PRELIMINARY

ASSESSMENT REPORT

DOCKET NO. 72-21

U.S. DEPARTMENT OF ENERGY

TOPICAL SAFETY ANALYSIS REPORT FOR THE CENTRALIZED INTERIM STORAGE FACILITY

January 2001

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ACRONYMS

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ALARA	As Low as Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
AR	Assessment Report
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BWR	Boiling Water Reactor
CAM	Continuous Air Monitor
CCTV	Closed Circuit Television
CISF	Centralized Interim Storage Facility
CNWRA	Center for Nuclear Waste Regulatory Analyses
CoC	Certificate of Compliance
DBE	Design Basis Event
DE	Design Earthquake
DHR	Decay Heat Removal
DOE	U.S. Department of Energy
DPC	Dual Purpose Canister
DSC	Dry Shield Canister
EPRI	Electrical Power Research Institute
GSDC	Generic Site Design Criteria
HEPA	High Efficiency Particulate Air
HSM	Horizontal Storage Module
HVAC	Heating, Ventilation, and Air Conditioning
IEEE	Institute of Electrical and Electronic Engineers
ISFSI	Independent Spent Fuel Storage Installation
LA	License Application
LCO	Limiting Conditions for Operation
LLW	Low-Level Waste
LWR	Light Water Reactor
MPC	Multi-Purpose Canister
MTU	Metric Tons Uranium
NAC	Nuclear Assurance Corporation International Services, Inc.
NFPA	National Fire Protection Association
NOAA	National Oceanic and Atmospheric Administration
NRC	U.S. Nuclear Regulatory Commission
OCRWM	Office of Civilian Radioactive Waste Management
PHA	Preliminary Hazards Assessment
PMF	Probable Maximum Flood

ACRONYMS (Cont'd)

PMP	Probable Maximum Precipitation
PWR	Pressurized Water Reactor
QA	Quality Assurance
RAI	Request for Additional Information
SAR	Safety Analysis Report
SER	Safety Evaluation Report
SNF	Spent Nuclear Fuel
SRSS	Square Root of the Sum of the Squares
SSC	Structure, System, and Component
STC	Storage Transport Cask
TEDE	Total Effective Dose Equivalent
TESS	TRW Environmental Safety Systems Inc.
TLD	Thermoluminescent Dosimeters
TNT	Trinitrotoluene
TSAR	Topical Safety Analysis Report
TSC	Transportable Storage Cask
UPS	Uninterruptible Power Supply

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INTRODUCTION

The U.S. Department of Energy (DOE) submitted a non-site-specific Centralized Interim Storage Facility (CISF) Topical Safety Analysis Report (TSAR) (U.S. Department of Energy, 1997) on May 1, 1997, to the U.S. Nuclear Regulatory Commission (NRC) for safety review with respect to the requirements of 10 CFR Part 72 and other applicable NRC regulations. The DOE submitted the CISF TSAR to the NRC with the intention that its review and evaluation by the NRC staff, ahead of any site designation, will reduce the time required later for preparation of any license application and reduce subsequent licensing risks related to design and safety considerations. The intention of the DOE is also to seek the NRC issuance of a generic Safety Evaluation Report (SER) that can be referenced by the DOE in any subsequent site-specific license for the construction and operation of a CISF at a given site. However, based on the DOE decision not to include certain non-site-specific information in this TSAR, the NRC has decided to issue an Assessment Report (AR) instead of a SER.

This AR documents the NRC staff review of generic design, construction, operations, and maintenance activities described in the TSAR for the proposed CISF. The NRC staff assessment is based on the CISF meeting the applicable requirements of 10 CFR Part 72 for spent fuel (SNF) storage and handling and 10 CFR Part 20 for radiation protection. No licensing determinations have been made. In addition, the findings identified in each chapter are preliminary and subject to further review when a complete application is submitted.

Since this review began, changes have been made to the NRC regulations and staff guidance for review of dry cask storage systems. For example, a loss of confinement accident (considered in the TSAR and in this report) is no longer considered a credible event. The complete application should account for all changes to NRC guidance up to the time of the submittal.

The scope of the review is limited to the information provided in the CISF TSAR Revision 1 (U.S. Department of Energy, 1998a) that incorporates the DOE responses to the NRC request for additional information (U.S. Department of Energy, 1998b), and the references cited. Because this TSAR is not site-specific, a complete review addressing all the requirements of 10 CFR Parts 20 and 72 is not possible. Additional information that must be included in the site-specific Safety Analysis Report (SAR) of the CISF is identified. The format of this AR has been arranged according to the Standard Review Plan for Spent Fuel Dry Storage Facilities, NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). In addition, two appendices have been added to this AR summarizing the additional site-specific and cask-specific information, respectively, that must be included in the site-specific CISF SAR as stated in each Chapter.

Cask-specific information is presented as stated in the DOE documents. Most of these casks were not approved by NRC at the time of the submittals, and the licensing status of the casks continues to evolve. In addition, the name and ownership of the casks in some cases has changed and may change in the future. Therefore, new submittals must account for these changes.

REFERENCES

U.S. Department of Energy. 1997. *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. 1998a. *Topical Safety Analysis Report of Centralized Interim Storage Facility*. Vols. I and II. Revision 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, 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.

PRELIMINARY

1 GENERAL DESCRIPTION

1.1 Review Objective

The objective for the review of this chapter is to ensure that the applicant has provided a nonproprietary description of major components and operations adequate to familiarize reviewers and other interested parties with the pertinent features of the Centralized Interim Storage Facility (CISF) installation. Because this was not a site-specific Topical Safety Analysis Report (TSAR) (U.S. Department of Energy, 1998), a complete review of the installation description was not possible. It was assumed that compliance with appropriate regulations by any reference to (i) cask-specific information would be evaluated in the cask vendor safety analysis report (SAR) reviews, and (ii) site-specific information would be evaluated at a later time when the required site-specific information will be available. Additional information that must be included in the site-specific SAR of the CISF is identified.

1.2 Areas of Review

Following are the areas of review addressed in Section 1.4, Conduct of Review:

Introduction

General Description of the Centralized Interim Storage Facility Installation

General Systems Description

Identification of Agents and Contractors

Material Incorporated by Reference

1.3 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 general description are

- 72.22(a–c)
- 72.24(b), (f), and (l)
- 72.44

1.4 Conduct of Review

The CISF TSAR (U.S. Department of Energy, 1998) describes the design and operation of the proposed U.S. Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM) CISF. The CISF provides a federal temporary storage facility for spent nuclear fuel (SNF) under the oversight of the DOE. The CISF is designed as a stand-alone facility and consists of a transfer facility, storage area, and support facilities. Information presented in Chapter 1, Introduction and General Description of Installation, of the CISF TSAR (U.S. Department of Energy, 1998) and the references cited were reviewed under the general areas named in Section 1.2, General Description, of the CISF TSAR to ensure an adequate description of the CISF components and operations was provided by the licensee.

1.4.1 Introduction

Review of Section 1.1, Introduction, of the CISF TSAR (U.S. Department of Energy, 1998) included Section 1.1.1, CISF Functions, and Section 1.1.2, Schedule. The storage of SNF at the CISF is based on the use of transportable storage casks (TSCs) and canister-based storage systems certified, or to be certified, by the U.S. Nuclear Regulatory Commission (NRC) under separate dockets. For developing bounding CISF design criteria, six cask systems have been selected as the basis for CISF design. They are NUHOMS® MP187/Horizontal Storage Module (HSM) [Dual Purpose Canister (DPC) System] (VECTRA Technologies, Inc., 1995), Holtec HI-STAR 100 (TSC) system (Holtec International, 1994), Sierra TranStor™ System (DPC System) (Sierra Nuclear Corporation, 1995), Westinghouse Large Multi-Purpose Canister (MPC) System (Westinghouse Government and Environmental Services Co., 1996a), Westinghouse Small MPC System (Westinghouse Government and Environmental Services Co., 1996b), and Nuclear Assurance Corporation International Services, Inc. (NAC) Storage Transport Cask (STC) system (Nuclear Assurance Corporation International Services, Inc., 1994). These cask systems are described in the vendor SARs, and complete cask-specific information was not reiterated in the CISF TSAR. Instead, reference was made to these vendor SARs. Consequently, cask-specific information was not reviewed.

Only storage cask systems that have been licensed by the NRC will ultimately be used at the CISF installation. Cask-specific information in this assessment report is presented as stated in the DOE documents. Most of these casks were not approved by NRC at the time of the submittals, and the licensing status of the casks continues to evolve. In addition, the name and/or ownership of some the casks has changed and may change in the future. Therefore, new submittals must account for these changes.

The proposed CISF design envisions that the SNF will arrive by rail car or heavy haul truck to the CISF in various transportation cask systems. After the appropriate security and receipt inspections, the transporter carrying the cask will be taken into the transfer facility. The transportation cask will be removed from its transporter and inspected and decontaminated if necessary. TSC systems will then be transported to the storage area for interim storage.

Canister-based cask systems will require transfer of the SNF canister from the transportation cask to the storage cask. These transfers will be performed in the transfer facility or the storage area, depending on the cask system design. All transfer and handling activities will be accomplished in a dry mode using cask vendor-supplied equipment and CISF SSC (SSCs). The CISF design, as presented in the TSAR, does not employ an SNF pool or other bare fuel handling capability. The CISF is designed for a nominal storage capacity of 40,000 metric tons uranium (MTU) of SNF. The CISF is designed for a minimum service life of 40 yr with only routine maintenance, but the NRC staff has evaluated the CISF for an expected licensing period of 20 yr. License renewal will be considered by NRC subject to 10 CFR Part 70.

1.4.2 General Description of Centralized Interim Storage Facility Installation

Review of the general description of the CISF included the (i) summary of principal site characteristics (Subsection 1.2.1, Location and Site Characteristics, of the CISF TSAR); (ii) a general description of the installation (Subsection 1.2.3, Facility Descriptions, of the CISF TSAR); (iii) a brief discussion of principal design criteria (Subsection 1.2.2, Principal Design Criteria, of the TSAR); (iv) the nominal capacity of the installation (Subsection 1.2.4, Materials to be Stored, of the CISF TSAR) and the characteristics of fuel to be stored; (v) waste products to be generated during operations (Subsection 1.2.5, Waste Products Generated During Operations, of the CISF TSAR) and drawings (Figures 1.2-1 and 1.2-2 of the CISF TSAR) showing the general layout of the installation.

A location for the CISF has not been designated; however, the CISF is designed to be located in one of the contiguous 48 United States as practical, using generic site design criteria. Once a site for the CISF is selected, site investigation will be performed to quantify actual site characteristics. If any of the generic site characteristics do not conservatively bound the actual site characteristics, then the respective characteristics and associated design criteria will be revised, and changes to the design and supporting analysis will be made as necessary.

The CISF principal design criteria are based on generic site characteristics, the design criteria associated with the vendor systems, and specific facility design criteria. As much as practical, the CISF is designed to accommodate each vendor system. The vendor systems need to be certified by the NRC before use at the CISF. Once a site is designated, additional design analyses and possible design modifications to the vendor systems or the CISF may be necessary to qualify a particular cask system for use at the CISF.

Storage and handling systems will be designed to allow ready retrieval of SNF, and the cask/canister handling systems will be designed in accordance with 10 CFR 72.128(a) to ensure adequate safety under normal and accident conditions. The criteria for SNF cask systems are given in Chapter 3, Principal Design Criteria, of the CISF TSAR.

The two major facilities at the CISF are the transfer facility and the storage area. The purpose of the reinforced concrete transfer facility is to receive and prepare shipments of canistered SNF in dual purpose cask/canister systems for storage. It will also retrieve SNF from storage and prepare the systems for off-site shipment. The transfer facility is designed to withstand all normal, off-normal and accident loads created by seismic activity, tornadoes, and other natural events.

As low as reasonably achievable (ALARA) principles will be incorporated to the maximum extent practical throughout the design to reduce radiation exposure to facility personnel. Overhead bridge cranes will be remotely operated from a crane operating room. Gantry-mounted robotic equipment will be provided in the shipping and receiving area, and stationary-mounted robotic equipment will be provided in the canister transfer area. The gantry-mounted robotic equipment will be controlled from the crane operating room, and other robotic equipment will be remotely operated from shielded rooms.

The storage area is a large area comprising concrete storage pads and storage casks. The purpose of the storage area is to provide safe storage for SNF in the NRC-approved dry cask systems. The storage area is designed to store 40,000 MTU of SNF in approximately 5,300–7,800 storage casks, depending on the vendor systems deployed, and is capable of withstanding normal, off-normal and accident loads created by seismic activity, tornadoes, and other natural events. The combination of fuels to be received will be determined by the transportation and storage systems proposed to be used by the DOE in the site-specific CISF SAR and certified, or to be certified, by the NRC under separate dockets.

The remainder of the CISF will provide support functions such as fuel receipt, fuel inspection, security, and fire protection.

The SNF to be received and stored at the CISF includes commercial light water reactor (LWR) fuel—both pressurized water reactor (PWR) and boiling water reactor (BWR)—and possibly noncommercial fuel. Only fuel delivered in NRC-approved cask/canister systems, however, will be accepted at the CISF. Thus, the controls for limiting the types and forms of SNF received at the CISF are the limitations placed on the cask systems by the NRC in the issuance of Certificates of Compliance (CoCs) for those transport/storage systems.

Based on the CISF design, gaseous wastes will not be generated at the CISF; however, airborne radioactive contamination may be generated in the transfer facility in the form of aerosols of surface contamination from cask transfer operations. Potential sources of liquid radioactive wastes may result from decontamination of transportation casks in the transfer facility decontamination booth. Low volumes of solid radioactive wastes are expected from routine operations involving contamination surveillance and decontamination activities. Potential liquid and solid waste streams will be collected and temporarily stored on-site for processing and disposal by an on-site contractor.

1.4.3 General Systems Description

Review of this section included a general overview of the CISF including systems and intended operations. These sections of the CISF TSAR included Section 1.3, General Description of Systems and Operations, and Section 1.4, Analysis of Operations.

The important to safety design features at the CISF are the transfer facility structure, the two overhead bridge cranes in the transfer facility, the transfer facility overhead rollup door (which is designed to blow out in the event of a tornado due to air pressure differential), concrete storage pads, and the fire protection program. Vendor-supplied important to safety design features include the transportation casks, canisters, storage units, cask transporters, canister transfer mechanisms, and other equipment as specified in the vendor SARs.

An ALARA evaluation has been performed and several dose reduction techniques are incorporated into the design of the CISF, including the use of robotics, remote monitoring, and automatic alignment devices. The goal of the CISF ALARA program is to reach an average dose of less than 1-rem/yr for the operations staff to ensure compliance with 10 CFR Part 20 limits and administrative goals. To ensure compliance with 10 CFR 72.104(a) (dose rate to any real individual less than 25 mrem/yr) from 40,000 MTU of SNF in the storage area, the controlled area boundary is conservatively located 2,300 ft from the storage array.

The preliminary hazards assessment has been performed by the DOE to systematically identify potential radiological hazards to facility workers, the public, and the environment together with evaluating the frequencies of occurrences and their potential consequences. Existing sources of information were reviewed by the DOE, including the SARs for reference storage systems and selected site-specific independent spent fuel storage installations (ISFSIs) (Virginia Electric and Power Company, 1994; Public Service Company of Colorado, 1991; Duke Power Company, 1989; Northern States Power Company, 1994; Sacramento Municipal Utility District, 1993; Portland General Electric Company, 1996) licensed or under review by the NRC before the submittal of the TSAR. These SARs provided substantial background regarding radiological hazards at comparable facilities. Based on the preliminary and qualitative assessment of the frequencies and consequences of these events, certain events are selected and incorporated in the accident analysis (Chapter 12, Accidents, of the CISF TSAR).

For most of the accidents analyzed, there are no radiological consequences produced as a direct result of the event, and there are no impacts on important to safety design features. These negligible consequences are attributed primarily to the use of NRC approved storage systems and the satisfactory implementation of operating controls and limits. Recovery operations to restore confinement, however, may involve some occupational exposure to personnel. A nonmechanistic loss of confinement accident may result in a minimal on-site radiological consequence. The analyses results, however, indicate there are no credible accident scenarios for the CISF that will result in a loss of confinement or a radiological release in excess of the radiological dose criterion of 10 CFR 72.106.

Highest priority is given by DOE ensuring that all operations will be conducted safely. This policy is implemented through a consolidated safety management program that entails radiation protection, conduct of operations, and quality assurance (QA).

The radiation protection program is designed to ensure that all operations will be performed in a manner that ensures occupational exposures are maintained within prescribed regulatory limits and will be ALARA. ALARA considerations have been integrated into the design of the CISF and will be incorporated into all operating procedures. The conduct of operations program is designed to ensure that the CISF is operated in a professional and safe manner. The activities associated with the CISF will be governed by the applicable portions of the DOE QA program as described in Chapter 15, Quality Assurance, of the CISF TSAR. The OCRWM QA program is designed to meet the requirements of 10 CFR Part 72, Subpart G.

1.4.4 Identification of Agents and Contractors

Review of identification of agents and contractors (Section 1.5, Identification of Agents and Contractors, of the CISF TSAR) included identification of the organization with responsibilities for design, construction, and operation of the proposed installations. The DOE is responsible for the design, analysis, construction, and operation of the CISF, as well as for providing QA services. Duke Engineering & Services, Inc., a teammate of TRW Environmental Safety Systems Inc. (TESS), has the lead responsibility for the CISF design. TESS provides management oversight. The prime agent for the construction and operation of the CISF will be determined after site selection and will be identified in the license application (LA). The storage units that are used in the CISF are designed and made by other organizations and will be purchased by the DOE. The storage unit suppliers are responsible for storage unit construction, testing, and delivery to the site. The DOE is responsible for confirming that vendor-supplied storage casks are within specification prior to use at the CISF.

1.4.5 Material Incorporated by Reference

Review of material incorporated by reference included enumeration of all documents incorporated in the CISF TSAR in a tabulated form. The CISF TSAR (Table 1.6-1) has incorporated SARs of five cask systems by reference: (i) Safety Analysis Report for the NUHOMS® MP187 Multi-Purpose Cask (VECTRA Technologies, Inc., 1995); (ii) Safety Analysis Report for Packaging for the Holtec International Storage, Transport and Repository Cask System [HI-STAR 100 Cask System, (Holtec International, 1994)]; (iii) Safety Analysis Report for the TranStor™ Shipping Cask System (Sierra Nuclear Corporation, 1995); (iv) Safety Analysis Report for the Large On-site Transfer and On-site

Storage Segment—Westinghouse (Westinghouse Government and Environmental Services Co., 1996a); and (v) Safety Analysis Report for the NAC Storable Transport Cask for use at an Independent Spent-Fuel Storage Installation (Nuclear Assurance Corporation International Services, Inc., 1994). Table 1.6-1 of the CISF TSAR, however, does not list the Safety Analysis Report for the Small On-site Transfer and On-site Storage Segment–Westinghouse (Westinghouse Government and Environmental Services Co., 1996b), and no details of the cask system have been included in the CISF TSAR. Additionally, every chapter of the CISF TSAR included a reference section that tabulated all documents referred to in that chapter.

1.5 Evaluation Findings

Based on a review of the information in the CISF TSAR and documents cited in the TSAR, the following evaluation findings can be made about the CISF.

1.5.1 Introduction

- The NRC staff has reviewed the information presented in the Introduction section of the CISF TSAR and finds that the information satisfies the requirements for the introduction to a non-site-specific CISF installation under 10 CFR 72.22, and 72.24. At this time, however, it is not possible to evaluate all cask systems that may be handled at the CISF throughout the life span of the facility. The CISF TSAR analyzes a wide range of events for several types of cask systems currently in use and others under development. From this evaluation and additional requirements identified elsewhere in the CISF TSAR, a list of vendor interface requirements was developed and is provided in CISF TSAR Section 3.3.7, Satisfaction of ALARA Goals.

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

- Cask-specific information is presented as stated in the DOE documents. Most of these casks were not approved by NRC at the time of the submittals, and the licensing status of the casks continues to evolve. In addition, the name and ownership of the casks in some cases has changed and may change in the future. Therefore, new submittals must account for these changes.

- For each vendor cask system, appropriate information must be submitted to the NRC to show that the cask design criteria envelope the site characteristics.

1.5.2 General Description of Centralized Interim Storage Facility Installation

- The staff has reviewed the information presented in Section 1.2, General Description of Installation, of the CISF TSAR and finds that the information satisfies the requirements for general description of the non-site-specific CISF installation under 10 CFR 72.24.

1.5.3 General Systems Description

- The staff has reviewed the information presented in Section 1.3, General Description of Systems and Operations, of the CISF TSAR and finds that the information satisfies the requirements for the general systems description of the non-site-specific CISF installation under 10 CFR 72.22 and 72.24.

1.5.4 Identification of Agents and Contractors

- The staff has reviewed the information presented in Section 1.5, Identification of Agents and Contractors, of the CISF TSAR and found that the information does not satisfy the requirements for identification of agents and contractor of the non-site-specific CISF installation under 10 CFR 72.22 and 72.24.

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

- Identification of prime agent for construction and operation

1.5.5 Material Incorporated by Reference

- The staff has reviewed the information presented in Section 1.6, Material Incorporated by Reference, of the CISF TSAR and finds that the information satisfies the requirements for material identified by reference of the non-site-specific CISF installation under 10 CFR 72.44.

The site-specific 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 TSAR, of the SAR for the Small On-site Transfer and On-site Storage Segment–Westinghouse (Westinghouse Government and Environmental Services Co., 1996b).

1.6 References

Duke Power Company. 1989. *Independent Spent Fuel Storage Installation Safety Analysis Report.* Oconee Nuclear Station. Charlotte, NC: Duke Power Company.

Holtec International. 1994. *Topical Safety Analysis Report for the HI-STAR 100 Cask System*. HI–941184, Rev. 00. Marlton, NJ: Holtec International.

Northern States Power Company. 1994. *Prairie Island Independent Spent Fuel Storage Installation Safety Analysis Report*. Revision 3. 1994. Minneapolis, MN: Northern States Power Company.

Nuclear Assurance Corporation International Services, Inc. 1994. *Topical Safety Analysis Report for the NAC Storage Transport Cask for Use at an Independent Spent-Fuel Storage Installation*. NAC–T–90002, Rev. 03. Norcross, GA: Nuclear Assurance Corporation International Services, Inc.

Portland General Electric Company. 1996. *Trojan Independent Spent Fuel Storage Installation Safety Analysis Report.* NRC Docket No. 72-0017. Portland, OR: Portland General Electric Company.

Public Service Company of Colorado. 1991. *Fort St. Vrain Independent Spent Fuel Storage Installation Safety Analysis Report.* Revision 2. NRC Docket No. 72-009. Platteville, CO: Public Service Company of Colorado.

Sacramento Municipal Utility District. 1993. *The Rancho Seco Independent Spent Fuel Storage Installation License Application and Safety Analysis Report.* DAGM NUC 93–135, Rev. 1. NRC Docket No. 72–11. Sacramento, CA: Sacramento Municipal Utility District.

Sierra Nuclear Corporation. 1995. *Safety Analysis Report for the TranStor™ Shipping Cask System*. SNC–95–71SAR, Rev. 00. Scotts Valley, CA: Sierra Nuclear Corporation.

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.

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

Virginia Electric and Power Company. 1994. *Surry Power Station Dry Cask Independent Spent Fuel Storage Installation Safety Analysis Report.* NRC Docket No. 72-002. Charlotte, VA: Virginia Electric and Power Company.

