CFR 72.11(a); 72.24(b); 72.40(a)(5 and 13); 72.44(c)(1); 72.122(g); 72.124(a); 72.128(a); 72.150; and 72.166.

- The provisions that will be made to ensure the canister for the VECTRA NUHOMS®-MP187/HSM System will not be damaged by a site-specific design basis earthquake, tornado, or tornado missile to the extent that the storage area would become inaccessible to off-site emergency facilities and services and/or nuclear criticality safety is compromised if they were to occur during the canister transfer process.

- Details of the contamination control device to be used during canister transfer operations.

- Analyses demonstrating that the site transporters are not susceptible to overturning during a design-basis earthquake or when struck by a design-basis tornado missile when transporting a cask loaded with spent nuclear fuel (SNF).

B.4.5.1 Materials to Be Stored

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- A summary of the type of SNF, maximum allowable enrichment of the fuel prior to irradiation, burn-up, minimum acceptable cooling time of the SNF prior to storage in the cask, maximum heat to be dissipated, maximum SNF loading limit, condition of the SNF, and the inert atmosphere requirements for each cask system proposed to be used at the CISF installation to satisfy the requirements of 10 CFR 72.11 and 72.24(c)(2).

B.4.5.3.1 General

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Confirmation that the specific cask systems identified for use at the CISF in the site-specific SAR bound the applicable CISF design criteria to satisfy the requirements of 10 CFR 72.24(c)(2).

B.4.5.3.4 Shielding, Confinement, Radiation Protection

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Confirmation that the specific cask systems identified for use at the CISF in the site-specific CISF SAR satisfy the radiological protection design criteria defined in Subsection 3.3.4, Radiological Protection, of the CISF TSAR and satisfy the regulatory requirements of 10 CFR 72.126.

- Confirmation that the specific cask systems identified for use at the CISF in the site-specific CISF SAR satisfy the confinement regulatory requirements of 10 CFR 72.122(h)(1).

B.4.5.3.5 Criticality

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Confirmation that the specific cask systems identified for use at the CISF in the site-specific CISF SAR satisfy the criticality regulatory requirements of 10 CFR 72.124.

B.4.5.3.6 Decommissioning

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Confirmation that the specific cask systems identified for use at the CISF in the site-specific CISF SAR satisfy the decommissioning design criteria requirements of 10 CFR 72.130.

B.4.5.3.7 Retrieval

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Confirmation that the specific cask systems identified for use at the CISF in the site-specific CISF SAR will not be placed in potentially unanalyzed drop accident conditions or scenarios to satisfy the requirements of 10 CFR 72.24(c).

- Confirmation that the specific cask systems identified for use at the CISF in the site-specific CISF SAR comply with the retrieval capability design criteria requirements of 10 CFR 72.130 and 72.236(m).

B.4.5.4 Design Criteria for Other Structures, Systems, and Components

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Confirmation that the specific cask systems identified for use at the CISF in the site-specific CISF SAR either bound the appropriate CISF design criteria or that they will not be placed in potentially unanalyzed conditions or scenarios to satisfy the requirements of 10 CFR 72.24(c) and 72.120(a).

B.5.5 Evaluation Findings

The site-specific CISF SAR must provide the following information, either directly or by reference to cask SARs or CoCs:

- Demonstration of compliance with the description requirements of confinement structures given in 10 CFR 72.24(b), (c)(4); 72.120(b); 72.122(f), (g), (i), (l); 72.128(a), (b); and 72.236(e), (f), (g), and (k)

- Demonstration of compliance with the design criteria requirements given in 10 CFR 72.24(c)(1), (4); 72.102(a), (b), (f); 72.120(a); 72.122(b)(1), (2), (c); and 72.236(b)

- Demonstration of compliance with the material property requirements given in 10 CFR 72.24(c)(1), (4); 72.102(a), (b), (f); 72.120(a); 72.122(b)(1), (2), (c); and 72.236(b)

- Demonstration of compliance with the structural analysis requirements given in 10 CFR 72.24(c)(2), (4), (d), (i); 72.122(b)(1), (2), (c); and 72.236(g)

B.5.5.1 Confinement Structures, Systems, and Components

The site-specific CISF SAR must provide, either directly or by reference to cask SARs or CoCs, the following information:

- Confirmation that the specific cask systems identified for use at the CISF in the site-specific

CISF SAR bound the appropriate site parameters. If actual site parameters exceed the bounds of those assumed in the vendor SAR or the cask CoC, the site-specific CISF SAR must fully address those areas affected by the variations.

B.6.5.2 Material Temperature Limits

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to satisfy the requirements of 10 CFR 72.128(a)(4) and 72.236(g):

- Calculated maximum temperature of all reinforced concrete Structures, Systems, and Components (SSCs) important to safety should meet the maximum temperature requirements stated in the CISF TSAR.