Westinghouse Government and Environmental Services Co. 1996a. *Large OST and OSS Safety Analysis Report*. MPC–CD–02–016, Rev. 01. San Jose, CA: Westinghouse Government and Environmental Services Co.

Westinghouse Government and Environmental Services Co. 1996b. *Small OST and OSS Safety Analysis Report*. MPC-CD–02–017, Rev. 01. San Jose, CA: Westinghouse Government and Environmental Services Co.

2 SITE CHARACTERISTICS

2.1 Review Objective

The objective of the site characteristics review is to make three determinations. The first is whether the applicant has properly identified the external natural and human-induced phenomena for inclusion in the design basis of the CISF and whether the design basis levels are adequate. The second is whether the applicant has adequately characterized local land and water use and population so that important individuals and populations likely to be affected can be identified. The third is whether the applicant has adequately characterized the transport processes that could move any released contamination from the facility to the maximally exposed individuals and populations.

The results of this review determine the acceptability of site-derived design bases. The determination of whether the design basis events were properly incorporated into the proposed design is made in the design review sections of this AR (Chapter 5, Installation and Structural Evaluations). The results also determine the location of maximally exposed individuals and populations and the dilution/dispersion parameters to be used by the radiation protection reviewer in determining the impacts of normal operations and accidents. Because this was not a site-specific TSAR (U.S. Department of Energy, 1998), a complete review of the site characteristics was not possible. Furthermore, it was assumed that compliance with appropriate regulations by any reference to cask-specific information will be evaluated in the cask vendor SAR reviews. Information that must be provided in the site-specific CISF SAR is identified.

2.2 Areas of Review

Following are the areas of review addressed in Section 2.4, Conduct of Review:

Geography and Demography

Site Location
Site Description
Population Distribution and Trends
Land and Water Use

Nearby Industrial, Transportation, and Military Facilities

Meteorology

Regional Climatology
Local Meteorology
On-site Meteorological Measurement Program

Surface Hydrology

Hydrologic Description
Floods
Probable Maximum Flood on Streams and Rivers
Potential Dam Failures (Seismically Induced)
Probable Maximum Surge and Seiche Flooding
Probable Maximum Tsunami Flooding
Ice Flooding
Flood Protection Requirements
Environmental Acceptance of Effluents

Subsurface Hydrology

Geology and Seismology

Basic Geologic and Seismic Information
Vibratory Ground Motion
Surface Faulting
Stability of Subsurface Materials
Slope Stability

2.3 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 site characteristics evaluation are

- 72.24(a)
- 72.90
- 72.92
- 72.94
- 72.96
- 72.98
- 72.100
- 72.102
- 72.122

The regulatory requirements given in 10 CFR 72.40(a)(2) are based on satisfying the requirements of subsection E that includes 10 CFR 72.102. If the individual requirements are met, it can be assumed that the requirements of 10 CFR 72.40(a)(2) are met.

2.4 Conduct of Review

Chapter 2, Site Characteristics, of the CISF TSAR describes the generic site characteristics and has used this information in developing the non-site-specific design of the CISF. In the absence of any site-specific information, the CISF design is based on site characteristics selected to bound as much of the contiguous 48 United States as possible. Once a CISF site is selected, the actual site characteristics and parameters will be determined for site-specific design. If it is demonstrated that the generic site design criteria bound the site-specific values, the CISF design products may be used in the site-specific design. If any CISF design criterion does not conservatively bound the actual site characteristics, the design criterion will be revised and the design will be changed as necessary. The altered design will be verified, and the supporting analysis and changes will be documented in the site-specific CISF SAR.

2.4.1 Geography and Demography

Review of Section 2.1, Geography and Demography of Site Selected, of the CISF TSAR included site location, site description, population distribution and trends, and land and water use and was carried out in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). Section 2.1 of the CISF TSAR does not contain any information on the geography and demography of the site because the site for the CISF is yet to be selected. Section 10 CFR 72.106(b) requires that compliance be assessed with respect to the maximum potential exposure to any individual located on or beyond the nearest boundary of the controlled area. Compliance with this criterion demonstrates the overall safety of the facility. Therefore, the demography is not critical for consequence evaluation following an accident if it can be shown that the maximally exposed individual will not receive a dose greater than 5 rem to the whole body or any organ from a design basis accident. The site-specific environmental assessment, however, will evaluate the overall risks to the population using the demographic information from the site-specific CISF SAR.

2.4.2 Nearby Industrial, Transportation, and Military Facilities

10 CFR 72.94 requires that the region be examined for manmade facilities that might endanger the proposed CISF. Review of Section 2.2, Nearby Industrial, Transportation and Military Facilities, of the CISF TSAR included the locations of nearby industrial, transportation, military, and nuclear installations and their relationship with the CISF and was carried out in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). Section 2.2 does not provide any site-specific information about nearby industrial, transportation, military, and nuclear fuel cycle facilities. The DOE, however, has committed in this section of the CISF TSAR to assess the hazards posed by nearby industrial, transportation, and military installations in the site-specific submittal and to verify that the design criteria associated with those hazards will be bounded by other design criteria. All facilities within a 5-mi radius and all relevant facilities at greater distances should be considered. Hazards associated with nearby transportation routes, military and civilian airports, aircraft (including helicopters) flying in the vicinity of the selected site through federal airways and restricted airspaces, etc. should be analyzed in the site-specific CISF SAR, as appropriate. Moreover, the CISF design has assumed no contribution from nearby uranium fuel cycle operations. Consequently, the selected site should not be near (less than 5 mi) any uranium fuel-cycle facility. Any uranium fuel-cycle facility outside the 5-mi radius that may pose any potential hazards to the proposed CISF should be considered.

2.4.3 Meteorology

The following sections from the CISF TSAR were reviewed: Subsections 2.3.1, Regional Climatology; 2.3.2, Local Meteorology; 2.3.3, On-site Meteorological Measurement Program; and 2.3.4, Diffusion Estimates. This review was conducted in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

10 CFR 72.90 requires that the site characteristics affecting the safety of the proposed CISF must be assessed. In the absence of any site-specific information, this non-site-specific TSAR has provided bounding design criteria related to maximum and minimum temperatures, extreme winds, tornadoes, hurricanes and tropical storms, precipitation, and snow and ice storms.

The design ambient temperature values are based on data from the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbook (American Society of Heating, Refrigeration and Air Conditioning Engineers, 1993) and are expected to bound most potential CISF sites in the 48 contiguous United States. The design wind speed (3 second gust, non-tornado) bounds all of the 48 contiguous United States except the coastlines of the Gulf of Mexico, the Atlantic Ocean, and most of Florida, based on the American National Standards Institute and American Society of Civil Engineers (ANSI/ASCE) 7-95 Standard (American National Standards Institute and American Society of Civil Engineers, 1995). The design maximum tornado wind speed is based on a Category I tornado and bounds all potential CISF sites in the 48 contiguous United States (U.S. Nuclear Regulatory Commission, 1974a). Based on data from the National Oceanic and Atmospheric Administration, Hydrometerological Report No. 52 (National Weather Service, 1982), the probable maximum precipitation (PMP) design values have been selected. These values are supposed to bound most potential CISF sites in the 48 contiguous United States. Based on ANSI/ASCE Standard 7-95, the design snow and ice load has been selected. Areas northwest of the Great Lakes region and extreme northeast United States may exceed this value, however. Because of the degree of local variability, ANSI/ASCE Standard 7-95 does not provide values in certain parts of the United States, particularly in mountainous areas.

The CISF lightning protection system will be designed in accordance with the National Fire Protection Association (NFPA) Code 780 (National Fire Protection Association, 1997). As this code is not based on geographic location, this criterion will encompass all of the 48 contiguous United States. Design of the final lightning protection system, however, will be site- and structure-specific.

This non-site-specific TSAR does not provide any information about local meteorology and on-site meteorological measurement program. For the site-specific CISF SAR, existing National Weather Service or best available data will be used to validate the bounding values used in the CISF TSAR (U.S. Department of Energy, 1998). The site-specific CISF SAR should describe the on-site meteorological measurement program if sufficient data are not available.

Assumptions regarding atmospheric diffusion to estimate the concentrations of gaseous radionuclides at the site boundary following routine releases and accident releases given in the CISF TSAR are based on NRC Regulatory Guide 1.4 (U.S. Nuclear Regulatory Commission, 1974b).

2.4.4 Surface Hydrology

Review of this section of the CISF TSAR included Subsections 2.4.1, Hydrologic Description; 2.4.2, Floods; 2.4.3, Probable Maximum Flood on Streams and Rivers; 2.4.4, Potential Dam Failures (Seismically Induced); 2.4.5, Probable Maximum Surge and Seiche Flooding; 2.4.6, Probable Maximum Tsunami Flooding; 2.4.7, Ice Flooding; 2.4.8, Flooding Protection Requirements; and 2.4.9, Environmental Acceptance of Effluents. This review was conducted in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). As this is a non-site-specific TSAR, no information is provided in these sections. The bounding assumptions regarding some of the site characteristics are presented instead.

The design of the CISF assumes that all SSCs important to safety will be located above the probable maximum flood (PMF) level, as defined in ANSI/American Nuclear Society (ANS) 2.8–1992 (American National Standards Institute and American Nuclear Society, 1992). A detailed flood analysis will be conducted following NRC Regulatory Guide 3.48 (U.S. Nuclear Regulatory

Commission, 1989) if the selected site is not clearly a flood-dry site. The site drainage facilities will be designed to accommodate the PMP (Table 2.3-2 of the CISF TSAR) runoff and drainage without flooding any SSCs important to safety.

2.4.5 Subsurface Hydrology

This section is not applicable to this non-site-specific CISF TSAR. Therefore, no information pertaining to the subsurface hydrology of the CISF site has been provided in Subsection 2.4.5 of the CISF TSAR.

2.4.6 Geology and Seismology

Review of this section of the CISF TSAR included Subsections 2.6.1, Basic Geology and Seismic Information; 2.6.2, Vibratory Ground Motion; 2.6.3, Surface Faulting; 2.6.4, Stability of Subsurface Materials; 2.6.5, Slope Stability; and 2.6.6, Volcanism. This review was conducted in accordance with NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

This non-site-specific TSAR does not provide information about the basic geology, seismic potential, data on epicenters of historical earthquakes and nearby capable faults. The current non-site-specific design of the CISF assumes that all SSCs important to safety will be located at an appropriate distance from any capable fault, as defined in 10 CFR Part 100, Appendix A IV(b)(4). Additionally, the DOE committed, in response to Request for Additional Information (RAI) 2-2, to investigate all capable faults as a part of the site investigation after the site is selected. Avoidance of the faults will be the preferred approach for the CISF siting. With this assumption, the CISF design presented in this TSAR is based on a design earthquake (DE) having a peak horizontal acceleration of 0.75 g applied at the structure foundation.

The CISF TSAR indicates that 0.75 g peak horizontal acceleration will bound the peak horizontal acceleration values at most sites in the 48 contiguous United States, evaluated at a mean annual probability of 1×10^{-4} or higher, except some sites in the western United States. This generic DE value bounds the 0.25 g DE value appropriate for most sites east of the Rocky Mountain Front, as defined in 10 CFR 72.102(a)(2). The DOE, however, needs to demonstrate that a peak horizontal acceleration of 0.75 g will bound the estimated peak horizontal acceleration at the selected site following the procedures outlined in 10 CFR Part 100, Appendix A, if the selected site is west of the Rocky Mountain Front (west of approximately 104°W longitude) and in other areas of known potential activity (including but not limited to the regions around New Madrid, Missouri; Charleston, South Carolina; and Attica, New York).

The CISF TSAR assumes a flat site for CISF design. Consequently, there is no discussion of stability of the slopes. The generic CISF design also assumes there are no nearby volcanic centers capable of impacting the CISF through explosive forces, lava flow, or ash fall. Consequently, no ash fall criteria are specified for the generic CISF design. Response to RAI 2-3 commits that the DOE will conduct site-specific investigations, once a site is selected, to determine if significant ash fall from volcanic eruptions is a credible loading condition.

2.5 Evaluation Findings

Based on the review of the information presented in Chapter 2, Site Characteristics, of the CISF TSAR, the following evaluation findings can be made about the TSAR.

2.5.1 Geography and Demography

- The staff has reviewed the information presented in Section 2.1, Geography and Demography of Site Selected, of the CISF TSAR and finds that the information satisfies the requirements for the general description of geography and demography for this non-site-specific CISF.

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:

- 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

2.5.2 Nearby Industrial, Transportation, and Military Facilities

- The staff has reviewed the information presented in Section 2.2, Nearby Industrial, Transportation, and Military Facilities, of the CISF TSAR and finds that the information satisfies the requirements for the general description of nearby industrial, transportation, and military facilities for this non-site-specific CISF.

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 as the CISF design assumed no nearby fuel cycle operations.

2.5.3 Meteorology

- The staff has reviewed the information presented in Section 2.3, Meteorology, of the CISF TSAR and finds that the information satisfies the requirements for the general description of both regional and local meteorology for this non-site-specific CISF.

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

2.5.4 Surface Hydrology

- The staff has reviewed the information presented in Section 2.4, Surface Hydrology, of the CISF TSAR and finds that the information satisfies the requirements for the general description of the surface hydrology for this non-site-specific CISF.

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 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 PMF 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 risks of inundation from surge and seiche flooding (including the frequency and magnitudes of potential causes, wave runup, erosion, and 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, 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.

2.5.5 Subsurface Hydrology

- There is no information on subsurface hydrology of the site presented in Section 2.5, Subsurface Hydrology, of the CISF TSAR as no general description can be provided in this non-site-specific CISF.

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

2.5.6 Geology and Seismology

- The staff has reviewed the information presented in Section 2.6, Geology and Seismology, of the CISF TSAR and finds that the information satisfies the requirements for the general description of geology and seismology for this non-site-specific CISF.

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, the 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.

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

- Confirmation that the stability evaluations for the specific cask systems identified for use at the CISF in the site-specific CISF SAR account for the peak earthquake horizontal acceleration.

2.6 References

American National Standards Institute and American Nuclear Society. 1992. *Determining Design Basis Flooding at Power Reactor Sites*. ANSI/ANS 2.8-1992. La Grange Park, IL: American National Standards Institute and American Nuclear Society.

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Washington Public Power Supply System. 1995. *Individual Plant Examination of External Events of Washington Nuclear Plant 2.* Richland, WA: Washington Public Power Supply System.

PRELIMINARY

3 OPERATION SYSTEMS

3.1 Review Objective

The objective of the review of the Operation Systems chapter is to evaluate, for clarity and completeness, the description of all operations, including systems, equipment, and instrumentation, particularly as they relate to handling and storage of SNF, confinement of nuclear material, and management of expected and potential radiological dose. The review also evaluated whether sufficient detail is provided to ensure that reviewers understand the operations and the operations effects on the design evaluations. Evaluations of features required to maintain the installation in a safe condition are performed in the appropriate technical sections. Because this was not a site-specific TSAR (U.S. Department of Energy, 1998a), a complete review of all operation systems of the CISF installation 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.

3.2 Areas of Review

The following areas of review are addressed in Section 3.4, Conduct of Review:

Operation Description

Spent Nuclear Fuel Handling Systems

Other Operating Systems

Operation Support Systems

Control Room and Control Area

Analytical Sampling

Shipping Cask Repair and Maintenance

Pool and Pool Facility Systems

3.3 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 Operation Systems are

- 72.11(a)
- 72.24(b), (e), (f), and (l)
- 72.26
- 72.40(a)(5 and 13)
- 72.44(c)(1–4)
- 72.104(b) and (c)
- 72.122(f), (g), (h)(1 and 3–5), and (i)–(l)
- 72.124(a)
- 72.126
- 72.128
- 72.150
- 72.166

3.4 Conduct of Review

The review of Operation Systems was accomplished using the guidelines of NUREG–1536 (U.S. Nuclear Regulatory Commission, 1997), NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000), and Regulatory Guide 3.48 (U.S. Nuclear Regulatory Commission, 1989). Information provided in Chapters 3, Principal Design Criteria; 4, Operating Systems; 5, Operating Procedures; 6, Waste Confinement and Management; 9, Radiation Protection; 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 TSAR were considered in the review.

3.4.1 Operation Description

The staff has reviewed the proposed operation descriptions provided in Sections 4.1, Installation Design; 5.1, Description of Operations; and 5.2, Identification of Subjects for Safety Analysis, of the CISF TSAR (U.S. Department of Energy, 1998a). Supporting documentation presented in Chapters 3, Principal Design Criteria; 4, Operating Systems; 6, Waste Confinement and Management; 13, Conduct of Operations; and 14, Technical Specifications, of the CISF TSAR and the responses to RAIs (U.S. Department of Energy. 1998b) were taken into consideration as well. The operation description of the operating system was reviewed for conformance with regulations described in 10 CFR 72.11(a); 72.24(b), (e), (f), and (l); 72.26; 72.40(a)(5 and 13); 72.44(c)(1–4); 72.104(b) and (c); 72.122(f), (g), (h)(1 and 3–5), and (i)–(l); 72.124(a); 72.126; 72.128; and 72.150.

Section 4.1, Installation Design, of the CISF TSAR (U.S. Department of Energy, 1998a) provides a description of the CISF layout and the major buildings, structures, and SNF storage areas (see Figure 3-1). The major functions to be performed at the CISF during the operational period are also identified. The layout of the CISF installation will be based on the generic site characteristics presented in Chapter 2, Site Characteristics, of the CISF TSAR, which are intended to envelop as much of the 48 contiguous United States as is practical. The principal CISF installation features that were summarily described included (i) site boundary, (ii) controlled area, (iii) controlled access area, (iv) switchyard, (v) security complex, (vi) main gatehouse, (vii) water utilities and fire protection, (viii) concrete cask staging area, (ix) receiving gatehouse, (x) on-site receiving area, (xi) inspection gatehouse, (xii) transporter wash-down station, (xiii) transportation cask queuing areas, (xiv) transfer facility, (xv) off-normal holding area, (xvi) storage area and concrete storage pads, (xvii) communications and alarms, (xviii) storage tanks, and (xix) temporary facilities. No stacks will be used at the CISF. The exhaust vent for the transfer facility ventilation system will be located on the side of the transfer facility building.

The CISF site boundary will encompass approximately 1,200 acres and will be owned by the DOE. The buildings and structures for the CISF installation will be located near the center of the site.

The controlled area is the area within the site boundary that DOE has the authority to determine all activities, including exclusion or removal of personnel and property.

The intention of the controlled access area is to protect individuals from exposure to radiation and radioactive materials. All personnel entering the controlled access area will be trained in radiological safety or escorted by someone trained in radiological safety.

The CISF switchyard will be used to distribute electrical power to the various CISF buildings and structures. A single transmission line from the local utility grid will supply the electrical power to the main switchyard transformer via a circuit breaker and associated disconnect switches.

The main operation center for the CISF site security personnel will be the security complex. The security complex will be the staging area for the site emergency vehicles and will be where site access for CISF personnel, visitors, and vehicles will be primarily controlled.

The main gatehouse, located at the control area boundary, will be used to control personnel and vehicular access to the CISF.

Potable water, fire protection, sewer, and wastewater systems will be supported by the CISF water utilities. The potable water system will be comprised of a yard well house, underground piping, a submersible well pump, and a groundwater storage tank. The dedicated CISF fire protection system distributes water to the automatic sprinkler systems, interior standpipe systems for building fire protection, and fire hydrants located throughout the CISF site by way of redundant 150,000-gal. water storage tanks, a pumphouse with redundant pumps, and a looped underground piping distribution system.

The concrete cask staging area will be used to receive and store empty SNF storage casks prior to their use.

After gaining access to the CISF installation through the receiving gatehouse, SNF deliveries may have to wait in the on-site receiving area until the inspection gatehouse is cleared of earlier shipments. The receiving gatehouse will only be manned when deliveries are expected.

The inspection gatehouse will be located outside of the controlled access area. The inspection gatehouse is the area allocated for receiving and inspecting SNF shipments arriving at the CISF installation by heavy haul truck or rail. The inspection gatehouse will also be used for performing final clearance operations for off-site shipments. Motorized rolling gateways for the road and rail penetrations control access to the inspection gatehouse area.

After passing through the inspection gatehouse, incoming SNF shipments will proceed to the transporter wash-down station to remove road dirt from the transporters and transportation casks. The intent of the transporter wash-down station is to maintain cleanliness in the transfer facility building and support security inspections.

The transportation cask queuing areas will be designed to accommodate 10 rail cars and 10 heavy haul truck transporters simultaneously. The queuing area will be a restricted area whenever a loaded cask is present. The cask queuing area is to be located a distance of at least 200 ft from the CISF unrestricted area.

Except for the three cases discussed in Subsection 3.4.2, Spent Nuclear Fuel Handling Systems, of this AR, the transfer facility building will be where the CISF canister transfer operations will take place. Section 5.1, Description of Operations, of the CISF TSAR (U.S. Department of Energy, 1998a) presented detailed operational flowsheets for the normal handling of the various vendor cask systems that may be used at the CISF. The specific vendor cask systems considered in the CISF TSAR were the (i) VECTRA NUHOMS®-MP187/HSM System (VECTRA Technologies, Inc.

1995), (ii) Holtec HI-STAR 100 System (Holtec International, 1994), (iii) Sierra TranStor™ System (Sierra Nuclear Corporation, 1995) (iv) Westinghouse Large MPC System (Westinghouse Government and Environmental Services Co., 1996a), (v) Westinghouse Small MPC System (Westinghouse Government and Environmental Services Co., 1996b), and (vi) NAC STC System (Nuclear Assurance Corporation International Services, Inc., 1994). The flowsheets conveyed the operational steps to be performed for the receipt, handling, transfer, and storage of the SNF for each of the vendor cask systems. See Subsection 3.4.2, Spent Nuclear Fuel Handling Systems, of this AR for an evaluation of the SNF canister transfer operating systems. Cask-specific information is presented as stated in the DOE documents. Most of these casks were not approved by NRC at the time of the submittals, and the licensing status of the casks continues to evolve. In addition, the name and ownership of the casks in some cases has changed and may change in the future. Therefore, new submittals must account for these changes.

The transfer facility building will be fully enclosed with a slab-on-grade floor. The building will be constructed of reinforced concrete that will be designed to withstand seismic and tornado loadings. The building has an open interior with partial-height interior concrete walls separating the three operational areas (i.e., the shipping and receiving area, canister transfer area, and the site transporter area). Two 225-ton overhead bridge cranes travel the length of the transfer facility building to handle the transportation and storage casks. These bridge cranes will be designed to accommodate seismic forces while fully loaded. A personnel support building will be attached to the transfer facility building. The personnel support building houses personnel locker rooms, electrical and mechanical component equipment storage rooms, the cask monitoring room (which includes computers and instrumentation for monitoring the cask temperatures and seal pressures), and radiation protection facilities. The radiation protection facilities includes offices, a counting laboratory, radiation protection equipment storage room, and a personnel dosimetry issue room.

The SNF received at the CISF will ultimately be stored in the storage area, unless various limiting conditions for operation (LCOs) described in Section 14.2, Limiting Conditions for Operation, of the CISF TSAR are not met. The specific LCOs of concern are the 10 mrem/hr radiation dose rate limit at 2 m from any vertical surface and the maximum removable surface contamination limits of 30,000 dpm/100 cm^2 gamma-beta and 3,000 dpm/100 cm^2 alpha. These particular LCOs are applicable to all of the various storage systems proposed for use at the CISF installation. The radiation dose rate and removable surface contamination will be measured prior to placement of the system into the storage area. The system will be moved to the off-normal holding area if these LCO limits are exceeded. The corrective actions to be taken will be determined after an evaluation of the potential causes for the LCO noncompliance has been completed.

The storage area has been sized to accommodate 40,000 MTU of SNF. A minimum 200-ft buffer will be provided between the unrestricted area and the closest cask storage. A minimum 2,300-ft distance will be provided from the site boundary to the stored fuel. It is not clear, however, if the off-normal holding area meets this criterion (see Figure 3-1). In addition, the storage capacity and design specifications of the off-normal holding area were not provided. The number of individual casks and cask transporters (both rail and heavy haul truck types) should be considered when estimating the storage capacity of the off-normal holding area. Note that, according to the operation flowsheets provided in Section 5.1, Description of Operations, of the CISF TSAR, transportation casks that do not meet performance requirements, as determined by tests performed immediately after arriving at the transfer facility building, will be reloaded on their transporter and moved to the off-normal holding area. Storage casks that do not meet performance requirements, as determined immediately after the canister transfer process, will be taken to the off-normal holding area as an individual unit using the site transporter. And, lastly, the CISF TSAR does not indicate that provisions have been made to monitor the outlet ventilation port temperatures or inter lid pressures, as appropriate for the different cask systems, after the off-normal casks have been placed in the off-normal holding area.

There are four communication systems that will be used at the CISF installation. These are the telephone system, public address system, alarms, and two-way radios.

The CISF TSAR indicated that chemical storage tanks are not expected to be needed. Two diesel fuel storage tanks will be used to store fuel for the emergency generators, however. One of these tanks will be located in the security complex and will supply fuel to the emergency generator for the security system. The other diesel fuel tank will supply fuel to the emergency fire pump generator and will be located in the fire protection pump building. Other storage tanks to be used at the CISF installation include the transfer facility radioactive waste water tank, transfer facility conventional waste water tank, washwater storage tank, transporter wash-down holdup tank, redundant fire protection water storage tanks, and separate septic tanks for the transfer facility and security complex buildings respectively.

Temporary site facilities will be provided at the CISF installation for office space, warehouses, maintenance and storage areas, space for the cask vendors, and other similar CISF functions. It needs to be clarified that cask maintenance and repair will not be performed in the CISF temporary facilities.

According to Section 3.6, Performance Requirements, of the CISF TSAR, the CISF installation will be capable of receiving SNF, in terms of MTU/yr, at the rates conveyed in Table 3-1. Table 3-2 delineates the SNF receipt rate capability of the CISF installation in terms of cask type and number of casks/yr. Note that the projected number of casks/yr SNF receipt rate was not provided beyond the first two years of operation. Moreover, no information has been given in the CISF TSAR conveying estimates of the time required to completely process incoming SNF shipments (i.e., from the time it arrives at the installation to the time it can be placed on the storage pad). This concern is primarily directed towards the extensive number of individual operations that must be performed to complete the Westinghouse Small/Large MPC and Sierra TranStor™ canister transfer procedures (see Subsection 3.4.2, Spent Nuclear Fuel Handling Systems, of this AR). In addition, the number of canister transfer operations that can be handled concurrently within the transfer facility building appears to be inherently limited to the number of overhead bridge cranes. The ability of the CISF installation design to meet cask throughput projections cannot be determined without SNF processing time estimates and consideration of the number of available overhead bridge cranes. To enable monitoring of the storage cask temperatures, as required by the VECTRA NUHOMS®-MP187/HSM, Westinghouse Small/Large MPC, and Sierra TranStor™ storage cask vendor specifications, temperature sensors will be installed at the ventilation outlet ports of these casks. The installation of the temperature sensors will be performed after the casks have been placed in the CISF storage area. If the cask temperature monitors are inoperable, alternate means will have to be used to obtain the temperature measurements or visual inspections will have to be performed, per the vendor requirements, until the storage unit temperature monitors are returned to service. The temperature monitor station, located in the cask monitor room of the personnel building, is to be checked daily. If the vendor technical specifications for a given storage cask cooling air temperature rise is exceeded, the operator will perform the actions required in the vendor technical specifications.

The NAC STC System requires the installation of a cask inter lid pressure monitoring system with a concomitant remote alarm capability. This monitoring and alarm system will be installed after the cask has been moved to the CISF storage area. None of the other proposed storage cask systems require pressure monitoring systems. The pressure monitor station will be located adjacent to the temperature monitor station, located in the cask monitor room of the personnel building, and will also be checked daily. If a storage cask inter lid pressure monitor and remote alarm are inoperable, pressure measurements will be taken manually according to the vendor's schedule until the pressure monitoring system is repaired. If the inter lid pressure exceeds allowable limits, the operator will perform the actions required by the vendor specifications.

The Holtec HI-STAR 100 storage cask does not require temperature or pressure monitoring sensors.

Section 5.2, Identification of Subjects for Safety Analysis, of the CISF TSAR presented the hazard identification process used to identify the design basis events (DBEs) considered in the development of the CISF installation design. The development of these DBEs included (i) a Preliminary Hazards Assessment (PHA); (ii) DBEs evaluated by the individual cask vendors; and (iii) DBEs associated with LWR SNF dry storage facilities previously identified in industry, regulatory documents, and commercial storage system SARs (see Table 5.2-1 of the CISF TSAR). A comprehensive list of potential DBEs applicable to the CISF installation was generated. The DBEs considered in the CISF TSAR can be found in Table 3-3. The DBEs identified in Table 3-3 could not be screened out using the process recommended by the Probabilistic Risk Assessment Guide, NUREG/CR–2300 (U.S. Nuclear Regulatory Commission, 1983), or did not require site-specific information to address them. An evaluation of the defense-in-depth features of the CISF installation designed to mitigate the consequences of the DBEs listed in Table 3-3 can be found in Chapter 15, Accident Analysis, of this AR.

A testing and maintenance program for various facets of the CISF installation has yet to be established (see Subsections 14.5.8.2.10, Equipment Maintenance Program, and 14.5.8.2.14, Testing and Maintenance Programs, of the CISF TSAR).

3.4.2 Spent Nuclear Fuel Handling Systems

The staff has reviewed the proposed SNF handling systems provided in Section 4.2, Spent Fuel Handling Systems, of the CISF TSAR (U.S. Department of Energy, 1998a). Supporting documentation presented in Chapters 3, Principal Design Criteria; 4, Operating Systems; 6, Waste Confinement and Management; 13; Conduct of Operations; and 14, Technical Specifications, of the CISF TSAR and the responses to RAIs (U.S. Department of Energy, 1998b) were taken into consideration as well. The description of the SNF handling systems was reviewed for conformance with regulations described in 10 CFR 72.11(a); 72.24(b), (e), (f), and (l); 72.26; 72.40(a)(5 and 13); 72.44(c)(1, 2, and 4); 72.104(b) and (c); 72.122(f) and (g); 72.124(a); 72.126; 72.128(a); 72.150, and 72.166.

PRELIMINARY

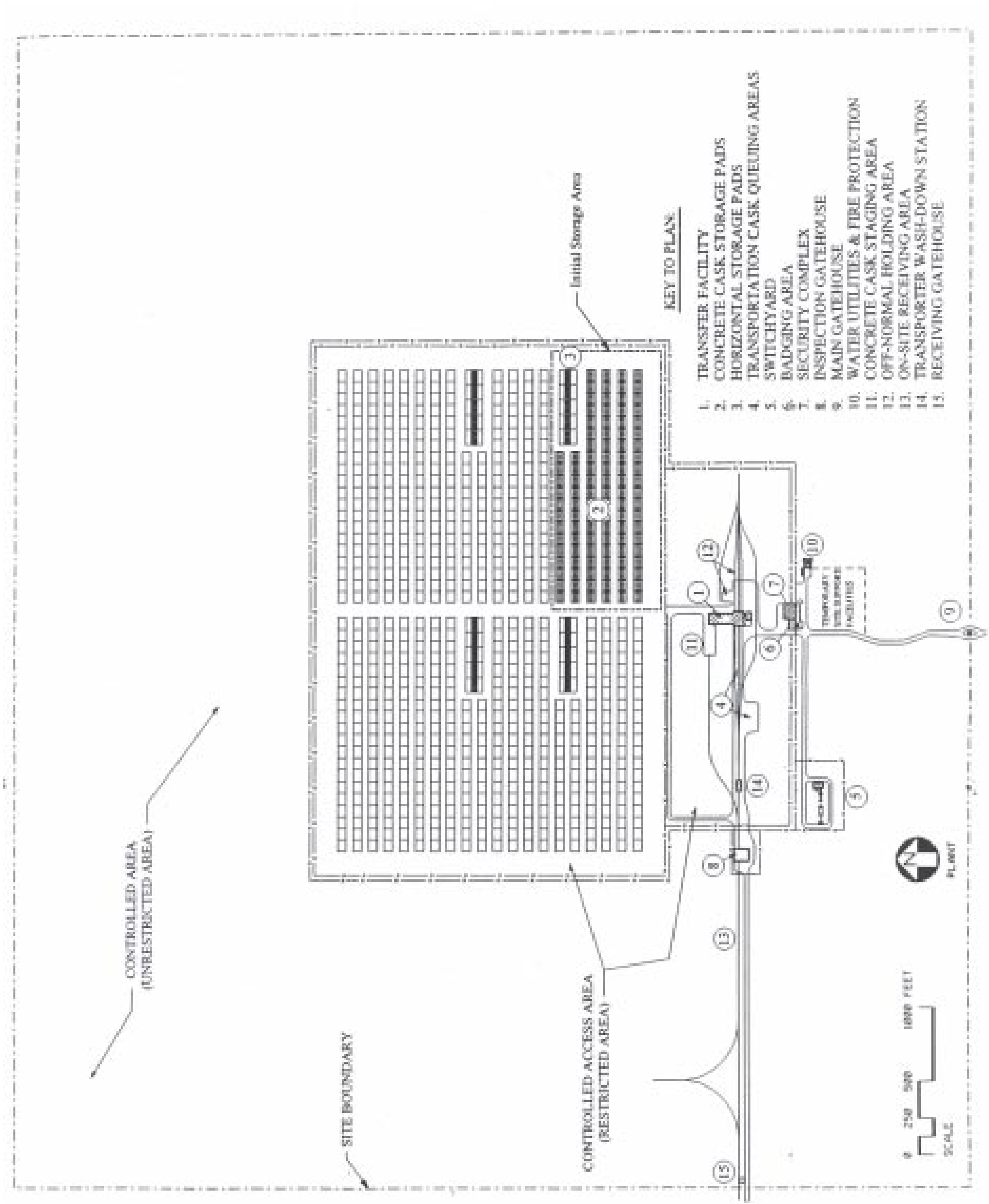

Figure 3-1. Centralized Interim Storage Facility (CISF) site plan (based on Figure 4.1-1 of the CISF Topical Safety Analysis Report)

Table 3-1. Centralized Interim Storage Facility (CISF) receipt rate capability (based on Table 3.6-1 of the CISF Topical Safety Analysis Report)

Year	SNF‡ (MTU/yr)
1	1200
2	1200
3	2000
4	2000
5	2700
6+	3000

[*] Metric Tons of Uranium
‡ Spent Nuclear Fuel

Table 3-2. Centralized Interim Storage Facility (CISF) receipt rate capability by cask type (based on Table 3.6-2 of the CISF Topical Safety Analysis Report)

Year	Receipt Rate (casks/yr)							
	Rail Casks						Truck Casks	
	Low Case Minimum Total Casks			High Case Maximum Total Casks			Low Case	High Case
	Small 12 PWR[*] 24 BWR[†]	Large 24 PWR 61 BWR	Total	Small 12 PWR[*] 24 BWR[†]	Large 24 PWR 61 BWR	Total		
1	86	90	176	160	72	232	0	0
2[‡]	76	86	162	195	35	230	0	0

[*] PWR–Pressurized Water Reactor
[†] BWR–Boiling Water Reactor
[‡] Receipt rate by cask type for years 3 through 6+ to be determined

Table 3-3. Accident and off-normal events determined to be applicable to the non-site-specific Centralized Interim Storage Facility by the U.S. Department of Energy (based on Table 5.2-3 of the CISF TSAR).

Accident Events	Off-Normal Events
Full Blockage of Air Inlets/Outlets	Partial Blockage of Air Inlets/Outlets
Drop Accident	Canister Misalignment
Earthquake	Failure of Instrumentation
Explosion	Handling Event
Extreme/Tornado Wind	Lightning
Failure of One Confinement Boundary	Loss of External Power
Fire	Off-Normal Ambient Temperature
Flood	Surface Contamination
Loss of Confinement	Vehicular Impact
Loss of Shielding	
Pressurization	
Tipover/Overturning	
Tornado Missiles	

SNF handling operations occur predominantly within the transfer facility building. Moreover, the canister transfer operations are not required for the Holtec HI-STAR 100 and NAC STC Systems. In the case of the VECTRA NUHOMS®-MP187/HSM System, the canister will be transferred directly from the transportation cask to the fixed HSM located in the CISF storage area. The VECTRA NUHOMS®-MP187/HSM System canister will be transferred into the HSM by a mobile hydraulic ram device. The remaining cask systems require their canisters be transferred from their transportation casks to their storage casks within the transfer facility building before being placed in the CISF storage area. In particular, the Westinghouse Small/Large MPC System canisters will be transferred from their transportation casks to concrete storage casks using a horizontal hydraulic ram apparatus similar to the VECTRA NUHOMS®-MP187/HSM System within the transfer facility building. The Westinghouse Small/Large MPC storage casks will subsequently be placed in the storage area in a vertical orientation. The Sierra TranStor™ System canisters will be transferred from their transportation to storage casks using an intermediary transfer cask within the transfer facility building. Unlike the Westinghouse Small/Large MPC Systems, the Sierra TranStor™ System canister and casks remain in a vertical orientation during the entire transfer process.

The transfer facility building is organized into three operational areas. These areas are the (i) shipping and receiving area, (ii) canister transfer area, and (iii) site transporter area.

The transfer facility shipping and receiving area will be used to receive and prepare for shipment all SNF transportation casks entering and leaving the CISF installation. Three rail lines/truck lanes will be provided in this area. Each rail line into the transfer facility will be equipped with a derailer to prevent vehicular impacts. After the transporter has been properly positioned within the transfer facility shipping and receiving area, a gantry-frame mounted robot will be used to remove the impact limiters, personnel barriers, tiedowns, and trunnion blocks (if necessary) from the cask and transporter. If necessary, the gantry frame-mounted robot will also be used to install trunnions and a transportation cask turning fixture. Once the transportation cask has been upended using the overhead bridge crane, the gantry frame-mounted robot will disengage the transportation cask turning fixture (if necessary). The overhead bridge crane will then be used to remove the transportation cask from the transporter and place it vertically on the floor near the cask decontamination booth. Radiological contamination surveys and, if necessary, decontamination procedures will then be performed. At this juncture, the SNF handling systems and procedures at the proposed CISF installation are cask-specific.

After the VECTRA NUHOMS®-MP187/HSM transportation cask has been removed from the transporter and the radiological contamination surveys and, if necessary, the decontamination procedures have been performed, a vent test will be conducted using the cask decontamination booth robotics. If contamination is found and the allowable radiological limits are exceeded, the cask will be returned to the transporter and moved to the off-normal holding area. If the vent test is completed with acceptable results, the overhead bridge crane will be used to move the cask directly to the site-transporter area of the transfer facility building where it will be loaded onto a site transporter. The site transporter for the VECTRA NUHOMS®-MP187/HSM transportation cask is unique in that it has a hydraulic ram mechanism that will be used to transfer the SNF canister from its transportation cask to the fixed HSM located in the CISF storage area. The VECTRA NUHOMS®-MP187/HSM site transporter takes the transportation cask to its assigned HSM after the HSM has been prepared, using the portable yard crane, to receive the SNF canister. The hydraulic ram unit on the site transporter will then be used to transfer the SNF canister to the fixed HSM. Once the HSM has been properly sealed, a radiological survey will be performed to determine if the 10 mrem/hr radiation dose rate limit at two meters from any vertical surface LCO is met. If this LCO is not met, an evaluation of the potential causes will be made and corrective actions taken accordingly. If the 10-rem/hr dose rate limit at two meters from any vertical surface is within the LCO, then the temperature monitor system will be installed on the HSM ventilation outlets, and the empty transportation cask will be returned to the transfer facility for dispatch. Before being allowed to be shipped from the CISF and reused, the removable surface contamination of the empty transportation cask must be within 2,200 dpm/100 cm^2 gamma-beta and 220 dpm/100 cm^2 alpha limits (see Subsection 14.5.8.2.7, Radiation Protection Program, of the CISF TSAR).

After the radiological contamination surveys and, if necessary, the decontamination procedures have been performed, the Holtec HI-STAR 100 TSC will be checked for leaks and thermal performance using the cask decontamination booth robotics. If cask leaks are found or the cask temperature limit is exceeded, the cask will be returned to the transporter and taken to the off-normal holding area. If the Holtec HI-STAR 100 TSC is found to be functioning properly, it will be moved directly to the site-transporter area of the transfer facility building where it will be loaded onto a site transporter. Prior to being moved to the CISF storage area, however, another radiological survey will be performed to determine if the 10 mrem/hr radiation dose rate limit at two meters from any vertical surface LCO is met. If the LCO is not met, the cask will be moved to the off-normal holding area using the site transporter.

After the Sierra TranStor™ System transportation cask has been removed from the transporter, radiological contamination surveys and, if necessary, decontamination procedures will be performed. The transportation cask will then be moved to the canister transfer area using the overhead bridge crane. The vent test rigging will then be attached to the transportation cask using a remotely operated canister transfer area robotics system. If contamination is found and the allowable radiological limits are exceeded, the transportation cask will be inerted, returned to the cask transporter, and moved to the off-normal holding area. Note that a cask is inerted by introducing a noble gas to the confines of the cask for the purpose of inhibiting the degradation of the SNF cladding. If the vent test is completed with acceptable results, the vent test rigging will be removed and the transportation cask lid will be unbolted using the canister transfer area robotics system and stud tensioner. The transportation cask lid will then be removed by using the overhead bridge crane (which is attached to the transportation cask lid lifting device). Closed circuit television (CCTV) cameras will then be used to remotely inspect the transportation cask lid seals. Prior to initiating the canister transfer from the transportation cask to the storage cask, a radiological survey of the canister will be performed using the canister transfer area robotics system. Once the radiological contamination survey and, if necessary, the decontamination procedures have been completed, the canister lifting device (eyebolts) will be installed using the canister transfer area robotics system. The transfer cask will then be moved to a position slightly above the transportation cask using the overhead bridge crane. After the lifting sling has been attached to the canister lifting device using the CCTV system and canister transfer area robotics, the transfer cask will be lowered onto the top of the transportation cask. Once the alignment of the canister and transfer cask have been verified, the canister will be lifted into the transfer cask and the bottom transfer cask doors will be closed. The canister will subsequently be lowered onto the transfer cask bottom doors, and the canister lifting sling will be disengaged. The loaded transfer cask will then be placed on top of the storage cask. The canister will then be lifted off the transfer cask bottom doors so they can be opened, allowing access to the storage cask beneath. If alignment between the transfer cask, canister, and storage cask is satisfactory, the canister will be lowered into the storage cask. The transfer cask will then be lifted slightly off the top of the storage cask to enable the detachment of the canister lifting sling using the CCTV system and long-handled tools. After the transfer cask has been positioned out of the way, the canister lid lifting device will be removed and the storage cask lid will be bolted on using the canister transfer area robotics system. The storage cask will then be moved to the site transporter, area using the overhead bridge crane and an intermediate storage cask lifting device. After the storage cask has been lifted and secured on the site transporter, another radiological survey will be performed to determine if the 10 mrem/hr radiation dose rate limit at two meters from any vertical surface LCO is met. If the LCO is not met, the cask will be moved to the off-normal holding area using the site transporter and corrective action will be taken once the reason for the high dose rate has been identified. If the surface radiation dose rate is acceptable, the storage cask will be moved to the CISF storage area using the site transporter, and the temperature monitoring system will be installed on the cask ventilation outlet ports. Additional procedural operations are delineated in the CISF TSAR flowsheets for the preparation of the Sierra TranStor™ System transfer and storage casks before the canister transfer operation can be performed and the steps required to dispatch the transportation cask after the canister transfer process has been completed.

The canister transfer procedures for both the Small/Large Westinghouse MPC Systems are the same. As a result, no distinctive differences in the canister transfer operations for these two systems have to be considered in the evaluation. The canister transfer operations for the Small or Large Westinghouse MPC transportation cask, after they have been removed from their transporter, will be as follows. First, the Westinghouse MPC transportation cask will be moved to the canister transfer area using the overhead bridge crane and lowered onto the canister transfer cradle pillow blocks, downended, and secured. The overhead bridge crane yoke will be released from the transportation cask and subsequently moved out of the way. The vent test rigging will then be attached to the transportation cask using a remotely operated canister transfer area robotics system. If contamination is found and the allowable radiological limits are exceeded, the transportation cask will be inerted, returned to the cask transporter, and moved to the off-normal holding area. If the vent test is completed with acceptable results, the vent test rigging will be removed, and the transportation cask lid lifting device will be installed using canister transfer area robotics. The transportation cask lid will then be removed by using the overhead bridge crane (which is attached to the transportation cask lid lifting device) and canister transfer area robotics system (which is used to unbolt the transportation cask lid). CCTV cameras will then be used to remotely inspect the transportation cask lid seals. Prior to initiating the canister transfer from the transportation cask to the storage cask, a radiological survey of the canister will be performed using the canister transfer area robotics system. Once the radiological contamination survey and, if necessary, the decontamination procedures have been completed, the canister ram pintle will be installed using the canister transfer area robotics system. The canister transfer cradle will subsequently be used to position and align the transportation cask with the storage cask. The hydraulic ram will then be attached to the canister ram pintle and used to pull the canister into the storage cask. At this juncture, the lower lid will be attached to the storage cask using the overhead bridge crane (which is attached to the lower lid lifting device) and canister transfer area robotics system (which is used to bolt the lower cask lid to the storage cask). A storage cask tamper indicator will then be installed using the canister transfer area robotics system. The hydraulic ram then pushes the canister against the storage cask bottom and will subsequently be retracted from the storage cask. The ram pintle will be removed from the canister using the canister transfer area robotics system, and the storage cask will be placed in a vertical orientation using the upender/downender. After the upender/downender has been detached and removed from the storage cask, the storage cask weather cover will be installed. The storage cask will then be moved to the site transporter area using the overhead bridge crane and an intermediate storage cask lifting device. After the storage cask has been lifted and secured on the site transporter, another radiological survey will be performed to determine if the 10-mrem/hr radiation dose rate limit at two meters from any vertical surface LCO is met. If the LCO is not met, the cask will be moved to the off-normal holding area using the site transporter, and corrective action will be taken once the reason for the high dose rate has been identified. If the surface radiation dose rate is acceptable, the storage cask will be moved to the CISF storage area using the site transporter, and the temperature monitoring system will be installed on the cask ventilation outlet ports. Additional procedural operations are delineated in the CISF TSAR flowsheets for the preparation of the Westinghouse storage cask before the canister transfer operation can be performed and the steps required to dispatch the transportation cask after the canister transfer process has been completed.