B.6.5.5 Fire and Explosions

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to satisfy the requirements of 10 CFR 72.122(c):

- Documentation that the certified cask systems can structurally withstand a 1-psi (6.9 kPa) pressure wave associated with a design basis explosion

- Documentation that the certified cask systems can withstand a design basis fire

B.7.5.2 Storage and Transfer Systems

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Documentation that the storage cask systems have dose rates (gamma plus neutron) less than 10 mrem/hr at 2 m from any vertical surface

- Documentation that the radiation streaming from storage cask vents and vertical surfaces is a small component of total dose rates (e.g., area weighted value less than 5 percent of radial surface dose rate) for all storage cask systems

- Documentation that the radiation streaming from storage cask vents and vertical surfaces has an insignificant (i.e., less than 1 percent) influence on dose rates at distances greater than 50 m for all storage cask systems

- Documentation that the storage cask systems should not have axial dose rates (gamma plus neutron) that exceed the dose rates calculated for the Large multi-purpose cask (MPC) cask (i.e., more than 650 mrem/hr at any point on the top of the cask or more than 5.1 mrem/hr averaged over the top of the cask)

- Documentation that all cask systems used on the site comply with all CISF requirements and the number of casks used and the on-site cask geometry are consistent with the site-specific CISF SAR shielding calculations

B.7.5.3 Shielding Composition and Details

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to satisfy the requirements for shielding composition and details under 10 CFR 72.24(c)(3) and (e), and 72.126(a)(6).

- Documentation that the temperature extremes that the cask may face at the CISF will not degrade the effectiveness of the shielding materials for all casks used in the CISF.

B.9.5.1 Radionuclide Confinement Analysis

The site-specific SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- The quantity of radioactive materials that could be released to the environment under normal operations and anticipated occurrences to satisfy the requirements of 10 CFR 72.24(l) and 72.104(a), (b), and (c)

- Documentation that the capability of welded and mechanical closure casks provides redundant sealing of the confinement system closure joints

- Appropriate tests to demonstrate that the cask confinement system will maintain confinement of radioactive material under normal, off-normal, and credible accident conditions

- Site-specific radiological effluent analysis of a loss of confinement under accident conditions for each cask system that will be used in the CISF, to satisfy the requirements of 10 CFR 72.106(b)

- Confirmation that the cask vendor assumptions for specific meteorological site characteristics and boundary distance are valid when an actual site is selected for the CISF

B.9.5.2 Confinement Monitoring

The site-specific SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Monitoring instrument and surveillance procedures are adequate to perform the required functions to meet the requirements of 10 CFR 72.122(i) and 72.126(c).

- The monitoring systems for mechanical seals will perform the intended functions and will incorporate a method of identification of monitor failure to meet the requirements of 10 CFR 72.24(g) and 72.126(d).

B.9.5.3 Protection of Stored Materials from Degradation

The site-specific SAR must provide the following information, either directly or by reference to cask SARs or CoCs:

- Documentation that the fuel matrix and fuel cladding are protected from degradation through appropriate temperature control
- Documentation that an inert atmosphere is used and a maximum concentration of oxidizing gases in the atmosphere is established
- Experimental results demonstrating that fuel cladding is protected from degradation if noninert gas is used

B.15.5.1.3 Operational Events

Canister Misalignment

The staff has reviewed the information presented with regard to canister misalignment and found reasonable assurance that the important to safety functions at the CISF will not be affected as a result of a canister misalignment provided the site-specific CISF SAR presents the following information, either directly or by reference to the vendor SARs or CoCs to satisfy the requirements of 10 CFR 72.122(h)(5), 72.124(a), and 72.236(c):

- Maximum ram pressure applied during pushing/pulling action of a horizontal canister transfer operation will not cause significant structural damage or a loss of confinement.
- No significant structural damage or loss of confinement will occur as a result of an impact during the lowering or raising of the canister by a crane with a vertical canister transfer.

Loss of External Power

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- All important to safety design functions of a cask system (e.g., shielding, confinement, thermal, and criticality control) operate passively (i.e., without power) to satisfy the requirements of 10 CFR 72.122(b)(2).

Handling Event

The site-specific CISF SAR provide the following information, either directly or by reference to vendor SARs or CoCs:

- Rigging equipment is designed with the proper safety margins so that a partial failure during a cask lifting operation does not occur.

B. 15.5.1.4 Off-Normal Ambient Temperature

The site-specific CISF SAR must provide the following information, either directly or by reference to the vendor SARs or CoCs:

- All cask systems to be used at the CISF should be able to structurally and thermally withstand the extreme ambient temperatures as specified in Table 3.3-8 of the CISF TSAR, in accordance with 10 CFR 72.90(c) and 72.122(b)(1).