After the NAC STC transportation cask has been removed from the transporter and the radiological contamination surveys and, if necessary, the decontamination procedures have been performed, the cask inter lid pressure will be checked using the cask decontamination booth robotics. If the cask inter lid pressure limit is exceeded, the cask will be returned to the transporter and taken to the off-normal holding area. Otherwise, the overhead bridge crane will be used to move the cask directly to the site-transporter area of the transfer facility building where it will be loaded onto a site transporter. Prior to being moved to the CISF storage area, however, another radiological survey will be performed to determine if the 10 mrem/hr radiation dose rate limit at two meters from any vertical surface LCO is met. If the LCO is not met, the cask will be moved to the off-normal holding area using the site transporter. The inter lid pressure monitor and alarm system will be installed after the cask has been moved to its storage location in the CISF storage area.

As was pointed out in Subsection 3.4.1, Operation Description, of this AR, no information has been given in the CISF TSAR conveying estimates of the time required to completely process incoming SNF shipments. This concern is primarily directed towards the extensive number of individual operations that must be performed to complete the Westinghouse Small/Large MPC and Sierra TranStor™ canister transfer procedures that were just summarized. The ability of the CISF installation design to meet cask throughput projections cannot be determined without these SNF processing time estimates.

No information pertaining to the contamination control mechanism employed during the canister transfer process was provided in the CISF TSAR.

The overhead bridge cranes and their components will be designed to be fail-safe in the event of a power loss as required by American Society of Mechanical Engineers (ASME) NOG–1 (American Society of Mechanical Engineers, 1995). These cranes will be designed to withstand an earthquake event under bounding load conditions (i.e., while supporting bounding cask loads). In addition, load sensors will be installed on the overhead bridge cranes to enable the detection of loads outside of the allowable limits. The overhead bridge cranes will not be used if the crane lift load indicator is not functioning properly.

The transportation casks will only be lifted the minimum height needed to perform loading and off-loading from the transporters. Storage casks will only be lifted 6 in. above the floor, and their movement within the transfer facility building will be restricted to predefined travel paths to minimize the potential for adverse interactions with other SSCs.

The hydraulic ram systems used for transferring the VECTRA NUHOMS®-MP187/HSM and Westinghouse Small and Large MPC System canisters will be equipped with pressure monitors. According to Section 14.2, Limiting Conditions for Operation, of the CISF TSAR, the hydraulic ram pressure monitor for the VECTRA NUHOMS®-MP187/HSM System is to be designed such that the maximum push/pull forces will be automatically limited to 25 percent of the dry shield canister (DSC) loaded weight. The Westinghouse Small/Large MPC System hydraulic ram pressure force will be limited to 80,000 lb. These hydraulic ram pressure force limits will prevent damage to the DSC or cask in the event that the DSC should become misaligned or jammed during the transfer process. The hydraulic ram pressure will be monitored continuously during canister transfers. The hydraulic ram operator will take corrective actions as necessary if the pressure limits are exceeded.

The Sierra TranStor™ System canister transfer crane lift load will be limited to the weight of a loaded canister. If binding were to occur between the canister and transfer cask the maximum crane lift load would be exceeded, and the crane operator would have to take corrective actions as necessary. Consequently, the crane operator will be expected to monitor the crane lift load indicator continuously during canister transfers.

To reduce radiation exposure to CISF personnel following ALARA principles, the overhead bridge cranes and robotic equipment will be operated remotely. A CCTV system, with cameras installed throughout the transfer facility building, will be used to enable remote operations. All automated and remote handling equipment will be included in preoperational and operational testing programs as described in Chapter 13, Conduct of Operations, of the CISF TSAR. In addition, long-handled tools and local shielding will be employed when hands-on tasks have to be performed within the canister transfer area.

The transfer facility building will also be equipped with a gas inerting system, platforms and ladders for crane maintenance, inspection and radiological sampling equipment, lifting devices/platforms for the various cask types, cask upender/downender devices, cask support frames, radiologically shielded working platforms, and other miscellaneous tools and devices. See Chapter 4, Structures, Systems, and Components and Design Criteria Specifications, of this AR for an evaluation of the QA designations and design criteria for the various CISF SSCs.

According to Subsection 4.2.1.4, Canister Transfer System, of the CISF TSAR, canister transfer activities will be protected from environmental phenomena by the transfer facility building. This is not the case for the VECTRA NUHOMS®-MP187/HSM System, however, because canister transfer operations take place for this system in the CISF storage area.

The primary function of the CISF storage area is to provide storage space for the SNF in a safe manner. The design of the CISF storage area will facilitate the transfer, storage, and retrieval of SNF in NRC-approved storage cask systems. Between 5,300 and 7,800 storage casks are expected to be deployed in the CISF storage area with the intent of accommodating 40,000 MTU of SNF. These storage casks will be placed on modular reinforced concrete pads. The top of each 3-ft thick concrete pad will be at grade level and rain water drainage will be enabled by providing a gentle slope to the overall contour of the individual modular pads. Each concrete pad is expected to support eight vertical storage casks. The concrete pads for the VECTRA NUHOMS®-MP187 HSM will be sized to support 20 individual units. The concrete pads will be designed to withstand a design basis earthquake. See Chapter 4, Structures, Systems, and Components and Design Criteria Specifications, of this AR for an evaluation of the QA designation and design criteria for the concrete pads to be used in the CISF storage and off-normal holding areas.

All of the storage cask systems that may be considered for use at the CISF installation must provide passive cooling capabilities. Variations in monitoring, instrumentation, surveillance, and maintenance requirements are expected for the different cask types. All casks must satisfy the 10 mrem/hr radiation dose rate limit at two meters from any vertical surface LCO, however. Subsection 4.2.2.2, Cask Storage Systems, of the CISF TSAR provides a summary design description for each of the individual casks types presently being considered for use at the CISF.

There are three different vertical cask transporters that are uniquely equipped to transport the various storage cask types from the transfer facility building to the storage or off-normal handling areas. The TSC Transporter will be designed to accommodate the NAC STC and Holtec HI-STAR 100 systems by using the top lifting trunnions installed on these particular casks. The TSC Transporter straddles the cask, engages the top trunnions with a lifting boom, hydraulically lifts the cask, and secures the cask before transport to the appropriate area (i.e., the storage or off-normal handling areas).

The TranStor™ Concrete Cask Transporter will be used to transport an empty Sierra TranStor™ storage cask from the storage cask staging area to the transfer facility building and, after being loaded with an SNF canister, from the transfer facility building to the storage or off-normal handling areas. The TranStor™ Concrete Cask Transporter straddles the cask, engages the lifting beams that have been inserted into the bottom air channels of the cask with a lifting boom, hydraulically lifts the cask, and secures the cask before transport to the appropriate area.

The Westinghouse Small/Large MPC storage casks will be transported between the storage cask staging area, transfer facility building, storage area, and off-normal holding area using the Westinghouse Concrete Cask Transporter. This particular transporter will be a modified version of the Westinghouse Small/Large MPC System upender/downender that will be used in the canister transfer process. Unlike the TSC and TranStor™ Concrete Cask Transporters, which will be self-propelled, wheel-or track-type transporters; the Westinghouse Concrete Cask Transporter will be an upender/downender mechanism on wheels that will be towed by a site tractor. The Westinghouse Concrete Cask Transporter straddles the cask, engages the bottom of the cask, hydraulically lifts the cask, and secures the cask before transport to the appropriate area.

The horizontal cask transporter will be used to transport the VECTRA NUHOMS®-MP187/HSM transportation cask to the HSM from the transfer facility building. The horizontal cask transporter is, in essence, a portable hydraulic ram system on wheels that will also be towed by a site tractor (similar to the Westinghouse Concrete Cask Transporter). The horizontal cask transporter cradles the top and bottom lifting trunnions of the VECTRA NUHOMS®-MP187 transportation cask during transport. Additional features of the horizontal cask transporter include (i) a transfer skid, (ii) a skid positioned, (iii) hydraulic stabilization jacks, and (iv) a hydraulic ram pressure indicator.

3.4.3 Other Operating Systems

The staff has reviewed the proposed other operating systems provided in Section 4.4, Other Operating Systems, of the CISF TSAR (U.S. Department of Energy, 1998a). Supporting documentation presented in Section 3.2, Classification of CISF Structures, Systems and Components, of the CISF TSAR and the responses to RAIs (U.S. Department of Energy, 1998b) were taken into consideration as well. The review confirmed that the list of systems important to safety that were not addressed in Sections 4.1, Installation Design; 4.2, Spent Fuel Handling Systems; and 5.1, Description of Operations, had been included in Section 4.4 of the CISF TSAR. The description of the other operating systems was reviewed for conformance with regulations described in 10 CFR 72.11(a); 72.24(b), (e), (f), and (l); 72.26; 72.40(a)(5 and 13); 72.44(c)(1 and 4); 72.104(b) and (c); 72.122(f), (g), and (k); 72.126; 72.128(a); 72.150; and 72.166.

The equipment and general operations of other operating systems presented in Section 4.4, Other Operating Systems, of the CISF TSAR were the (i) heating, ventilation, and air conditioning (HVAC) system, (ii) electrical power distribution system, (iii) compressed air supply system, (iv) water supply system, (v) wastewater water system, (vi) communication and alarm system, (vii) fire protection system, (viii) maintenance system, (ix) radiation monitoring system, (x) cask decontamination system, and (xi) transporter wash-down system. Of these systems, only the fire protection program is considered an important to safety SSC (see Chapter 4, Structures, Systems, and Components and Design Criteria Specifications, of this AR for an evaluation of the QA designations and design criteria for the various CISF SSCs). Consequently, the fire protection system is evaluated here, and the remaining systems are designated operation support systems and evaluated in Subsection 3.4.4, Operation Support Systems, of this AR.

The CISF fire protection system is subdivided into three major fire protection systems. These major fire protection systems are the (i) yard, (ii) building, and (iii) transformer fire protection systems.

The yard fire protection system will be the fire fighting water distribution system for the CISF installation. The dedicated fire protection water distribution system provides water for the automatic sprinkler systems, interior standpipe systems, and fire hydrants provided at the site. Water for the fire protection system will be maintained in two redundant storage tanks. Each of these water storage tanks will be sized to provide the water supply needed to control and extinguish a design basis fire anywhere in the CISF. At least one of these tanks will be available for use at all times and will be designed to withstand a design basis earthquake. In the event these water tanks are emptied, off-site sources will be used to supplement the potable water well pump to refill them. The details as to how off-site sources will be used to supplement the potable water well pump were not given in the CISF TSAR.

Redundant fire pumps will be maintained in the CISF fire protection pumphouse. Each of these pumps will be sized to provide the water output needed to control and extinguish a potential credible fire. One of the fire protection pumps will be electric motor driven and the other will be diesel-engine driven. The electric motor driven pump will start automatically upon sensing a decrease in system water pressure. No information was provided pertaining to the redundancy and operation of the system water pressure sensor. In the event that electrical power is not available, the diesel-engine driven pump will start automatically when a decrease in system water pressure occurs. Two sets of starting batteries will be maintained for the purpose of starting the diesel-engine. The diesel fuel oil tank will be located within the fire protection pump building and will be of sufficient size to operate the diesel-engine driven pump for eight hours.

The piping network for the fire protection water distribution system will be designed such that a single pipe break or valve failure will not disrupt water flow during a design basis fire event. This will be achieved by arranging the main CISF yard piping in a looped-type configuration. If an individual pipe or valve failure occurs, water pressure will be maintained by using a sectional valve to isolate the failure from the system. Individual feed mains connect the water distribution system to the automatic sprinklers and/or standpipe fire protection systems for the transfer facility building, personnel building, security facilities, fire protection pump building, and the switchgear building.

The applicant has stated that the CISF storage area does not require a fire protection loop to suppress or mitigate a fire because the storage area does not have significant quantities of combustibles other than the diesel fuel stored in the site transporter fuel tanks and nearby vegetation. This needs to be confirmed in the site-specific application.

The transfer facility building fire protection system will be comprised of standpipes, fire detection and alarms, smoke controls, and portable fire extinguishers. An automatic sprinkler system will not be installed in the transfer facility building because of a lack of significant combustibles (see Subsection 4.4.7.2.3, Transfer Facility Fire Protection System, of the CISF TSAR). Ventilation flow to the control room, which will be protected by an inert gas system, will be terminated if a fire is detected. Ventilation equipment for all other areas of the transfer facility building will continue operating in the event of a fire. The primary combustible sources that were identified for the transfer facility building were the hydraulic fluids used for the canister transfer ram system, the hydraulic fluids and diesel fuel for the storage cask transporters, and lubricating oil for the overhead bridge cranes and air compressors. The fire hazard analysis did not take into consideration, however, the potentially large amounts of diesel fuel that could be introduced to the shipping and receiving area of the transfer facility by way of heavy haul trucks or locomotives. Consequently, an automatic sprinkler system for the shipping and receiving area of the transfer facility capable of controlling and extinguishing this particular design basis fire may have to be installed. The welding apparatus for the TranStor™ cask system and the radiant heat of the air compressors and storage cask transporter were identified as the primary ignition sources for the transfer facility building.

The fire protection pump building will be equipped with an automatic wet pipe sprinkler system. The primary source of combustible materials within the fire protection pump building will be the diesel fuel storage tank for the diesel-engine-driven water pump and the lubricating oil in the air compressors. The primary ignition sources will be the radiant heat from the diesel-engine-driven water pump and air compressor themselves. An 8-in., fire-rated concrete wall with a fire-rated double door separates the diesel-engine driven pump and fuel tank from the electric motor-driven pump. According to an analysis presented in Subsection 4A.3.7.4 of the CISF TSAR, the size of the diesel fuel storage tank should be less than 400 gallons in order to ensure the fire rating of the 8-in. concrete wall and double doors. It is not clear if the 400-gallon fuel limit is sufficient to operate the diesel-driven water pump for eight hours.

Subsection 4.4.7, Fire Protection, of the CISF TSAR also provides descriptions of the fire protection systems related to the manual fire fighting equipment, life safety features, passive fire protection features, fire brigades, security complex fire protection system, switchgear building fire protection system, gatehouse fire protection system, transformer fire protection system, inspection and test requirements of the various fire protection systems, and personnel qualification and training in the use of the various fire protection systems.

3.4.4 Operation Support Systems

In addition to reviewing the operation support systems, this subsection of the AR also reviews the proposed operating systems that were not evaluated in Subsection 3.4.3, Other Operating Systems, of this AR because they are not considered important to safety SSCs. Specifically, the staff has reviewed the proposed operation support systems descriptions provided in Sections 4.4, Other Operating Systems, and 4.5, Operation Support Systems, of the CISF TSAR (U.S. Department of Energy, 1998a). Supporting documentation presented in Chapters 3, Principal Design Criteria; 4, Operating Systems; 6, Waste Confinement and Management; 9, Radiation Protection; 13, Conduct of Operations; and 14, Technical Specifications, of the CISF TSAR and the responses to RAIs (U.S. Department of Energy, 1998b) were taken into consideration as well. The description of the operating support systems was reviewed for conformance with regulations described in 10 CFR 72.11(a); 72.40(a)(5 and 13); 72.122(h)(4) and (i); 72.126; 72.128; 72.150, and 72.166.

A description of the HVAC systems for the transfer facility building, security complex, site gatehouse, fire protection pump building, and the switchgear building was provided. The CISF ventilation systems will be designed for smoke control and, where appropriate, exhaust capability to mitigate the spread of airborne effluents or particles of combustion.

The HVAC system for the transfer facility building will be designed to maintain, under normal operating conditions, a 78°F dry-bulb temperature and 50 percent relative humidity during the summer months. During the winter, the normal operating temperature will be 55°F dry bulb with no relative humidity requirements. The power source for the transfer facility building HVAC system will be supplied by the primary electrical power grid for the site. To keep potential effluent exposure ALARA, all airborne effluents within the transfer facility building will be released through a single exhaust port located on the side of the building (i.e., no exhaust stack will be used). This exhaust port will be monitored for radionuclide release. High-Efficiency Particulate Air (HEPA) filters and a damper for bypassing these filters will be included in the exhaust system design. The transfer facility building vent air effluent will be monitored on a continuous basis. Under normal operating conditions, the in-line HEPA filters will be bypassed. In the event that the exhaust exceeds acceptable effluent levels, which have yet to be specified, the system damper bypass will automatically reroute the exhaust through the HEPA filters. The supply and exhaust air flow rates will be controlled such that a negative pressure with respect to ambient and the attached personnel building will be maintained within the transfer facility building. Maintaining a negative pressure within the transfer facility building ensures that all air flow out of the building will pass through the monitored HVAC exhaust system. The exterior roll-up doors that allow access to the shipping and receiving area of the transfer facility building will be closed whenever possible to prevent airborne effluents being released to the atmosphere through this pathway. In addition, a high-velocity air curtain designed to minimize the entrance of dust and insects as well as minimize unfiltered air release will be enabled when opening these roll-up doors. Supply air filters will also be incorporated into the design of the transfer facility building HVAC system to minimize dust and control environmental conditions within the building. HVAC fan status indicators will be provided locally and remotely. Failure of a running fan and transfer facility building high and low temperatures will also be alarmed. A remote exhaust system damper/alignment indicator will also be provided. Differential pressure indicators across the supply and HEPA filters will be located at the filter train.

Electric wall heaters and roof fans will be used for heating and ventilating the fire protection pump and switchgear buildings. These mechanisms will be thermostatically controlled. The various gatehouse will be fitted with conventional, self-contained, or roof-top HVAC systems. Automatic fire dampers, automatic fire protection for the ventilation filters, and a capability to remove smoke after suppression of a fire will be incorporated into the design of the conventional HVAC systems for the security complex and personnel building.

The CISF electrical system supplies power to all of the CISF installation facilities. Because the overhead bridge cranes and other canister transfer mechanisms located in the transfer facility building will be designed to be fail-safe in the event of a loss of electrical power, the CISF electrical power distribution system is not considered to be an important to safety SSC. The staff agrees with this designation. Power will be transmitted to the CISF through a single line from a host utility. The major components of the CISF electrical system will be the (i) transmission line, (ii) circuit breakers and disconnect switches, (iii) main transformer, (iv) power delivery switchgear, (v) power distribution components, including cable, cable tray, conduit and duct banks, (vi) building service transformers, and (vii) site grounding system. Descriptions of these components can be found in Subsection 4.4.2, Electrical System, of the CISF TSAR.

A grounding grid will be installed under the CISF facility buildings to provide grounding and lightning protection. The individual building ground systems will be interconnected to each other and the switchyard substation ground. A separate instrument ground will be provided for the control system equipment which, in turn, will be connected to the building ground mat.

Backup power will be provided for the (i) communication system, (ii) building fire detection systems, (iii) security monitoring and alarm systems, (iv) site security lights, (v) fire protection system, and (vi) cask monitoring system. The backup power for the communication and security systems will be provided by a dedicated diesel-engine-driven generator equipped with enough fuel to operate for 24 hr. The fire protection system will also use a dedicated diesel-engine-driven generator to supply power to the backup water pump. The building fire detection and cask monitoring systems will also have a dedicated uninterruptible power supply (UPS) that will allow these systems to operate for 24 hr in the event normal electrical power is lost. The location and type of UPS to be used for the building fire detection and cask monitoring systems needs to be clarified.

Additional information pertaining to the CISF electrical power distribution system can be found in Subsection 4.4.2, Electrical System, of the CISF TSAR.

Separate compressed air supply systems will be provided for the transfer facility building and security complex. The transfer facility compressed air system provides air to various pneumatic tools, robotics, and other equipment used for operations and maintenance. Both the transfer facility building and security complex compressed air systems provide instrument quality air to air-operated instrumentation, pneumatic valve operators, and HVAC pneumatic dampers. See Subsection 4.4.3, Compressed Air Supply Systems, of the CISF TSAR for additional design details.

The CISF water supply system provides potable water, hot and cold water, water for emergency safety shower and eyewash stations, makeup water for the fire protection distribution system storage tanks, and water for the site transporter wash-down station. The system will be comprised of (i) a yard well house and piping distribution system, (ii) a submersible well pump, (iii) water storage tanks, (iv) pressure control equipment, and (v) instrumentation and controls. Additional water treatment and filtration will be incorporated into the design if necessary.

The CISF waste water system is evaluated in Chapter 14, Waste Confinement and Management Evaluation, of this AR.

The CISF communications equipment will include (i) a telephone system (with utility and microwave capability), (ii) a public address handset system, and (iii) a radio system. As pointed out earlier, these systems will be powered by the security complex UPS in the event that normal electrical power is disrupted. See Subsection 4.4.6, Communications and Alarm Systems, of the CISF TSAR for additional CISF communications design and utilization information.

Dedicated maintenance periods will be scheduled at the CISF installation. The anticipated length and rate of these scheduled maintenance periods was not provided. When performing maintenance operations in the transfer facility building, all significant sources of direct radiation (e.g., transportation and storage systems containing SNF) will be removed from the area to provide unrestricted access to the lifting equipment and remote operating devices.

Cold chemical systems will not be used while handling SNF at the CISF.

The CISF cask decontamination system will primarily be used to remove surface contamination from incoming transportation casks that have been submerged in utility fuel pools. This system will be located in the transfer facility building shipping and receiving area. The cask decontamination booth will be enclosed and equipped with robotics and a decontamination solution pressure spray system. The remotely controlled robotics system will be used to obtain radiological samples from the surface of the cask as well as perform the decontamination wash-down procedures. The waste decontamination solution will be routed to the transfer facility building radioactive waste tank. It is anticipated that only 10 percent of the transportation casks will have to be decontaminated. No technical basis was provided to substantiate this estimate.

The CISF transporter wash-down station will be used to remove road dirt from an incoming transporter. The wash-down station uses a water reclamation system that reclaims water at its system design flow rate. The water reclamation system will initially be charged with potable water. Water pumped from a subgrade storage tank will be run through a centrifugal separator and basket filter to an aboveground wash water storage tank. The water will then be pumped to the wash-down station where it will be used to clean the transporter before being drained to the subgrade storage tank, closing the reclamation loop. An evaluation of the proposed collection, filtering, and disposal of the wash water is evaluated in Chapter 14, Waste Confinement and Management Evaluation, of this AR.

The CISF will be equipped with (i) a radiation monitoring system, (ii) storage module thermal and pressure monitoring system, and (iii) a hydraulic ram pressure monitoring system.

An area radiation monitor system will be used to monitor direct gamma and neutron dose rates in the transfer facility, in the cask wash-down area, and on the cask transporter. It is not clear if all of the transfer facility areas (i.e., shipping and receiving area, canister transfer area, and site transporter area) will be encompassed by the area radiation monitor system. In addition, the use of the area radiation monitor system for the cask transporter needs to be clarified. Specifically, it is the intent of this system to monitor incoming rail and heavy haul truck cask transporters, the storage cask site transporter, or both. A remote readout and alarm panel for the area radiation monitor system will be located in the personnel building. Subsection 9.3.5.1, Area Radiation Monitoring System, of the CISF TSAR provides additional information regarding the equipment used for this system.

The radioactive airborne effluent monitoring system will be used to monitor the transfer facility building HVAC exhaust. The system output will be monitored locally (i.e, at the HVAC exhaust port) and remotely from the cask monitor room located in the personnel building. Each channel of the monitor has an adjustable alarm setting for aligning the HVAC exhaust air flow through the HEPA filters. Subsection 9.3.5.2, Radioactive Airborne Effluent Monitoring System, of the CISF TSAR provides additional information regarding the equipment used for this system.

Portable continuous air monitors (CAMs) will be located throughout the transfer facility and will be used to monitor the atmosphere during tasks that may generate airborne effluents. The CAM system will be equipped with local audible alarms that will alert personnel in the event allowable limits are exceeded.

A whole body contamination monitor will be located in the contamination control area between the personnel and transfer facility buildings. Personnel will also be equipped with thermoluminescent dosimeters (TLDs) to record cumulative exposures and self-reading dosimeters to monitor instantaneous dose rate and short-term cumulative exposure. There will also be a walk-through type portal radiation monitor installed at the badge issue station to verify that personnel leaving the site have not been contaminated. In addition, personnel friskers will be installed at all locations that provide access to areas where the potential for contamination exists. Lastly, a whole body counter to detect possible internal radioactive contamination will be available.

The radiation protection counting laboratory will be located in the personnel building. This laboratory will be capable of processing contamination smears as well as gas and liquid samples.

The concrete pads located in the storage area of the CISF will be electronically wired during construction to accommodate storage cask thermal and pressure monitoring instrumentation. As was pointed out in Section 3.4.1, Operation Description, of this AR, the VECTRA NUHOMS®-MP187/HSM, Westinghouse Small/Large MPC, and Sierra TranStor™ storage cask vendor specifications require temperature sensors be installed to detect the potential blockage of their ventilation ports. A single electrical terminal box will be used to transmit the sensor readings from the vertical storage casks placed on two modular concrete pads to the cask monitor control room located in the personnel building. Because no more than eight vertical storage casks can be placed on a single concrete pad and assuming two sensors will be used for each cask, each electrical terminal box is capable of handling 32 sensor transmission cables. Similarly, a single electrical terminal box will be used to transmit the sensor readings from two HSM modular concrete pads to the cask monitor control room. Given 20 HSM units per concrete pad and allowing for two sensors per HSM unit, a single electrical terminal box for two HSM modular concrete pads is capable of accommodating 80 sensor transmission cables. The transmission cables from the electrical terminal boxes to the cask monitor control room will run through buried conduit.

The NAC STC System requires the installation of a cask inter lid pressure monitoring system with a concomitant remote alarm capability. These pressure sensor readings will be routed to the cask monitor control room through the same electrical terminal boxes that will be used for the temperature sensors. The cask instrumentation monitoring terminal and alarm board will be monitored on a daily basis and tested annually. In the event of an electrical power disruption, the thermal and pressure monitoring system will be powered by a UPS system located in the cask monitor room. Moreover, diagnostic software will be used for calibration verification of the temperature and pressure sensors by comparison with a known source.

The hydraulic ram pressure sensors are evaluated in Subsection 3.4.2, Spent Nuclear Fuel Handling Systems, of this AR.

3.4.5 Control Room and Control Area

The staff has reviewed the proposed control room and control area descriptions provided in Sections 4.6, Control Room and Control Area, of the CISF TSAR (U.S. Department of Energy, 1998a). The responses to RAIs (U.S. Department of Energy, 1998b) were taken into consideration as well. The operation description of the control room and control area was reviewed for conformance with regulations described in 10 CFR 72.11(a); 72.24(e); 72.40(a)(5 and 13); and 72.122(j).

There will be four control and monitoring areas located in the transfer facility and personnel buildings. These are the (i) crane operating room, (ii) remote operating room, (iii) remote control consoles, and (iv) cask monitoring room. These areas are provided for the purpose of remotely observing, controlling, and monitoring operations performed in the transfer facility building and maintaining vigilance of the storage cask performance parameters from locations that can keep radiation exposure to CISF personnel ALARA.

The crane operating room will be located approximately 27 ft above the transfer facility building floor. This room will be constructed so that tornado-generated missiles cannot penetrate through the exterior wall. A large viewing window will allow the crane and gantry-mounted robot operators to see the shipping and receiving and canister transfer areas of the transfer facility building without any obstructions. CCTV monitors will allow personnel in the crane operating room to view images from the cameras mounted on the overhead bridge cranes, gantry-mounted robot, and others located throughout the transfer facility building. The ability of the crane operating personnel to adequately view operations being performed in the site transporter area of the transfer facility building was not addressed in the CISF TSAR.

The remote operating room will be located below the crane operating room in the transfer facility building. The remote control of the automated bolt/stud tensioners in the shipping and receiving area will be conducted from the remote operating room. As with the crane operating room, the remote operating room will be equipped with CCTV monitors to enhance the ability of the remote operators to perform their duties.

The remote console rooms will be located in the canister transfer area of the transfer facility building. The remote console rooms will be used to remotely operate the various equipment associated with the canister transfer operations to be performed in the canister transfer area. CCTV monitors will also be used by operators in the remote console rooms.

The computers and instrumentation for monitoring the storage cask temperatures and inter lid pressures will be located in the cask monitoring room, which, in turn, will be located in the personnel building.

Several remote control or monitoring areas, or both, have been provided in the transfer facility for ALARA purposes. These shield areas have been provided for operators to control, observe, or monitor, operations of storage cask performance parameters at sufficient distances from a radiation source to maintain ALARA worker dose.

3.4.6 Analytical Sampling

The staff has reviewed the proposed analytical sampling description provided in Section 4.7, Analytical Sampling, of the CISF TSAR (U.S. Department of Energy, 1998a). Supporting documentation presented in Sections 6.3, Liquid Waste Treatment and Retention; 6.4, Solid Wastes; 9.3.5.2, Radioactive Airborne Effluent Monitoring System; and 9.6.2, Effluent and Environmental Monitoring Program, of the CISF TSAR and the responses to RAIs (U.S. Department of Energy, 1998b) were taken into consideration as well. The description of the analytical sampling was reviewed for conformance with regulations described in 10 CFR 72.11(a); 72.24(e); 72.44(c)(3); 72.126; and 72.128(b).

Liquid, solid, and gaseous radioactive waste sampling capabilities will be maintained at the CISF installation. Liquid radioactive waste may arise from the cask and canister decontamination operations performed in the transfer facility building. These liquid wastes will be collected in a radioactive waste collection tanks and sampled for contamination. The specific sampling rate was not provided in the CISF TSAR. The amount of waste generated during all phases of handling SNF (receipt, storage, retrieval, and transfer) is expected to be small.

Solid radioactive wastes expected at the CISF installation are expected to be limited to the paper or cloth swipes, paper towels, and rubber gloves used to obtain cask contamination samples and/or perform decontamination activities. Solid radioactive waste arising from decontamination activities will be surveyed prior to disposition.

Air samples of the annular space between the transportation cask and SNF canister will be drawn before opening the transportation cask. Particulates from the air sample will be collected in sample filter paper. The sample filter will be analyzed using on-site equipment located in the radiation protection counting laboratory located in the personnel building.

3.4.7 Shipping Cask Repair and Maintenance

The staff has reviewed the proposed shipping cask repair and maintenance descriptions provided in Section 4.8, Transportation Cask Repair and Maintenance, of the CISF TSAR (U.S. Department of Energy, 1998a). The responses to RAIs (U.S. Department of Energy, 1998b) were taken into consideration as well. The description of the shipping cask repair and maintenance was reviewed for conformance with regulations described in 10 CFR 72.11(a) and 72.128(a)(3).

The major repair, reconfiguration, maintenance, and/or annual certification of the transportation casks will not be performed at the CISF installation. If necessary, those casks requiring these activities will be shipped to an off-site facility after sufficient incidental repairs needed to ensure safe transport have been completed.

Repairs that will be performed in the transfer facility building will be limited to those repairs needed to unload a transportation cask off an incoming transporter or closing empty transportation casks for dispatch. Specific repairs that may be performed within the transfer facility building include replacement of lid seals, repair or replacement of bolts/studs, and/or installation of threaded bolt/stud inserts for lids, trunnions, cask sample ports, impact limiters, or personnel barriers.

3.4.8 Pool and Pool Facility Systems

Neither the use of a pool nor any system supporting a pool is incorporated into the CISF.

3.5 Evaluation Findings

Based on a review of the information in the CISF TSAR, responses to the NRC RAIs, and references cited in the CISF TSAR, the following evaluation findings can be made about the proposed CISF installation.

3.5.1 Operation Description

- The staff reviewed the proposed operation descriptions provided in Sections 4.1, Installation Design, 5.1, Description of Operations, and 5.2, Identification of Subjects for Safety Analysis, of the CISF TSAR (U.S. Department of Energy, 1998a). Supporting documentation presented in Chapters 3, Principal Design Criteria; 4, Operating Systems; 6, Waste Confinement and Management; 13, Conduct of Operations; and 14, Technical Specifications, of the CISF TSAR and the responses to RAIs (U.S. Department of Energy, 1998b) were taken into consideration as well. The staff found reasonable assurance that the operation description satisfies the requirements of 10 CFR 72.24(b), (e), (f), and (l); 72.26; 72.44(c)(2–4); 72.104(b) and (c); 72.122(f), (h)(1 and 3–5), and (i–l); 72.124(a); 72.126; and 72.150.

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 off-normal holding area storage capacity and design specifications are acceptable

- Confirmation that the CISF off-normal holding area will be equipped to monitor the outlet ventilation port temperatures and inter lid 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

3.5.2 Spent Nuclear Fuel Handling Systems

- The staff reviewed the proposed SNF handling systems provided in Section 4.2, Spent Fuel Handling Systems, of the CISF TSAR (U.S. Department of Energy, 1998a). Supporting documentation presented in Chapters 3, Principal Design Criteria; 4, Operating Systems; 6, Waste Confinement and Management; 13, Conduct of Operations; and 14, Technical Specifications, of the CISF TSAR and the responses to RAIs (U.S. Department of Energy, 1998b) were taken into consideration as well. The staff found reasonable assurance that the SNF handling system will satisfy the requirements of 10 CFR 72.24(e), (f), and (l); 72.26; 72.44(c)(2 and 4); 72.104(b) and (c); 72.122(f); and 72.126.

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. This information is necessary because canister transfer operations take place for this system in the CISF storage area, not in the transfer facility building.

- 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 SNF.

3.5.3 Other Operating Systems

- The staff reviewed the proposed other operating systems provided in Section 4.4, Other Operating Systems, of the CISF TSAR (U.S. Department of Energy, 1998a). Supporting documentation presented in Section 3.2, Classification of CISF Structures, Systems, and Components, of the CISF TSAR and the responses to RAIs (U.S. Department of Energy, 1998b) were taken into consideration as well. The staff found reasonable assurance that the other operating systems important to safety will satisfy the requirements of 10 CFR 72.24(e), (f), and (l); 72.26; 72.40(a)(5); 72.104(b) and (c); 72.126; and 72.166.

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

- Confirmation that the CISF storage area does not require a fire protection loop to suppress or mitigate a fire because the storage area does not have significant quantities of combustibles other than the diesel fuel stored in the site transporter fuel tanks and nearby vegetation.

3.5.4 Operation Support Systems

- The staff reviewed the proposed operation support systems descriptions provided in Sections 4.4, Other Operating Systems, and 4.5, Operation Support Systems, of the CISF TSAR (U.S. Department of Energy, 1998a). Supporting documentation presented in Chapters 3, Principal Design Criteria; 4, Operating Systems; 6, Waste Confinement and Management; 9, Radiation Protection; 13, Conduct of Operations; and 14, Technical Specifications, of the CISF TSAR and the responses to RAIs (U.S. Department of Energy, 1998b) were taken into consideration as well. The staff found reasonable assurance that the operation support systems will satisfy the requirements of 10 CFR 72.40(a)(5); 72.122(h)(4) and (i); 72.126(d); 72.150; and 72.166.

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 HEPA 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

3.5.5 Control Room and Control Area

- The staff reviewed the proposed control room and control area descriptions provided in Sections 4.6, Control Room and Control Area, of the CISF TSAR (U.S. Department of Energy, 1998a). The responses to RAIs (U.S. Department of Energy. 1998b) were taken into consideration as well. The staff found reasonable assurance that the control room and control area will satisfy the requirements of 10 CFR 72.24(e); 72.40(a)(5 and 13); and 72.122(j).

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

3.5.6 Analytical Sampling

- The staff reviewed the proposed analytical sampling description provided in Section 4.7, Analytical Sampling, of the CISF TSAR (U.S. Department of Energy, 1998a). Supporting documentation presented in Sections 6.3, Liquid Waste Treatment and Retention; 6.4, Solid Wastes; 9.3.5.2, Radioactive Airborne Effluent Monitoring System; and 9.6.2, Effluent and Environmental Monitoring Program, of the CISF TSAR and the responses to RAIs (U.S. Department of Energy, 1998b) were taken into consideration as well. The staff found reasonable assurance that the analytical sampling procedures will satisfy the requirements of 10 CFR 72.11(a); 72.24(e); 72.44(c)(3); 72.126; and 72.128(b).

3.5.7 Shipping Cask Repair and Maintenance

- The staff reviewed the proposed shipping cask repair and maintenance descriptions provided in Section 4.8, Transportation Cask Repair and Maintenance of the CISF TSAR (U.S. Department of Energy, 1998a). The responses to RAIs (U.S. Department of Energy. 1998b) were taken into consideration as well. The staff found reasonable assurance that the shipping cask repair and maintenance procedures will satisfy the requirements of 10 CFR 72.11(a) and 72.128(a)(3).

3.5.8 Pool and Pool Facility Systems

This section is not relevant to the CISF review because neither a pool, nor any system supporting a pool, is incorporated into the CISF.

3.6 References

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Westinghouse Government and Environmental Services Co. 1996b. *Large OST and OSS Safety Analysis Report*. MPC–CD–02–016, Rev. 01. San Jose, CA: Westinghouse Government and Environmental Services Co.

4 STRUCTURES, SYSTEMS, AND COMPONENTS AND DESIGN CRITERIA EVALUATION

4.1 Review Objective

The objective of this review is to ensure that the applicant for the CISF acceptably defines (i) the limiting characteristics of the SNF to be stored; (ii) the classification of SSC according to importance to safety; and (iii) the design criteria and design bases, including the external conditions during normal and off-normal operations, accident conditions, and natural phenomena events. Because this TSAR (U.S. Department of Energy, 1998a) is not site-specific, a complete review of the principal design criteria as specified in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000) is not possible. The CISF will utilize only cask storage systems licensed by the NRC. Design criteria based on cask-specific information will be derived from the cask-specific SARs. Additional cask-specific and site-specific information that must be included in the site-specific SAR for the CISF is identified.

4.2 Areas of Review

The following areas of review are addressed in Section 4.4, Conduct of Review:

Materials to Be Stored

Spent Nuclear Fuel

Classification of Structures, Systems, and Components

Design Criteria for Structures, Systems, and Components Important to Safety

General
Structural
Thermal
Shielding, Confinement, and Radiation Protection
Criticality
Decommissioning Consideration
Retrieval Capability
Satisfaction of As Low As Is Reasonable Achievable Goals

Design Criteria for Other Structures, Systems, and Components

Design Criteria for Transportable Storage Casks and Cask/Canister Systems
Design Criteria for Other Structures, Systems, and Components Subject to U.S. Nuclear Regulatory Commission Approval

4.3 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 to SSC and design criteria evaluation are

- 72.2(a)(1)
- 72.3
- 72.11
- 72.24(a), (c)(1–4), (d), and (n)
- 72.92
- 72.94
- 72.102
- 72.104
- 72.106
- 72.120(a)
- 72.122
- 72.124
- 72.126
- 72.128
- 72.130
- 72.144(a) and (c)
- 72.182
- 72.236(a)–(g) and (k–m)

4.4 Conduct of Review

Chapter 3, Principal Design Criteria, of the CISF TSAR (U.S. Department of Energy, 1998a) identifies the principal design criteria for the CISF. Safety protections systems are designed for the safe containment and storage of SNF without the release of radioactive material. The staff evaluated the CISF principal design criteria by reviewing Chapter 3, Principal Design Criteria, of the CISF TSAR, DOE responses to the NRC RAIs (U.S. Department of Energy, 1998b), and supporting documentation. Limited hand calculations were performed to evaluate data provided in the CISF TSAR.

The principal design criteria identified in the CISF TSAR were compared to engineering codes and guidelines such as those identified in ANSI–ANS 57.9 (American National Standards Institute and American Nuclear Society, 1984), ANSI/ASCE 7-95 (American National Standards Institute and American Society of Civil Engineers, 1996), Regulatory Guide 1.60 (U.S. Atomic Energy Commission, 1973), Regulatory Guide 1.61 (U.S. Atomic Energy Commission, 1973b), Regulatory Guide 1.76 (U.S. Atomic Energy Commission, 1974), and NUREG–0800 (U.S. Nuclear Regulatory Commission, 1981).

The information in Chapter 3, Principal Design Criteria, of the CISF TSAR was reviewed with respect to the applicable siting evaluation regulations defined in the following sections. Where appropriate, findings of regulatory compliance are made for the 10 CFR Part 72 requirements that are fully addressed in Chapter 3 of the CISF TSAR. Because compliance with some regulations can only be determined by the integrated review of several sections in Chapter 3 and/or other chapters within the CISF TSAR, a finding of regulatory compliance is not made in each major section unless the specific regulatory requirements are fully addressed. However, findings of technical adequacy and acceptability are made for each section in Chapter 3 as it relates to the regulatory requirements.

The material evaluated in this chapter of the AR includes information supporting partial compliance with some of the regulatory requirements identified in Section 4.3, Regulatory Requirements, of this AR. Additional evaluation considerations are addressed in other chapters of this AR. Specifically, requirements of 10 CFR 72.104 identify criteria for radioactive materials as controlled by design, operational restrictions, and operational limits. Operational restrictions and limits are covered in Chapters 3, Operation Systems, and 10, Conduct of Operations, of this AR. Radiation protection evaluation is covered in Chapter 11, Radiation Protection Evaluation, of this AR. Requirements of 10 CFR 72.106 deal with the controlled areas of an ISFSI and are also covered in Chapter 11, of this AR. Discussion of the design basis and structural analysis of SSC important to safety as required in 10 CFR 72.122(b) is covered in Chapters 5, Installation and Structural Evaluation, and 15, Accident Analysis, of this AR. The QA requirements of 10 CFR 72.122(a) and 72.144(a) and (c) are covered in Chapter 12, Quality Assurance Evaluation, of this AR. The requirements of 10 CFR 72.130 are evaluated in Chapter 13, Decommissioning Evaluation, of this AR.

The regulatory requirements of 10 CFR 72.24(n); 72.102(c), (d), (e), and (f); and 72.122(b)(4), (d), (e), (g), and (k) require site-specific information to determine compliance. Consequently, these regulatory requirements must be addressed in the site-specific CISF SAR.

The regulatory requirements of 10 CFR 72.236 address specific requirements for SNF storage cask approval. Compliance with 10 CFR 72.236 is assumed to be demonstrated in the vendor SARs and the associated NRC CoC publications. The evaluation of these cask systems by the staff was limited to determination if the cask-specific design criteria bound the CISF TSAR design criteria.

Table 4-1. Centralized Interim Storage Facility bounding cask systems

Name	Type
NUHOMS® MP187/HSM	Dual Purpose Canister (DPC) System (VECTRA Technologies, Inc., 1995a and 1995b)
Holtec HI-STAR 100	Transportable Storage Cask (TSC) (Holtec International, 1994 and 1995)
Sierra TranStor™ System	Dual Purpose Canister System (Sierra Nuclear Corp., 1995)
Westinghouse Large MPC	Multi-Purpose Canister (MPC) System (Westinghouse Government and Environmental Services Co., 1996a)
Westinghouse Small MPC	Multi-Purpose Canister System (Westinghouse Government and Environmental Services Co., 1996b)
Nuclear Assurance Corporation International Services, Inc., STC	Storage Transport Cask (STC) (Nuclear Assurance Corporation International Services, Inc., 1994)

4.4.1 Materials to be Stored

The bounding parameters for the materials to be stored within the sealed canisters for each of the cask systems are identified in the vendor SARs. The site-specific CISF SAR will identify the cask system(s) to be used at the facility. Selection of cask system(s) will establish the materials to be stored and the corresponding design criteria. Therefore, the materials to be stored at the CISF installation are considered by the staff to be a site-specific issue. The CISF is designed to store between 5,300 and 7,800 casks with a total dry, commercial SNF storage capacity of 40,000 MTU until retrieval for disposal in a geologic repository. Only storage casks approved by the NRC can be used at the CISF. The actual number of casks at the CISF installation is dependent on the specific cask systems to be used. The materials to be stored at the CISF installation are identified by reference to the individual cask system SARs in Section 3.1, Stored Materials, of the CISF TSAR (i.e., Table 3.1-1 of the CISF TSAR). To ensure that the applicable CISF LCOs identified in Chapter 14, Technical Specifications, and the design criteria itemized in Section 3.7, Material Handling, Storage, and Retrieval Capability, of the CISF TSAR are met, an explicit 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 designed to be dissipated, maximum SNF loading limit, condition of the SNF, and the inert atmosphere requirements for each cask system to be used at the CISF installation must be provided in the site-specific CISF SAR to satisfy the requirements of 10 CFR 72.24(c)(2).

The CISF is designed to have the capability to receive SNF at the rates (MTU/yr) listed in Table 3.6-1 of the CISF TSAR. As stated in Section 3.6, Performance Requirements, of the CISF TSAR, the CISF is designed to receive, handle, transfer, store, and ship SNF contained in TSCs and cask/canister systems approved by the NRC under separate docket. This limits the facility to receive, transfer, package, and possess SNF as required by 10 CFR 72.2(a)(1).

The identification of the materials to be stored, by reference to the individual cask SARs, form a part of the design criteria for the CISF as required by 10 CFR 72.120(a).

4.4.2 Classification of Structures, Systems, and Components

The classifications of SSC given in Section 3.2, Classification of CISF Structures, Systems, and Components, and Section 7.1, Description of Systems, Structures, and Components, of the CISF TSAR (U. S. Department of Energy, 1998a) are based on definitions developed by the Office of Civilian Radioactive Waste Management (OCRWM) for the CISF. The OCRWM classification categories as identified in DOE/RW 0333P (U.S. Department of Energy, 2000) include

- Important to Radiological Safety (QA–1)—Includes those SSC whose function is

  — to maintain the conditions required to store SNF safely
  — to prevent damage to the SNF during handling and storage
  — to provide reasonable assurance that SNF can be received, handled, packaged, stored, and retrieved without undue risk to the health and safety of the public.

- Important to Waste Isolation (QA–2)—Is applicable only to a geologic repository.

- Important to Radioactive Waste Control (QA–3)—Includes those items associated with the control and management of site-generated liquid, gaseous, and solid radioactive waste; does not include SNF or high-level waste forms.

- Important to Fire Protection (QA–4)—Includes those items whose associated with detecting, controlling or extinguishing a fire for protection of classification QA–1 SSC.

- Important to Potential Interaction (QA-5)—Includes those items whose continued function is not required, but whose consequential failure during a design basis event could impair the capability of other items to perform intended radiological safety functions.

- Important to Physical Protection of Facility and Materials (QA–6)—Includes those items associated with security safeguard systems to protect from acts of radiological sabotage and to prevent the theft of special nuclear material in accordance with 10 CFR Part 73.

- Important to Occupational Radiological Exposure (QA–7)—Includes those items associated with exposure control as well as effluent and area radiation monitoring in accordance with 10 CFR Part 20.

Note that the quality list given in Subsection 2.2.2 of DOE/RW 0333P (U.S. Department of Energy, 2000) has been updated since the CISF TSAR was published and no longer includes the QA–6 category. Consequently, to be in compliance with DOE/RW 0333P, the classification of the various CISF SSCs should be updated in the site-specific CISF SAR.