B.15.5.2.1 Cask Tip Over/Overturning

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Analyses demonstrating that the casks systems will not tip over as a result of a credible CISF earthquake, explosion, handling event, tornado missile, tornado/extreme wind, or vehicular impact

- Analyses demonstrating that the cask support frames will prevent cask/canister movements and tipovers as a result of the design basis earthquake or handling event

- Analyses demonstrating that the rigging equipment is designed with the proper safety margins so that a partial failure during a cask lifting operation does not occur

- Analyses demonstrating that site transporters, transfer trailers, and upenders/downenders associated with these cask systems will not overturn as a result of a design-basis earthquake, tornado missile, handling event, or a vehicular impact

B.15.5.2.2. Cask Drop

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to demonstrate compliance with 10 CFR 72.128(a)(2):

- Analyses demonstrating that the site transporters and upenders/downenders associated with the cask systems are designed to restrict the lift heights to those established for each cask system, which should be no less than the maximum handling height established for the proposed CISF

- Analyses demonstrating that all of the cask systems proposed to be used in the CISF can withstand drops from their maximum handling height at the proposed facility without any significant effect to their important to safety design functions

B.15.5.2.3 Flood

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to demonstrate compliance with 10 CFR 72.122(b)(2):

- Analyses demonstrating that all of the cask systems proposed to be used in the CISF can withstand the maximum static pressure exerted on the cask when completely submerged in water.

B.15.5.2.5 Lightning

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to demonstrate compliance with 10 CFR 72.122(b)(2):

- Documentation that all of the storage casks proposed to be used can withstand any thermal excursion from a lightning strike with only a localized temperature increase at the surface of the cask and still continue their intended safety functions

B.15.5.2.6 Earthquake

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to satisfy the requirements of 10 CFR 72.90(c), 72.92, and 72.128(a):

- Documentation that the upenders/downenders and transfer cradles to be used for horizontal canister transfers, and cask support frames to be used for vertical canister transfers, can withstand a design basis earthquake without affecting any safety functions

- Documentation that the site transporters and site transfer trailers for transporting casks from the transfer facility are designed not to overturn due to a CISF design-basis earthquake

- Analyses demonstrating that the proposed cask systems are designed to prevent a tipover during the CISF design-basis earthquake or, alternatively, can withstand a tipover event

B.15.5.2.8 Adiabetic Heatup/Full Blockage of Air Inlets and Outlets

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- A thermal evaluation of the TranStor storage cask assuming a complete loss of circulation in accordance with 10 CFR 72.236(d) and (l)

B.15.5.2.9 Tornadoes and Missiles Generated by Natural Phenomena

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Analyses demonstrating that the site transporters to be used for transferring a loaded cask from the transfer building to the storage pads will not overturn when carrying a loaded storage cask when struck by a design-basis tornado in accordance with 10 CFR 72.128(a)(2).

B.15.5.2.13 Failure of Primary Confinement Boundary

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Analyses demonstrating that the cask systems will not to tip over or overturn as a result of a credible CISF earthquake, explosion, handling event, tornado missile, tornado/extreme wind, or vehicular impact
- Analyses demonstrating that the cask support frames will prevent cask/canister movements and tipovers as a result of the design basis earthquake or handling event
- Analyses demonstrating that the site transporters, transfer trailers, transfer cradles, and upenders/downenders associated with these cask systems will not overturn as a result of the design basis earthquake, tornado missile, handling event, or vehicular impact
- Analyses demonstrating that the cask systems are designed to minimize the impact to structural shielding caused by credible CISF design basis events

B.15.5.3.1 Pressurization

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs:

- Analyses demonstrating that the cask systems are designed to structurally withstand the internal pressures produced when 100 percent of the fuel rod cladding has ruptured, subsequently releasing all of the fuel rod fill gases and 30 percent of the fission product gases in accordance with 10 CFR 72.236(d)

B.15.5.3.2 Loss of Confinement

The site-specific CISF SAR must provide the following information, either directly or by reference to vendor SARs or CoCs, to satisfy the requirements of 10 CFR 72.106:

- Doses at the site boundary caused by the loss of confinement event for all cask systems to be used at the CISF

B.16.5.2 Limiting Conditions

The site-specific CISF SAR must provide the following information, either directly or by reference to the vendor SAR or COC, to satisfy the requirements of 10 CFR 72.24(g) and 72.26:

- A summary of the maximum allowable temperatures for all of the applicable storage systems proposed to be used
- A summary of the maximum allowable storage cask interlid pressures for all of the applicable storage systems proposed to be used

- A summary of the maximum allowable hydraulic ram pressures for the applicable canister transfer systems.

REFERENCES

Westinghouse Government and Environmental Services Co. 1996. *Small OST and OSS Safety Analysis Report*. MPC-CD–02–017, Rev. 01. San Jose, CA: Westinghouse Government and Environmental Services Co.