The CISF TSAR states that QA–1, Important to Radiological Safety, includes all SSC important to safety as defined in 10 CFR 72.3. In particular, important to safety SSC are defined by the NRC as those SSC whose functions are to (i) maintain the conditions required to store SNF or high-level radioactive waste safely, (ii) prevent damage to the SNF or the high-level radioactive waste container during handling and storage, or (iii) provide reasonable assurance that SNF or high-level radioactive waste can be received, handled, packaged, stored, and retrieved without undue risk to the health and safety of the public. The definition of SSC important to safety identified in Section 3.2, Classification of CISF Structures, Systems and Components, of the CISF TSAR is analogous to the NRC definition given in 10 CFR 72.3. The CISF TSAR graded classification system for SSCs important to safety conforms to the requirements of 10 CFR 72.24(n). The CISF TSAR classification system was used to group SSCs by function and to establish the appropriate design criteria.

In response to RAI 12-3, the DOE (U.S. Department of Energy,1998b) specified the important to safety SSC of the CISF. They are

- All QA–1 SSC (summarized in Table 4-3 of this AR)
- Fire Protection Program
- Thermal Monitor Surveillance
- Pressure Monitor Surveillance

In addition, the staff considers that the cask storage pads should also be an important to safety SSC. The rationale for staff's conclusion is given later.

Table 4-2 conveys the CISF QA designations for the CISF SSC as identified in the CISF TSAR. The staff reviewed these classifications with respect to DOE/RW 0333P and NUREG/CR–6407 (Idaho National Engineering Laboratory, 1996). The CISF TSAR classifies the storage cask system SNF canisters as QA–1 because they are the primary confinement barrier. The staff agrees with this classification based on the fact that failure could directly result in a condition adversely affecting public health and safety. Moreover, the staff concludes that the SNF canisters can also be classified as an important to safety, Category A, SSC in accordance with NUREG/CR-6407 . Other components of the storage cask systems are also classified as QA–1 in conjunction with QA–3, QA–4, QA–5, QA–6, and QA–7 in the CISF TSAR. As identified in Table 4-3, these other components included the storage casks, lifting yokes, casks carriers, canister transfer equipment, and facility storage cask transporters. Failure or malfunction of these components could indirectly result in a condition adversely affecting public health and safety. The staff concludes that these other components can also be classified as important to safety, Category B, in accordance with NUREG/CR–6407. The failure of a Category B item, in conjunction with the failure of an additional item, could result in an unsafe condition.

Thermal and pressure monitoring are required for certain storage cask systems after emplacement on the concrete pads located in the CISF storage area. Failure of these monitoring systems does not immediately affect the safe storage of the SNF nor the public health because the cask systems are required to operate in a passive manner for several days without incident. This allows sufficient time to detect a given sensor failure and perform the necessary repairs. Therefore, the instrumentation for thermal and pressure monitorings of storage cask systems are not classified as important to safety. However, surveillance of the monitored signals from these instruments is necessary to detect abnormal temperature increase due to blockage or air inlet(s) and, for the NAC STC system, leakage of the inner seals. Therefore, the staff concurs that the surveillance of temperature and pressure are important to safety features. The radiation monitoring system to be used at the CISF installation is not considered to be important to safety because it is not used in conjunction with any interlocks to control access to unshielded, high radiation areas. The thermal, pressure, and radiation monitoring systems are identified in the CISF TSAR as supporting aspects of the ALARA program. The staff agrees with the classifications of the thermal, pressure, and radiation monitoring systems.

The CISF TSAR identifies the transfer facility as QA–1, QA–3, QA–4, QA–5, QA–6, and QA–7. Specific components of the transfer facility that are classified as QA-1 are identified in Table 4-3. The staff agrees with this classification because failure of the transfer facility or some of its components could indirectly result in a condition that would adversely affect public health and safety. The failure of the transfer facility structure (e.g., a wall) or one of its QA-1 components (e.g., an overhead bridge crane), in conjunction with the failure of an additional item, could result in an unsafe condition during canister transfer operations. Therefore, the staff concludes that the transfer facility and the QA–1 components delineated in Table 4-3 can also be classified as important to safety, Category B, SSC in accordance with NUREG/CR–6407.

Monitoring systems identified in the CISF TSAR for the transfer facility include monitoring of the load handling equipment. The load handling systems are required to be fail-safe. Therefore, the load handling monitoring instrumentation and control systems for important to safety components do not have to be classified as important to safety. The monitoring systems support the defense in-depth program but do not perform important to safety functions.

Although the transfer facility contains a control room, it does not perform any important to safety functions, and, consequently, does not have to be designed to provide safe control under off-normal or accident conditions as required by 10 CFR 72.122(j). Therefore, the staff agrees that the control room does not have to be classified as important to safety SSC.

The CISF TSAR identifies cask storage areas as QA-5, Important to Potential Interaction. The staff agrees with this classification based on the fact that they are designed to ensure a stable and level support surface for the storage cask under normal, off-normal, and accident level conditions. The cask storage areas also provide an impact surface for the drop/tipover accident conditions of the storage casks.

Failure of the storage pads may not create a situation adversely affecting public health and safety. However, the staff finds that the storage pads could have an impact on safety. Therefore, the storage pads can also be classified as important to safety, Category C, SSC in accordance with NUREG/CR–6407. The site-specific CISF SAR may need to be adjusted regarding the classification of the concrete storage pads to important to safety and the necessary analyses performed to demonstrate the ability to withstand applicable design basis events.

The Fire Protection Program is identified in the CISF TSAR as an important to safety feature to mitigate the effect of fire. The fire protection pump building is classified as QA–4, Important to Fire Protection and QA–7, Important to Occupational Radiological Exposure. The staff agrees with the QA–4 classification based on the fact that it includes those items associated with detecting, controlling, or extinguishing a fire for protection of classification QA–1 SSC. The staff also agrees with the QA–7 classification based on the fact that it includes those items associated with exposure control as well as effluent and area radiation monitoring in accordance with 10 CFR Part 20. It should be noted that the CISF TSAR does not take credit for functionality of the fire protection program in the accident analysis in accordance with 10 CFR 72.122(c). The CISF TSAR states that limited combustible material at the facility limits the bounding fire duration and temperature to levels that will not adversely influence the performance of QA–1 SSC. Consequently, failure of the fire protection system would not reduce the effectiveness of the storage cask systems and would not be likely to create a situation that would adversely affect the public health and safety. In addition, use of the fire protection system during a fire would not result in the necessity for effluent control because of the low levels of contamination on the exterior of the canister systems. Therefore,the staff finds that the fire protection program classification is equivalent to an important to safety, Category C, designation.

The CISF TSAR identifies both the security complex and inspection gatehouse as QA–6, Important to Physical Protection of Facility and Materials. The staff agrees with the QA–6 classification based on the fact that it includes those items associated with security safeguard systems to protect from acts of radiological sabotage and to prevent the theft of special nuclear material in accordance with 10 CFR Part 73. As a result, the staff finds that the security complex and inspection gatehouse can be classified as not important to safety. As noted previously, the QA–6 category has been eliminated from Subsection 2.2.2 of DOE/RW 0333P (U.S. Department of Energy, 2000). The site-specific CISF SAR should be updated to reflect the latest version of the classification categories.

Table 4-2. Centralized Interim Storage Facility quality assurance classifications (based on Tables 1.2-2 and 7.1-1 and Figure 1.2-1 of the Topical Safety Analysis Report)

Facility	CISF Quality Assurance (QA) Classification
Storage Cask Systems	QA–1, QA–3, QA–4, QA–5, QA–6, and QA–7
Transfer Facility Including Concrete and Structural Steel	QA–1, QA–3, QA–4, QA–5, QA–6, and QA–7
Storage Areas Including Pads	QA–5
Fire Protection Pump Building	QA–4, QA–7
Security Complex and Badging Area	QA–6
Inspection Gatehouse	QA–6
Switchgear Building	Conventional quality designed to industrial standards
Main Gatehouse	Conventional quality designed to industrial standards
Transporter Wash-Down Station	Conventional quality designed to industrial standards
Receiving Gatehouse	Conventional quality designed to industrial standards
Potable Water Well House	Conventional quality designed to industrial standards
Transportation Cask Queuing Area Operations, Facilities, and/or Structures, Systems, and Components	Not Identified
Off-Normal Holding Area Operations, Facilities, and/or SSCs	Not Identified
On-Site Receiving Area Operations, Facilities, and/or SSCs	Not Identified
Concrete Cask Staging Area Operations, Facilities, and/or SSCs	Not Identified

CISF–Centralized Interim Storage Facility
SSC–Structures, Systems, and Components

Table 4-3. Centralized Interim Storage Facility QA–1, structures, systems, and components (based on Table 3.2-1of the CISF Topical Safety Analysis Report)

System	Components
Storage Facility Storage Cask Systems	NUHOMS® MP187 Cask System,* NUHOMS® HSM System,* Holtec HI-STAR Cask System,* NAC STC Cask System,* Sierra TranStor™ Cask System,* Westinghouse Large MPC Cask System,* and Westinghouse Small MPC Cask System*
Transfer Facility Structural	Concrete columns, beams, grade and roof slabs, walls and crane corbels
	Structural steel shapes, plates and bolts, and welding materials
	Access door blowout panels
	Miscellaneous equipment mounting structures, hangers, and anchorages
	Caissons, rock anchors, or both
	Rails for overhead bridge cranes
Transfer Facility Cask Off-Loading and Loading	225-ton capacity overhead bridge cranes
	Lifting yokes for NUHOMS® MP187 transport cask,* Holtec HI-STAR,*TranStor™ transport casks,* Westinghouse Large and Small transport casks,* and NAC STC*
Transfer Facility Cask Carrier	Intermediate lifting devices for storage casks*
	Transfer cradles: Westinghouse Large and Small transport casks*
	Upender/downender and equipment: Westinghouse Large and Small transport casks*
	Support frame: TranStor™ transport, transfer, and storage casks*
Transfer Facility Canister Transfer	Rams for transferring Westinghouse Large and Small canisters*
	TranStor™ transfer cask and canister lifting slings*
Storage Facility Storage Cask Transporter	NAC STC/Holtec/Sierra transporter*, Westinghouse MPC transporter,* NUHOMS® MP187 transfer trailer*
*Vendor-supplied equipment	

The switchgear building, main gatehouse, transporter wash-down station, receiving gatehouse, and potable water well house are identified as conventional quality designed to industrial standards. The staff agrees with this classification of these SSC.

The storage cask systems are passive systems that do not require electricity to maintain their ability to perform their safety function. Because the canister transfer SSC are designed to be fail-safe, they do not require electricity to maintain the canisters in a safe condition. There are no important to safety SSC at the CISF installation that require electrical power to maintain their ability to perform their safety function. Consequently, the electrical system SSC are not classified important to safety. The staff agree that the electrical system SSC are not important to safety.

The main gatehouse is used to control and monitor personnel and vehicular access to the CISF. The safety function of important to safety SSC is not directly affected by the performance of this system. Therefore, the staff finds that the main gatehouse can be classified as not important to safety.

The transporter wash-down station is used to remove road dirt from the transporter vehicles prior to access to the transfer facility. DOE states that the design of the cask transportation systems is such that the level of potential contamination from this activity should be below levels necessary for control of the effluent. The safety function of important to safety SSC should not be directly affected by the performance of this system. Therefore, it appears that the transporter wash-down station can be classified as not important to safety.

The receiving gatehouse is used to monitor and approve access to the CISF installation for incoming deliveries. It is located on the controlled area boundary and is staffed only when deliveries are expected. The safety function of important to safety SSC is not directly affected by the performance of this system. Therefore, the staff finds that the receiving gatehouse can be classified as not important to safety.

The potable water well house is part of the water supply system that provides domestic drinking water, hot and cold water, and water for emergency safety shower and eyewash stations within the CISF. The system also provides service water for various uses, makeup water for the site fire protection distribution system storage tanks and the site HVAC systems, and water to the site transporter wash-down station. The safety function of important to safety SSC is not directly affected by the performance of this system. Therefore, the staff found reasonable assurance that the potable water well house can be classified as not important to safety.

It should be noted that the CISF TSAR has not classified some of the facility components that were identified in Table 1.2-2 and Figure 1.2-1 of the CISF TSAR. This includes operations, facilities, and/or SSCs associated with include the transportation cask queuing area, the off-normal holding area, the on-site receiving area, and the concrete cask storage area. The site-specific CISF SAR must identify the classification of these area operations, facilities, and/or SSCs and the associated design criteria as appropriate. The staff finds that the concrete pads of the off-normal holding area should be classified at the same level as the concrete storage pads. The holding area should be designed to ensure a stable and level support surface for the storage cask under normal, off-normal, and accident level conditions. The holding area should also provide an impact surface for the drop/tip-over accident conditions of the storage casks. Although failure of the concrete pads of the off-normal holding area would not be likely to create a situation adversely affecting public health and safety, the off-normal holding area pads will have a minor impact on safety. Therefore, the off-normal holding area can also be classified as important to safety, Category C SSC in accordance with NUREG/CR–6407. The site-specific CISF SAR should classify the off-normal holding area as important to safety SSC and perform the necessary analyses to demonstrate its ability to withstand applicable design basis events commensurate with the concrete storage pads.

The CISF TSAR identified the SSC important to safety to be covered by the QAP as required in 10 CFR 72.144(a) and (c). The staff concluded that this list of SSC is based on the definition of SSC important to safety in 10 CFR 72.3 as identified in 10 CFR 72.120(a). They are identified as items whose functions are: (i) to maintain the conditions required to store SNF safely; (ii) to prevent damage to the SNF container during handling and storage; and (iii) to provide reasonable assurance that SNF can be received, handled, packaged, stored, and retrieved without undue risk to the health and safety of the public. The SSC classified as QA–1 and considered to be important to safety are identified in Table 4-2 of this AR.

4.4.3 Design Criteria for Structures, Systems, and Components Important to Safety

After establishing the SSC classifications, design criteria are selected for each classification. The principal design criteria identified for SSC important to safety at the CISF are described in Chapter 3, Principal Design Criteria, of the CISF TSAR. This section of the AR presents the evaluation of Sections 3.3, Design Criteria for CISF QA–1 Structures, Systems, and Components; 3.4, Design Criteria for Transportable Storage Casks and Cask/Canister Systems; 3.5, Design Criteria for Other Structures, Systems, and Components Subject to NRC Approval; 3.6, Performance Criteria, and 3.8, Summary of CISF Principal Design Criteria, of the CISF TSAR. Details of the design criteria evaluation for SSC important to safety are provided in Subsections 4.4.3.1 through 4.4.3.7 of this AR.

Evaluation of the CISF TSAR with respect to some regulatory requirements pertaining to SSC and design criteria evaluation is contained in other chapters of this AR. Evaluation of the quality standards to which the SSC important to safety must be designed, fabricated, erected, and tested as required by 10 CFR 72.122(a) and 72.144(c) is provided in Chapter 12, Quality Assurance Evaluation, of this AR. 10 CFR 72.122(f) requires that SSC important to safety must be designed to permit inspection, maintenance, and testing. These requirements are addressed in Subsection 4.4.8, Maintenance Systems, and 13.2, Pre-Operational Testing and Operation, of the CISF TSAR and Chapter 10, Conduct of Operations Evaluation, of this AR.

As identified in Subsection 4.4.2, Classification of Structures, Systems, and Components, of this AR, the instrumentation and control systems, control room/area, and utility services are not classified as important to safety. Therefore, the requirements of 10 CFR 72.122(i–k) are not applicable to the discussion in this section.

10 CFR 72.182 requires that the design for physical protection must show the site layout and the design features provided to protect the ISFSI from sabotage. Section 4.9, Physical Protection, of the CISF TSAR provides a description of the material to be contained in the site-specific

security plan. An evaluation of the CISF physical protection plan is beyond the scope of review of this chapter.

4.4.3.1 General

The general design criteria used in the design of CISF QA–1 SSC are given in Sections 3.1, Stored Materials, and 3.3, Design Criteria for CISF QA–1 Structures, Systems, and Components, of the CISF TSAR. An evaluation of the design criteria for the materials to be stored at the CISF was performed. Table 4-4 provides a summary the general CISF design criteria.

DOE states in Subsection 3.6.4, Facility Service Life, of the CISF TSAR that the CISF will have a maintainable service life of 40 yr. As pointed out in 10 CFR 72.42, however, the license term for an ISFSI must not exceed 20 yr from the date of issuance. To continue operation of the CISF beyond the initial licensing period, application for renewal of the license should be filed in accordance with the applicable provisions of 10 CFR Part 72, Subpart B, at least 2 yr prior to the expiration of the existing license (as per 10 CFR 72.42).

The design criteria delineated in the CISF TSAR satisfied the overall requirements given in 10 CFR 72.122(b) for protection against environmental conditions and natural phenomena. The overall requirements given in 10 CFR 72.122(c) were not satisfied for protection against fires and explosions, however. The design criteria for fire for the off-normal and accident conditions are based on the CISF TSAR contentions that fire is not a credible event because of the lack of combustible material and the inherent design of the transfer facility and cask/canister systems. The staff determined that all of the potential combustible sources have not been considered (i.e., the locomotive and heavy-haul vehicle fuel tanks were not addressed).

Details of the design criteria of the individual storage cask and canister systems confinement structures are contained in the vendor SARs. The staff did not review these documents in detail. Compliance with the requirements of 10 CFR Part 71 and 10 CFR 72.236 was assumed to be demonstrated in the vendor SARs and evaluated in the individual cask system NRC CoC SERs. The six cask systems presented in Table 4-1 were used for the purpose of developing bounding CISF design criteria. The bounding nature of the CISF design criteria will have to be reevaluated in the context of the specific cask systems chosen for use in the site-specific CISF SAR.

Table 4-4. Summary of Centralized Interim Storage Facility design criteria—general

Design Parameters	Design Conditions	Criteria and Codes
Design Life	40 yr	CISF Specifications
Storage Capacity	40,000 MTU of commercial spent nuclear fuel	CISF Specifications
Number of Casks	5,300 to 7,800 casks	CISF Specifications
* CISF–Centralized Interim Storage Facility ‡ MTU–Metric Tons of Uranium		

4.4.3.2 Structural

The structural design criteria, given in Subsection 3.3.1, Structural, of the CISF TSAR, considered for the design of CISF QA–1 SSC are developed from generic site characteristics and used in determining the structural loads and load combinations for the analyses identified in Chapter 7, Installation Design and Structural Evaluation, of the CISF TSAR. Table 3.8-1 of the CISF TSAR gives a summary of the design criteria that are comprehensive and consistent with standard design criteria (i.e., ANSI/ANS 57.9, 1992, and ANSI/ASCE 7-95, 1996) as required by 10 CFR 72.24(c)(1). The structural design criteria are identified in Table 4-5. Table 4-5 also identifies the applicable codes and standards as required by 10 CFR 72.24(c)(4). Each of the design criteria identified in Table 4-5 is discussed in detail below.

Design basis tornado characteristics, given in Subsection 3.3.1.1, Tornado (Wind Load), of the CISF TSAR, are based on Regulatory Guide 1.76 and NUREG–0800 (U.S. Nuclear Regulatory Commission, 1974, 1981a). The design basis tornado wind speed and air pressure drop parameters represent the worst case conditions identified in Regulatory Guide 1.76 and, therefore, are considered by the staff to envelope design criteria for the continental United Sates. Three design basis tornado missiles, given in Subsection 3.3.1.2, Tornado (Missile Spectrum), of the CISF TSAR included massive, penetrating, and small missiles. Details of the missiles are contained in Tables 3.3-2 through 3.3-4 of the CISF TSAR. Design basis tornado missiles are based on Subsection 3.5.1.4, Spectrum I Tornado Missiles, of NUREG–0800 (U.S. Nuclear Regulatory Commission, 1981a). The staff finds that the CISF TSAR meets the guidance given in Regulatory Guides 1.76, and NUREG–0800 for tornado and tornado missile design criteria.

Non-tornado wind parameters, given in Subsection 3.3.1.3, Straight Wind, of the CISF TSAR, are based on criteria from ANSI/ASCE 7-95 (American National Standards Institute and American Society of Civil Engineers, 1995). The 50-yr mean recurrence interval, 110-mph wind speed bounds most locations in the 48 contiguous United States, with the exception of coastal regions with hurricane exposure. Exposure Category C is the most conservative classification for land based facilities and represents full development of the wind over unobstructed land. The Importance Factor, 1.15, for QA–1 SSC increases the wind speed to a 100 year mean recurrence interval. The staff finds that the CISF TSAR meets the requirements of 10 CFR 72.120(a) and 72.122(b) in that the environmental design criteria for straight wind conditions are identified consistent with standard design criteria.

Precipitation criteria, given in Subsection 3.3.1.5, Precipitation, of the CISF TSAR, are based on a review of historical data for the continental United States contained in National Weather Service Report No. 52 (National Weather Service, 1982) and are intended to ensure that CISF drainage areas and drainage systems are adequately designed. Estimates are based on probable maximum precipitation values that are based on a 100-yr recurrence interval. QA–1 SSC are to be located above the maximum flood level. If the CISF is sited at a location susceptible to flooding, an analysis should be made in accordance with Regulatory Guide 3.48 (U.S. Nuclear Regulatory Commission, 1989) for potential flood effects in the site-specific CISF SAR. The staff finds that the CISF TSAR meets the requirements of 10 CFR 72.120(a) and 72.122(b) in that the environmental design criteria for precipitation and floods are identified consistent with standard design criteria.

Snow and ice loading criteria, given in Subsection 3.3.1.6, Snow and Ice, of the CISF TSAR, are adopted from ANSI/ASCE 7-95 (American National Standards Institute and American Society of Civil Engineers, 1995). Based on Figure 7-1 of ASCE 7-95, snow and ice loading criteria covers the majority of the 48 contiguous United States with the exception of some mountainous locations and the North Central portion of the country. The staff finds that the CISF TSAR meets the requirements of 10 CFR 72.120(a) and 72.122(b) in that the environmental design criteria for snow and ice loading are identified consistent with standard design criteria.

Seismic design requirements, given in Subsection 3.3.1.7, Seismic-Ground Motion, of the CISF TSAR, include a 0.75-g horizontal acceleration used in conjunction with Regulatory Guide 1.60 (U.S. Nuclear Regulatory Commission, 1973a) response spectra. This earthquake is applied at the structure foundation (assuming a shallow foundation). Given the horizontal acceleration, Regulatory Guide 1.60 (U.S. Nuclear Regulatory Commission, 1973a) sets both horizontal and vertical response spectra that will be validated against actual site characteristics (and possibly modified) once a site is designated. The CISF design (Subsection 3.3.1.8, Seismic - Surface Faulting, of the CISF TSAR) assumes that all SSC important to safety are located away from capable faults. The design criteria for the earthquake loading anchored at 0.75 g satisfied the regulatory requirements of 10 CFR 72.102(a, b, and f). The CISF TSAR meets the Regulatory Guides 1.60 and 1.61 (U.S. Nuclear Regulatory Commission, 1973b) for seismic events.

The probability of a volcanic eruption in the vicinity of most United States nuclear facilities is low enough that no specific design considerations are made for ash fall, as identified in Subsection 3.3.1.9, Volcanic Eruption (Ash Fall), of the CISF TSAR. This reasoning supported a no-ash-fall criterion for the design of the CISF installation. Site-specific characteristics may require the consideration of volcanic ash-fall loads.

The CISF will be designed to ensure that air overpressures produced by postulated off-site and on-site explosions do not exceed 1.0 psi (Subsection 3.3.1.10, Explosions, of the CISF TSAR). Postulated off-site explosions are based on Regulatory Guide 1.91, (U.S. Nuclear Regulatory Commission, 1978a). A vapor explosion involving a 2,000-gal. diesel fuel tanker truck provided the basis for an on-site explosion. Based on the information provided in Regulatory Guide 1.91 this air overpressure will not result in damage to structures important to safety. The site-specific CISF SAR will have to demonstrate 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 SSC important to safety to withstand this loading condition without affecting their ability to perform their safety functions will have to be demonstrated.

Absence of a design basis aircraft criterion, given in Subsection 3.3.1.11, Aircraft Impact, of the CISF TSAR, is consistent with the typical approach taken in nuclear power plant design and licensing. NUREG–0800 (U.S. Nuclear Regulatory Commission, 1981a) provides criteria against which hazards from aircraft can be assessed. Meeting those criteria provides reasonable assurance that the probability of off-site release resulting in radiological consequence greater than the 10 CFR Part 100 limits due to aircraft impact is low. Similar arguments can be applied to the CISF. If the CISF is sited at a location susceptible to aircraft impact, an analysis will be necessary to determine the site-specific potential effects in the site-specific CISF SAR.

The structural design criteria for lightning are addressed in Subsection 4.4.2.1.1.7, Grounding and Lightning Protection, of the CISF TSAR. The lightning protection system will be designed in accordance with NFPA 780 (National Fire Protection Association, 1997a). The staff finds that the CISF TSAR meets the requirements of 10 CFR 72.120(a) and 72.122(b) in that the environmental design criteria for lightning are identified and consistent with standard design criteria.

4.4.3.3 Thermal

Thermal design criteria, given in Subsection 3.3.2, Thermal, of the CISF TSAR are derived from generic site characteristics and include ambient temperature and insolation (solar load) (Table 4-6). These criteria are used in the analysis of CISF SSC. Details of the design criteria used in the thermal performance analyses of the individual storage cask and canister systems are contained in the vendor SARs. Compliance with the design criteria requirements 10 CFR 72.122(b and c) was assumed to be demonstrated in the vendor SARs and associated NRC CoC evaluations. The bounding nature of the CISF design criteria will have to be validated with respect to the specific cask systems chosen in the site-specific SAR.

Ambient temperature values given in Subsection 3.3.2.1, Ambient Temperature, of the CISF TSAR are based on a review of temperature data and chosen to bound most of the locations in the 48 contiguous United States. The normal, long-term annual average design ambient temperature of 76°F is based on the maximum average annual temperature in the 48 contiguous United States as identified in the ASHRAE Handbook (American Society of Heating, Refrigeration and Air Conditioning Engineers, 1993). The selection of 76°F as the maximum average annual temperature is acceptable. The minimum temperature of −40°F and the maximum of 125°F bound most potential CISF sites in the 48 contiguous United States. The National Oceanic and Atmospheric Administration (NOAA) identifies the lowest temperature extreme in North America as -70°F in Rogers Pass, Montana, on January 20, 1954. The minimum guideline temperature used to test packaging for transport of radioactive material as stated in 10 CFR 71.71(c)(2) is −40°F. NOAA identifies the highest temperature extreme in North America as 134°F in Death Valley, California on July 10, 1913. The recorded extremes are not bounded by the design criteria specified in the CISF TSAR. The median value of the temperature extremes experienced each year implies that the maximum temperature during some years is more extreme than the median values reported in the ASHRAE Handbook (American Society of Heating, Refrigeration and Air Conditioning Engineers, 1993). The staff finds that the CISF TSAR meets the requirements of 10 CFR 72.120(a) and 72.122(b) in that the environmental design criteria for temperature extremes are identified and consistent with standard design criteria. The bounding nature of the CISF design criteria will have to be validated with respect to the site-specific environmental conditions in the site-specific CISF SAR.

Solar insolance criteria, given in Subsection 3.3.2.2, Solar Load (Insolation), of the CISF TSAR, are based on values specified in 10 CFR Part 71 for testing transportation packages. The staff finds that the CISF TSAR meets the requirements of 10 CFR 72.120(a) and 72.122(b) in that the environmental design criteria for solar load are identified and consistent with standard design criteria.

Specific design basis fire parameters are not identified in the CISF TSAR. The fire hazard analysis for the facility contained in Appendix 4A, Fire Hazard Analysis Summary and System Evaluation, characterizes potential fires as “low,” “ordinary,” “moderate,” “high,” or “severe.” Specific design basis fire parameters for each of these levels are not identified. The probable or expected severity of a fire is one of the factors used to determine the level of fire protection required. The severity of fire can also be used to determine the credible fire scenario within a given location. The site-specific CISF SAR must provide specific fire design basis parameters, such as duration and flame temperature, so that the integrity of SSC can be evaluated under these conditions. The design basis fire parameters must include all potential combustibles (e.g., locomotives and heavy-haul vehicle fuel sources).

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Table 4-5. Centralized Interim Storage Facility structural design criteria (based on tables 1.2-1 and 3.8-1 of the Topical Safety Analysis Report)

Design Parameter	Design Criteria		Condition	Basis
Tornado (Wind Load)	Max translational speed: Max rotational speed: Max tornado wind speed: Radius of maximum rotational speed: Tornado pressure drop: Rate of pressure drop: Gust factor:	70 mph 290 mph 360 mph 150 ft 3.0 psi 2.0 psi/s 1.0	Accident	Regulatory Guide 1.76 NUREG–0800
Tornado (Missile)	Massive Missile, Automobile: 3968 lb, 28 ft^2 frontal area, 126 mph horizontal impact speed, 88.2 mph vertical impact speed Penetrating Missile, Artillery shell: 276 lb, 8 in. diameter, 126 mph horizontal impact speed, 88.2 mph vertical impact speed Small Missile, Steel sphere: 0.15 lb, 1 in. diameter, 126 mph horizontal impact speed, 126-mph vertical impact speed		Accident	NUREG–0800, Spectrum I
Straight Wind	110 mph (3 second gust), Exposure Category C, QA–1, Structures, Systems, and Components, IF = 1.15 All other Structures, systems, and components IF = 1.00		Off-Normal	ANSI/ASCE 7-95
Floods	None specified. QA–1, Structures, Systems, and Components, are located above maximum flood plain by site-selection		Accident	Regulatory Guide 3.48
Precipitation	Cumulative, 5 min: 6.2 in. Cumulative, 1 hr: 19.4 in.		Normal	NWS Report No. 52
Snow and Ice	Loading: 50 lb/ft^2 QA–1, Structures, Systems, and Components, IF = 1.2 All other structures, systems, and components, IF = 1.0		Normal	ANSI/ASCE 7-95
Seismic (Ground Motion)	Design response spectra anchored at horizontal acceleration of 0.75 g		Accident	Regulatory Guide 1.76 Regulatory Guide 1.60
Seismic (Surface Faulting)	No surface faulting by site selection.		Accident	10 CFR 100, Appendix A
Volcanic Eruption (Ash Fall)	No volcanic ash fall by site selection.		Accident	N/A
Explosions	Air overpressure at facility owing to on-site or off-site explosion not to exceed 1.0 psi		Accident	Regulatory Guide 1.91
Aircraft Impact	None specified		Accident	NUREG–0800
Lightning	All SSCs to be designed in accordance with NFPA 780		Off-Normal	NFPA 780

Table 4-6. Centralized Interim Storage Facility thermal design criteria (based on Table 3.8-1 of the Topical Safety Analysis Report)

Design Parameter	Design Criteria	Condition	Basis
Ambient Temperature	Normal temperature: 76.0°F Minimum temperature: −40.0°F Maximum temperature: 125.0°F	Normal	ASHRAE Handbook 10 CFR 71.71
Solar Load (Insolation)	Horizontal flat surface solar insolation: 2,949.4 Btu/day-ft^2 Curved surface solar insolation: 1,474.7 Btu/day-ft^2	Normal	10 CFR 71.71
Fire	Based on fire hazard analysis given Appendix 4A of the CISF TSAR	Accident	ANSI/ANS 57.9 NFPA Codes

ANSI–American National Standards Institute
ASHRAE–American Society of Heating, Refrigeration and Air Conditioning Engineers
NFPA–National Fire Protection Association

4.4.3.4 Shielding, Confinement, and Radiation Protection

The design criteria given in Subsection 3.3.4, Radiological Protection, of the CISF TSAR, apply to radiation protection of the CISF. As identified in the CISF TSAR, the occupational radiation exposure protection for the CISF is provided in accordance with 10 CFR Part 20 requirements. NUREG–0761 (U.S. Nuclear Regulatory Commission, 1981b) was used in the CISF TSAR to establish radiation protection criteria for the transfer facility building. A summary of the CISF shielding, confinement, and radiation protection design criteria is given in Table 4-7.

As identified in the CISF TSAR, during normal operations and all anticipated occurrences, the annual dose equivalent for any individual located beyond the controlled area will not exceed 25 mrem to the whole body, 75 mrem to the thyroid, or 25 mrem to any other critical organ. The staff finds that the annual dose equivalent is in accordance with the requirements of 10 CFR 72.104(a). The design criteria for radioactive materials in effluents and direct radiation from the CISF are in accordance with the requirements of 10 CFR 72.104(b) and (c).

As identified in the CISF TSAR, the dose in any unrestricted area from external sources will not exceed 2 mrem in any one hour, in accordance with 10 CFR 20.1301(a)(2). The CISF installation will not be located in the vicinity of any uranium fuel cycle operations so that any activities at those facilities will not pose any potential hazards to the proposed CISF. This assumption is consistent with the assumption stated in Section 2.2, Nearby Industrial, Transportation, and Military Facilities, of the CISF TSAR. Therefore, the influence of other uranium fuel cycle operations on the exposure of the public and/or workers can be eliminated, which is in accordance with the requirements of 10 CFR 72.104(a)(3).

As identified in the CISF TSAR, the maximum individual dose at or beyond the site boundary, resulting from a design basis accident, will be less than 5 rem to the whole body or any organ. Since the release of the CISF TSAR, the requirements identified in 10 CFR 72.106 have been modified. The current version of the CISF TSAR identifies that any individual located on or beyond the nearest boundary of the controlled area may not receive from any design basis accident the more limiting of a total effective dose equivalent (TEDE) of 0.05 Sv (5 rem), or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue (other than the lens of the eye) of 0.5 Sv (50 rem). The lens dose equivalent shall not exceed 0.15 Sv (15 rem) and the shallow dose equivalent to skin or any extremity shall not exceed 0.5 Sv (50 rem). The staff finds that the accident dose limits for controlled areas in the CISF are identified as required by 10 CFR 72.106, but the CISF TSAR must be modified to address the current regulatory requirements.

The CISF TSAR identifies that the facility will include the means to shield personnel from radiation exposure in accordance with 10 CFR 72.126. In normally occupied areas (2,000 hr/yr), the shielding design basis limits the maximum exposure to an individual worker to 500 mrem/yr (0.25 mrem/hr). In intermittently occupied areas, shielding is provided to support achievement of an ALARA goal for average personnel exposure of 1 rem/yr. When possible, equipment that normally is operated in a radioactive environment is designed to allow removal to a nonradioactive environment for maintenance and repair. When this is not possible, the design allows for installation of temporary shielding. The staff finds that the radiation protection design criteria for workers are identified as required by 10 CFR 72.126.

To limit dose rates to the public and workers below regulatory requirements, the CISF TSAR indicated that dose rates (gamma plus neutron) at 2 m from any vertical surface (as stored) are required to be less than 10 mrem/hr. Radiation streaming from storage cask vents and vertical surfaces must be a small component of total dose rates (e.g., area weighted value less than 5 percent of radial surface dose rate) and have an insignificant (i.e., less than 1 percent) influence on dose rates at distances greater than 50 m. The air-scattered component of total dose rate at distances greater than 50 m must be less than 50 percent.

The surface contamination limit for casks and canisters at the facility is given as 30,000 dpm/100 cm^2 prior to placement in storage. Prior to shipment off-site, the transport cask surface contamination must meet the requirements of 10 CFR 71.87. These design criteria are to limit potential exposure to the public and workers.

As identified in the CISF TSAR, the design of concrete radiation shielding for the CISF is to comply with ANSI/ANS 6.4 (American National Standards Institute and American Nuclear Society, 1985) and American Concrete Institute (ACI) 349-90 (American Concrete Institute, 1990) when it provides a critical confinement or structural function. For other radiation shields, ACI 318-95 (American Concrete Institute, 1995) has been considered. Straight-line penetration of shield walls are avoided to prevent radiation streaming. The staff finds that the radiation shielding design criteria for the facility are identified as required by 10 CFR 72.126. Details of the design criteria used in the design of cask radiological protection features of the individual storage cask and canister systems are provided in the respective vendor SARs. Criteria used in the confinement design of the cask systems, given in Subsection 3.3.3, Confinement, of the CISF TSAR, are provided in the vendor SARs. The staff did not review these documents in detail. Compliance with the design criteria requirements of 10 CFR 72.126 was assumed to be demonstrated in the vendor SARs and associated NRC CoC evaluations.

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Table 4-7. Centralized Interim Storage Facility shielding, confinement, and radiation protection design criteria (based on Table 3.8-1 of the Topical Safety Analysis Report)

Design Parameter	Design Criteria	Condition	Basis
Type of Fuel	Commercial, light water reactor, SNF as identified in the cask vendor SARs	Normal	Vendor SARs
Storage Systems	TSCs and cask/canister systems docketed by the NRC or under development by the DOE as of 6/1/96	Normal	Vendor SARs
Fuel Characteristics	Criteria as specified in cask/canister systems in use at CISF	Normal	Vendor SARs
Shielding	< 5 rem (Public)	Accident	10 CFR 72.106
Proximity to Uranium Fuel Cycle Operations	No uranium fuel cycle operation located in vicinity of CISF	Normal	10 CFR 72.104
Confinement	As listed in vendor system SARs	N/A	N/A
Radiological Protection	< 25 mrem, whole body (Public) < 75 mrem, thyroid (Public) < 25 mrem, other organ (Public)	Normal	10 CFR 72.104
	< 5 rem, whole body (Public)	Accident	10 CFR 72.106
	< 500 mrem/yr (Worker)	Normally occupied area	10 CFR Part 20
	< 1 rem/yr (Worker)	Intermittently occupied area	

As identified in the CISF TSAR, site-specific CISF procedures and engineering controls will be based on sound radiation protection principles to achieve occupational and public doses that are ALARA, as given in Subsection 3.3.7, Satisfaction of ALARA Goals, of the CISF TSAR. The facility design will comply with the ALARA criteria of 10 CFR 20.1003 and Regulatory Guide 8.8 (U.S. Nuclear Regulatory Commission, 1978b). The staff concurs that the ALARA principles of time, distance, and shielding were considered in the design of the CISF. For tasks requiring access to areas in the vicinity of transportation and storage casks, the system design is based on minimizing the time spent near the casks. In the site-specific CISF SAR, special consideration will be given to utility SSC located in radiation areas. The design of these systems will minimize the number of SSC, the need for maintenance on SSC that pass through radiation areas, or both. Where utility subsystem components must be routed through radiation areas, ALARA design principles will be incorporated into the system design. Design criteria incorporating ALARA features into cask systems are provided in the vendor SARs. The staff did not review these documents in detail. Compliance with the design criteria requirements of 10 CFR 20.1003 was assumed to be demonstrated in the vendor SARs and associated NRC CoC evaluations.

Design criteria to establish performance of the storage cask systems to provide confinement barriers, as required by 10 CFR 72.122(h), are assumed to be contained in the vendor SARs. The staff did not review these documents in detail. Compliance with the design criteria requirements of 10 CFR 20.22(h) was assumed to be demonstrated in the vendor SARs and associated NRC CoC evaluations.

The staff finds that the general radiation protection design criteria, given in Subsection 3.3.4, Radiological Protection, of the CISF TSAR, are identified as required by 10 CFR 72.126. The storage area is defined as a radiation area requiring radiological control, per 10 CFR 72.126(a). The CISF design includes the means to measure and control contamination of areas requiring access, per 10 CFR 72.126(a)(4). Radiation monitoring and surveys are to be conducted in accordance with 10 CFR 20.1501 and as necessary to comply with the operating limits imposed by the cask system vendor SARs. The facility design identifies systems for measuring the direct radiation levels in and around areas containing radioactive materials, per 10 CFR 72.126(c)(2).

The staff finds that the design criteria for SNF storage and handling, given in Subsection 3.3.4, Radiological Protection, of the CISF TSAR, were identified as required by 10 CFR 72.128.

4.4.3.5 Criticality

Details of the design criteria for criticality, given in Subsection 3.3.5, Nuclear Criticality Safety, of the TSAR, are based on the individual storage cask and canister systems and are contained in the vendor SARs (see Table 4-8). No attempt was made to review these documents in detail. Compliance with the criticality design criteria requirements of 10 CFR 72.124 was assumed to be demonstrated in the vendor SARs and associated NRC CoC evaluations.

4.4.3.6 Decommissioning Considerations

Criteria for decommissioning, given in Subsection 3.3.6, Decommissioning, of the CISF TSAR, are based on minimizing the areas of potential radioactive contamination and the generation of radioactive waste and contaminated equipment. Materials and coatings utilized will facilitate decontamination or the removal of contaminated materials in the areas of possible radioactive contamination (see Table 4-8). The staff finds that use of these materials and coatings satisfy the requirements of 10 CFR 72.130 and are considered in the CISF design. Criteria used to facilitate decommissioning of vendor cask systems are provided in the vendor SARs. No attempt was made to review these documents in detail. Compliance with the decommissioning design criteria requirements 10 CFR 72.130 for the various cask systems proposed for use at the CISF was assumed to be demonstrated in the vendor SARs and associated NRC CoC evaluations.

4.4.3.7 Retrieval Capability

Design criteria for the CISF functional requirements to receive, package, transfer, store, and retrieve SNF (as identified in Table 4-8) are given in Section 3.7, Material Handling, Storage, and Retrieval Capability, of the CISF TSAR. Additional criteria used in the design of cask systems are provided in the vendor SARs. QA–1 cranes and associated cask/canister lifting equipment identified in the site-specific SAR shall be designed using guidelines Chapter 5 of NUREG–0612, NUREG–0554 (U.S. Nuclear Regulatory Commission, 1980, 1979a), and ANSI/ANS N14.6–1986 (American National Standards Institute and American Nuclear Society, 1986). Storage and handling systems, including the QA–1 cranes, are designed to allow retrieval of SNF in accordance with 10 CFR 72.128(a) to ensure adequate safety under normal and accident conditions.

PRELIMINARY

Table 4-8. Centralized Interim Storage Facility criticality, decommissioning, and retrieval design criteria (based on Table 3.8-1 of the Topical Safety Analysis Report)

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards, and Bases
Nuclear Criticality	As listed in vendor system safety assessment reports	Not Applicable	Not Applicable
Decommissioning	Minimize potential contamination. Utilize materials and coatings to facilitate decommissioning	Normal	10 CFR 72.130
Materials Handling and Retrieval Capability	Cask/canister handling systems safe under all facility conditions	Accident, Off-Normal, and Normal	10 CFR 72.128
	Storage system allows ready retrieval of spent nuclear fuel for further processing	Normal	10 CFR 72.122(l)

Cask systems are designed to withstand tipover or drop during transfer and storage operations under normal and accident conditions. Cask systems are designed and certified to withstand a drop from heights specified in Table 3.3-9 of the CISF TSAR. These height values are based on the required lifting operations at the CISF and a review of individual cask system vendor SAR design criteria. For a drop event, "designed to withstand" is defined as no effects on important to safety functions except the following: partial loss of shielding and confinement system deformation to the extent evaluated in the reference vendor SARs. Cask systems using vertical transfer must be qualified for a 6-in. drop of the storage cask or transportation cask lid during transfer operations. Based on Tables 8-1 and 8-2 of Drop Accident CISF TSAR Design Basis Event Analysis (Bader, 1997), a number of the proposed cask systems (Table 3.1-1 of the CISF TSAR) are not qualified to be used in the CISF based on end or side drop heights criteria. If the site-specific operational conditions are shown to exceed these specified heights, allowances for the inspection process identified in the particular cask system vendor SAR will have to be incorporated into the site-specific SAR. Retrieval capability is considered in the CISF design. Criteria used to facilitate retrieval of vendor cask systems are also provided in the vendor SARs. No attempt was made to review these documents in detail. Compliance with the retrieval capability design criteria requirements of 10 CFR 72.236(m) was assumed to be demonstrated in the vendor SARs and associated NRC CoC evaluations.

As identified in the CISF TSAR, cask systems designed to transfer SNF canisters external to the transfer facility structure are assumed to be designed to withstand the impact of the postulated tornado missiles during transfer operations. For this event, "designed to withstand" is defined as no effects on important to safety functions except the following: partial loss of shielding to the extent evaluated in the reference vendor SARs. No attempt was made to review these documents in detail. Compliance with the retrieval capability design criteria requirements was assumed to be demonstrated in the vendor SARs and associated NRC CoC evaluations.

As identified in the CISF TSAR, a recovery method for the unlikely loss of confinement event will be provided for cask systems using canisters. The CISF TSAR states that the method of recovery must be independent of any bare fuel handling facilities.

The staff finds that criteria for retrievability, given in Section 3.7, Material Handling, Storage, and Retrieval Capability, of the CISF TSAR, satisfied the requirements of 10 CFR 72.122(l) and are considered in the CISF design. Criteria used to facilitate retrievability of vendor cask systems are provided in the vendor SARs. No attempt was made to review these documents in detail. Compliance with the design criteria requirements given in 10 CFR 72.130 was assumed to be demonstrated in the vendor SARs and the associated NRC CoC evaluation.

4.4.4Design Criteria for Other Structures, Systems, and Components

The design criteria for other CISF SSC are discussed in Section 3.5, Design Criteria for Other Structures, Systems, and Components Subject to NRC Approval, of the CISF TSAR. The other SSC subject to NRC approval have not been described in sufficient detail for an adequate evaluation to be performed. This information is needed to determine the adequacy of these SSC to perform their function and/or to ensure that they do not adversely influence important to safety SSC.

4.4.4.1 Design Criteria for Transportable Storage Casks and Cask/Canister Systems

SNF storage at the CISF is based on the use of TSC and cask/canister systems docketed by the NRC or under development by the DOE. Design criteria for these systems are included in the CISF TSAR by reference. Vendor cask principal design criteria are summarized in Tables 3.4-1 through 3.4-15 of the CISF TSAR. Generic site design criteria (GSDC) are also provided for comparison. The CISF TSAR states that the cask/canister systems are found to meet the majority of the GSDC. Some cask/canister system parameters are less conservative than the GSDC or are not given or not considered in the vendor SARs. Following designation of a CISF site, further cask/canister system evaluations, design analyses and possible design modifications must be performed to qualify the system for use at the CISF. Tables 4-9 through 4-16 are portions of the tables provided in the CISF TSAR that must be considered in the site-specific SAR because these cask systems currently do not meet the generic site design criteria. Cask design criteria that do not bound the CISF design criteria or were not considered in the cask SAR are identified in these tables. Portions of Tables 4-9 through 4-16, where the staff concluded that the cask design criteria bound the CISF design criteria, are either blanked out or not included. The specific cask systems identified for use at the CISF in the site-specific CISF SAR must be shown to bound the appropriate CISF design criteria or confirm that they will not be placed in potentially unanalyzed conditions or scenarios.

Table 4-9. Cask/canister design criteria—tornado (Missile Spectrum) (based on Table 3.4-2 of the Topical Safety Analysis Report)

Criterion	CISF GSDC	HI-STAR	TranStor™	MP187
Massive Missile Vertical Velocity (mph)	88.2	*Unanalyzed Condition*	*Unanalyzed Condition*	*Unanalyzed Condition*
Massive Missile Frontal Area (ft^2)	28	*Unanalyzed Condition*	*Unanalyzed Condition*	—
Penetrating Missile Vertical Velocity (mph)	88.2	*Unanalyzed Condition*	*Unanalyzed Condition*	*Unanalyzed Condition*
Small Missile Vertical Velocity (mph)	126	*Unanalyzed Condition*	*Unanalyzed Condition*	*Unanalyzed Condition*

Table 4-10. Cask/canister design criteria—straight wind (based on Table 3.4-3 of the Topical Safety Analysis Report)

Criterion	CISF GSDC	NAC STC	MP187	W-MPC
Wind Speed (mph)	110	105	—	100
Importance Factor	1.15	*Unanalyzed Condition*	1.07	1.07

Table 4-11. Cask/canister design criteria—precipitation (based on Table 3.4-5 of the Topical Safety Analysis Report)

Criterion	CISF GSDC	HI-STAR	NAC STC	TranStor™	MP187	W-MPC
5 min cumulative (in.)	6.2	*Unanalyzed Condition*	*Unanalyzed Condition*	*Unanalyzed Condition*	*Unanalyzed Condition*	*Unanalyzed Condition*
1 hr cumulative (in.)	19.4	*Unanalyzed Condition*	—	*Unanalyzed Condition*	*Unanalyzed Condition*	*Unanalyzed Condition*

Table 4-12. Cask/canister design criteria—snow and ice (based on Table 3.4-6 of the Topical Safety Analysis Report)

Criterion	CISF GSDC	HI-STAR	NAC STC	TranStor™	MP187
Load (psf)	50	—	*Unanalyzed Condition*	—	—
Exposure Factor	1.0	*Unanalyzed Condition*	*Unanalyzed Condition*	0.8	*Unanalyzed Condition*
Importance Factor	1.2	—	*Unanalyzed Condition*	—	*Unanalyzed Condition*

Table 4-13. Cask/canister design criteria—seismic ground motion (based on Table 3.4-7 of the Topical Safety Analysis Report)

Criterion	CISF GSDC	NAC STC	TranStor™	MP187	W-MPC
Horizontal Peak Ground Acceleration (g’s)	0.75	0.261	0.38	0.25	0.25

Table 4-14. Cask/canister design criteria—ambient temperature (based on Table 3.4-10 of the Topical Safety Analysis Report)

Criterion	CISF GSDC	HI-STAR	NAC STC	MP187
Normal (°F)	76	—	70	70
Range (°F)	−40 to 125	−20 to 126	—	—

Table 4-15. Cask/canister design criteria—solar load (Insolation) (based on Table 3.4-11 of the Topical Safety Analysis Report)

Criterion	CISF GSDC	HI-STAR	MP187
Horizontal Flat (Btu/day-ft^2)	2,949.4	—	1,476
Curved Surfaces (Btu/day-ft^2)	1,474.7	*Unanalyzed Condition*	*Unanalyzed Condition*

Table 4-16. Cask/canister design criteria—lightning (based on Table 3.4-12 of the Topical Safety Analysis Report)

Criterion	CISF GSDC	HI-STAR	Tran-Stor™	MP187	W-MPC
Applicable Code	NFPA 780	*Unanalyzed Condition*	*Unanalyzed Condition*	*Unanalyzed Condition*	*Unanalyzed Condition*

4.4.4.2 Design Criteria for Other Structures, Systems, and Components Subject to U.S. Nuclear Regulatory Commission Approval

The classification of SSC allowed the application of design criteria in a graded manner. Design criteria for QA–3, QA–4, QA–5, QA–6, and QA–7 are discussed in Section 3.5, Design Criteria for Other Structures, Systems, and Components Subject to NRC Approval, of the CISF TSAR. The use of specific QA practices for QA–3, QA–4, QA–5, QA–6, and QA–7 can be determined at the beginning of each phase of work commensurate with the importance of the item and activity.

QA–3 to QA–7 items are identified in the CISF TSAR to be other SSC subject to NRC approval. Design criteria for QA–3 SSC are defined in Chapter 6, Waste Confinement and Management, of the CISF TSAR. Design criteria for QA–4 SSC are defined in Chapter 4, Operational Systems, of the CISF TSAR. Design criteria for QA–5 SSC are defined in Chapters 4, Operational Systems, and 7, Installation Design and Structural Evaluation, of the CISF TSAR. Design criteria for QA–6 SSC are defined in Chapter 4, Operational Systems, of the CISF TSAR. Design criteria for QA–7 SSC are defined in Chapter 9, Radiation Protection, of the CISF TSAR.

QA–3, Important to Radioactive Waste Control, SSC are designed and constructed in accordance with Sections C.1, C.4, and C.5 of Regulatory Guide 1.143 (U.S. Nuclear Regulatory Commission, 1979b). The staff finds that the CISF TSAR meets the requirements of 10 CFR 72.120(a) in that the design criteria for QA–3 items are identified and consistent with standard design criteria.

QA–4, Important to Fire Protection, SSC are designed to comply with the requirements of ANSI/ANS 57.9-1992 (American National Standards Institute and American Nuclear Society, 1992) and applicable NFPA codes. These SSC will undergo additional installation verification, maintenance inspections, and operational reviews that will provide added reasonable assurance that the system will perform as designed. Protection of personnel is also ensured in accordance with NFPA 101 (National Fire Protection Association, 1997b). Fire protection system design codes are specified in Chapter 4, Operating Systems, of the CISF TSAR. The staff finds that the CISF TSAR meets the requirements of 10 CFR 72.120(a) in that the design criteria for QA–4 items are identified and consistent with standard design criteria.

QA–5, Important to Potential Interaction, structures whose failures can impair other safety-related structures will be designed to accommodate a design basis event, in accordance with the requirements of Sections C.1.1 and C.2 of Regulatory Guide 1.29 (U.S. Nuclear Regulatory Commission, 1978c). Use of conventional quality design criteria will ensure that the SSC will not break under the design basis event. Therefore, no SSC can impair the capability of other items to perform intended radiological safety functions. Supports require special consideration to ensure that the SSC remain in place during and after the design basis event. Therefore, conventional quality design criteria are used for these auxiliary systems. The staff finds that the CISF TSAR meets the requirements of 10 CFR 72.120(a) in that the design criteria for QA–5 items are identified and consistent with standard design criteria.

QA–6, Important to Physical Protection of Facility and Materials, SSC are designed to satisfy the requirements of 10 CFR Part 72, subpart H, for a physical security and safeguards contingency plan and physical protection design. Physical protection design requirements and criteria are described in Section 4.9, Physical Protection, of the CISF TSAR. The main function of the security system is to provide protective services, which include material control and accountability, physical security, emergency preparedness/response, and emergency medical treatment. A complete review of Subsection 4.9.4, Physical Protection Plan Components, of the CISF TSAR was beyond the scope of this review. A separate detailed physical security plan and standard safeguard contingency plan will be provided in the site-specific CISF SAR. Design criteria for physical protection of the CISF are identified and satisfy the requirements of 10 CFR 72.182(a). Determination of the adequacy of the physical protection system to perform its intended function is beyond the scope of this review. Note that the latest revision of DOE/RW 033P no longer contains a QA–6, Important to Physical Protection of Facility and Materials, and the site-specific SARs must reflect this change.

QA–7, Important to Occupational Radiological Exposure, SSC may be located in areas of potential radiological exposure and include electrical, communication, fire protection, HVAC, and compressed air. Where auxiliary system components must be routed through radiation areas, ALARA design principles are used in accordance with the criteria specified in Subsection 3.3.7, Satisfaction of ALARA Goals, of the CISF TSAR. In consideration of reduced maintenance time to limit worker exposure, the design should consider providing equipment with high reliability, low maintenance requirements, and ease of replacement. These considerations, in addition to the conventional quality design criteria are used to design these SSC. The staff finds that the CISF TSAR meets the requirements of 10 CFR 72.120(a) in that the design criteria for QA–7 items are identified and consistent with standard design criteria.

CISF SSC not designated as QA–1, QA–3, QA–4, QA–5, QA–6, or QA–7 are considered to be of conventional quality. Conventional quality SSC are designed and constructed in accordance with commercial standards. The design of conventional quality structures conform to the requirements of ACI 318-95 (American Concrete Institute, 1995) for concrete and the American Institute of Steel Construction (AISC) Manual of Steel Construction (American Institute of Steel Construction, 1991) for structural steel. The design and installation of piping systems at the CISF pertaining to water, compressed air, oil, and sewer services will conform to the requirements of the ASME/ANSI B31.1–1995 (American Society of Mechanical Engineers and American National Standards Institute, 1995). This code invokes appropriate American Society for Testing and Materials (ASTM), American Welding Society, and American Water Works Association Standards. Additionally, the design and installation of piping systems located inside buildings will conform to the applicable Uniform Building Code (International Conference of Building Officials, 1996), National Plumbing Code (American Plumbing Association, 1990) or equivalent building code of the locality and good work practices. The design of conventional HVAC systems at the CISF will conform to the design criteria demonstrated in applicable ASHRAE, Air-Conditioning and Refrigeration Institute, and NFPA standards. The design of conventional electrical systems will conform to ANSI/NFPA 70, National Electric Code (National Fire Protection Association, 1996), ANSI– C2–1997, National Electric Safety Code (American National Standards Institute, 1997), National Electrical Manufacturers Association Standards (National Electrical Manufacturers Association, 1992) and applicable state, county, municipal, and other local regulations, and building and zoning codes. The switchyard and electrical distribution designs will conform to Institute of Electrical and Electronic Engineers (IEEE) Standard 141, IEEE Recommended Practice for Electric Power Distribution and Industrial Plants; IEEE 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems; and IEEE 80 (Institute of Electrical and Electronic Engineers, 1993, 1991a,b), Guide for Safety in Substation Grounding. Lightning protection for all structures will comply with NFPA 780, Standard for Lightning Protection Code (National Fire Protection Association, 1992). The staff finds that the CISF TSAR meets the requirements of 10 CFR 72.120(a) in that the design criteria for items not classified in accordance with the DOE/RW 0333P are identified and consistent with standard design criteria.

4.5 Evaluation Findings

4.5.1 Materials to Be Stored

- The staff has reviewed Section 3.1, Stored Materials, of the CISF TSAR and finds that the requirements for materials to be stored are satisfied for this non-site-specific CISF installation, in conformance with the requirements of 10 CFR 72.2(a)(1) and 72.120(a).

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).

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 SSC and perform the analyses 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).

4.5.3 Design Criteria for Structures, Systems, and Components Important to Safety

4.5.3.1 General

- The staff has reviewed the information presented in the CISF TSAR and finds that the design criteria for the ISFSI; the materials of construction, general arrangement, dimensions of principal structures, and descriptions of all SSC important to safety; and applicable codes and standards required by 10 CFR 72.24(c)(1, 3, and 4) are identified.

- The staff has reviewed the information presented in Chapter 3, Principal Design Criteria, of the CISF TSAR and finds that the design criteria for protection against environmental conditions and natural phenomena required by 10 CFR 72.122(b) are identified.

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).

4.5.3.2 Structural

- The CISF TSAR meets the guidance given in Regulatory Guides 1.76, and NUREG–0800 for tornado and tornado missile design criteria.

- The CISF TSAR meets the requirements of 10 CFR 72.120(a) and 72.122(b) in that the environmental design criteria for straight wind conditions are identified and consistent with standard design criteria.

- The CISF TSAR meets the requirements of 10 CFR 72.120(a) and 72.122(b) in that the environmental design criteria for precipitation and floods are identified and consistent with standard design criteria.

- The CISF TSAR meets the requirements of 10 CFR 72.120(a) and 72.122(b) in that the environmental design criteria for snow and ice loading are identified and consistent with standard design criteria.

- The design criteria for the earthquake loading anchored at 0.75 g satisfy the regulatory requirements of 10 CFR 72.102(a), (b), and (f). The CISF TSAR meets the requirements of Regulatory Guides 1.60 and 1.61 for seismic events.

- The CISF TSAR meets the requirements of 10 CFR 72.120(a) and 72.122(b) in that the environmental design criteria for lightning are identified consistent with standard design criteria.

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 SSC 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).

4.5.3.3 Thermal

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

- Confirmation that the design criteria of the specific cask systems identified for use at the CISF in the site-specific CISF SAR bound the CISF thermal performance design criteria to satisfy the requirements of 10 CFR 72.120(a).

4.5.3.4 Shielding, Confinement, Radiation Protection

- The design criteria for radioactive materials in effluents and direct radiation from the CISF are in accordance with the requirements of 10 CFR 72.104.

- The general radiation protection design criteria, given in Subsection 3.3.4, Radiological Protection, of the CISF TSAR, are identified as required by 10 CFR 72.126. The storage area was defined as a radiation area requiring radiological control, per 10 CFR 72.126(a). The CISF design includes the means to measure and control contamination of areas requiring access, per 10 CFR 72.126(a)(4). Radiation monitoring and surveys will be conducted in accordance with 10 CFR 20.1501 and as necessary to comply with the operating limits imposed by the storage system vendor SARs. The facility design identifies systems for measuring the direct radiation levels in and around areas containing radioactive materials, per 10 CFR 72.126(c)(2).

- The design criteria for SNF storage and handling, given in Subsection 3.3.4, Radiological Protection, of the CISF TSAR, are identified as required by 10 CFR 72.128.

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.

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)

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

4.5.3.6 Decommissioning

- The decommissioning criteria and materials and coatings proposed to be used at the CISF in Subsection 3.3.6, Decommissioning, of the CISF TSAR will facilitate decommissioning procedures, satisfying the requirements of 10 CFR 72.130.

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.

4.5.3.7 Retrieval

- The criteria for retrievability, given in Section 3.7, Material Handling, Storage, and Retrieval Capability, of the CISF TSAR, satisfy the requirements of 10 CFR 72.122(l).

- The SNF storage and handling systems, including the QA–1 cranes, are designed to allow retrieval of SNF in accordance with 10 CFR 72.128(a).

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).

4.5.4 Design Criteria for Other Structures, Systems, and Components

- The CISF TSAR meets the requirements of 10 CFR 72.120(a) in that the design criteria for QA–3 through QA–7 items are identified and consistent with standard design criteria.

- The CISF TSAR meets the requirements of 10 CFR 72.120(a) in that the design criteria for items not classified in accordance with the DOE/RW 0333P are identified and consistent with standard design criteria.

- The CISF TSAR meets the requirements of 10 CFR 72.182(a) in that the design criteria for physical protection of the CISF are identified.

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

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

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).

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5 INSTALLATION AND STRUCTURAL EVALUATIONS

5.1 Review Objective

The objective of the installation design review was to ensure compliance with required site features and to support other evaluation areas. The objective of the structural evaluation review was to ensure the structural integrity of SSC with emphasis on SSC important to safety. These SSC provide confinement, criticality control, radiation shielding, and retrievability of the stored materials, and must be appropriately maintained under all credible loads for normal, off-normal, and design basis accident conditions. These conditions also include natural phenomena.

Because this was not a site-specific TSAR (U.S. Department of Energy, 1998a), a complete review of the installation design and structural evaluation was not possible. Compliance with appropriate regulations by any reference to cask-specific information will need to be evaluated in the review performed by the NRC of the cask SARs. Issues that must be addressed in the site-specific SAR for the CISF are identified.

5.2 Areas of Review

The following areas of review are addressed in Section 5.4, Conduct of Review:

Confinement Structures, Systems, and Components

Description of Confinement Structures
Design Criteria for Confinement Structures
Material Properties
Structural Analysis

Pool and Pool Confinement Facilities

Reinforced Concrete Structures

Description of Concrete Structures
Design Criteria
Material Properties
Structural Analysis

Other Structures, Systems, and Components Important to Safety

Description of Other Structures, Systems, and Components Important to Safety
Design Criteria
Material Properties
Structural Analysis

Other Structures, Systems, and Components

Description of Other Structures, Systems, and Components
Design Criteria
Material Properties
Structural Analysis

5.3 Regulatory Requirements

This section identifies portions of 10 CFR Part 72 relevant to the review areas addressed by this chapter.

- 72.24(a), (b), (c)(1), (2), (3), and (4), (d), and (i)
- 72.40(a)(1), (2), and (3)
- 72.82(c)(2)
- 72.102(a)(1) and (2), (b–c), (d), (e), and (f)(1) and (2)
- 72.106(a–c)
- 72.120(a and b)
- 72.122(a–d), and (f and l)
- 72.128(a and b)

The following regulatory requirements are site-specific and, therefore, must be fully addressed in the site-specific CISF SAR.

- 72.24(a)
- 72.40(a)(2 and 3)
- 72.102(c–e)
- 72.106(a–c)
- 72.122(a, b, and d)

The regulatory requirements of 10 CFR 72.122(j) and (k) are applicable for control rooms and utility services important to safety. Neither are applicable to the CISF as discussed in Section 4.4.2 of this AR.

The regulatory requirements of 10 CFR 72.236(b), (e), (f), (g), and (k) apply to ISFSI confinement casks. Compliance with these regulatory requirements is evaluated in the NRC review of the cask SAR as previously certified under 10 CFR Part 72, Subpart L.

5.4 Conduct of Review

The review focused on the information provided in Chapter 7, Installation Design and Structural Evaluation, of the CISF TSAR with supporting information demonstrated in the following chapters of the TSAR:

Chapter 1 – Introduction and General Description of Installation (AR Chapter 1, General Description)
Chapter 2 – Site Characteristics (AR Chapter 2, Site Characteristics)
Chapter 3 – Principal Design Criteria (AR Chapter 4, Structures, Systems, and Components and Design Criteria Evaluation)
Chapter 12 – Accident Analysis (AR Chapter 15, Accident Analysis)
Chapter 14 – Technical Specifications (AR Chapter 16, Technical Specifications).

Information in Chapter 7, Installation Design and Structural Evaluation, of the CISF TSAR (U.S. Department of Energy, 1998a), responses to NRC RAIs (U.S. Department of Energy, 1998b), and cited documentation were considered in the review of the structural description, design criteria, material properties, and design analysis for major CISF structures. Structures reviewed included the confinement structures, transfer facility, storage pads, and other structures classified as QA–3, QA–4, QA–5, QA–6, and QA–7. The review was conducted following five major areas of review outlined in Section 5.2, Areas of Review, of this AR. The details of the review and the concomitant findings are given in the following sections.

5.4.1 Confinement Structures, Systems, and Components

The CISF confinement SSC identified in the CISF TSAR are limited to the storage cask and canister systems. The storage cask systems being evaluated for use at the CISF are described in Chapter 1, Introduction and General Description of Installation, of the CISF TSAR. Section 7.2, Confinement SSC, of the CISF TSAR provides details of the structural evaluation of the confinement SSC. Note that for this review, the staff assumed that the storage cask and canister systems would be licensed by the NRC under a separate docket.

5.4.1.1 Description of Confinement Structures

For the purpose of developing bounding CISF design criteria, the following six storage cask and canister systems have been identified for potential use at the CISF installation in the CISF TSAR:

- NUHOMS® MP187/HSM DPC System (VECTRA Technologies, Inc., 1995)
- Holtec HI-STAR 100 System (Holtec International, 1994)
- Sierra TranStor™ DPC System (Sierra Nuclear Corp., 1995)
- NAC STC TSC System (Nuclear Assurance Corporation International Services, Inc., 1994)
- Westinghouse Large MPC System (Westinghouse Government and Environmental Services Co., 1996a)
- Westinghouse Small MPC System (Westinghouse Government and Environmental Services Co., 1996b)

Note that only storage cask systems that have been licensed by the NRC will ultimately be used at the CISF installation. Detailed descriptions of the design of individual storage cask and canister systems are demonstrated in the individual cask system vendor SARs. The staff did not review the vendor SARs in detail. Demonstration of compliance, with the description requirements of confinement structures in accordance with 10 CFR 72.24(b), (c)(4); 72.120(b); 72.122(f), (g), (h), (i), (l); 72.128(a), (b); and 72.236(e), (f), (g), and (k), is assumed to be demonstrated in the SARs of the individual cask systems and associated NRC CoC evaluations. These cask systems will be licensed under separate NRC dockets.

5.4.1.2 Design Criteria for Confinement Structures

The overall design criteria for the storage cask and canister systems confinement structures are described in Chapter 3, Principal Design Criteria, of the CISF TSAR. Details of the design criteria of the individual storage cask and canister systems are demonstrated in the individual vendor SARs. For purposes of the generic CISF design, the vendor storage cask and canister systems are evaluated against the CISF design criteria detailed in Chapter 3, Principal Design Criteria, of the CISF TSAR. The results of this evaluation are presented in Section 4.5, Evaluation Findings, of this AR.

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), (h); and 72.236(b) is assumed to be demonstrated in the SARs of the individual cask systems and associated NRC CoC evaluations.

As part of the site-specific CISF SAR, it will be necessary to review the unique characteristics of the site with the storage cask and canister systems design criteria to ensure the assumed site characteristics (Chapter 2, Site Characteristics, of the CISF TSAR) are bounded by the cask and canister design criteria.

5.4.1.3 Material Properties

Details of the material properties of the individual storage cask and canister systems are demonstrated in the specific cask vendor SARs. Demonstration of compliance with the material properties requirements given in 10 CFR 72.24(c)(3) and (4) was assumed to be demonstrated in the SARs of the individual cask systems and associated NRC CoC evaluations.

5.4.1.4 Structural Analysis

Details of the structural analysis of the individual storage cask and canister systems are demonstrated in the cask vendor SARs. 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), (h); and 72.236(g) is assumed to be demonstrated in the SARS of the individual cask systems and associated NRC CoC evaluations.

5.4.2 Pool and Pool Confinement Facilities

There are no pool or pool confinement facilities at the CISF. Therefore, this section is not applicable to this review.

Note that a number of the cask vendor SARs require that the storage cask and canisters be returned to a pool for inspection for damage following an impact or drop event greater than specified heights. If the site-specific CISF SAR operational conditions are shown to exceed these specified heights, allowances for this inspection process will have to be incorporated in the site-specific SAR.

5.4.3 Reinforced Concrete Structures

The transfer facility main structural system and vendor-specific concrete storage casks are the only CISF reinforced concrete structures identified in the CISF TSAR as important to radiological safety, that is, QA–1. The staff also concluded that the cask storage pads and off-normal holding areas should be considered as CISF reinforced concrete structures important to safety (see Subsection 4.4.2, Classification of Structures, Systems, and Components, of this AR). Subsection 7.4.1, Transfer Facility, of the CISF TSAR describes the transfer facility reinforced concrete structures. Subsection 7.4.2, Storage Casks, of the CISF TSAR addresses vendor-specific storage casks, by referring to the vendor SARs. Subsection 7.6.1, Storage Pads, of the CISF TSAR describes the reinforced concrete storage pad structures classified as other SSC. The off-normal holding area is not addressed directly in the CISF TSAR.

5.4.3.1 Description of Concrete Structures

Subsection 7.4.1, Transfer Facility, of the CISF TSAR describes the QA–1 transfer facility as a cast-in-place, fully enclosed, reinforced concrete building with a slab-on-grade floor. Cast-in-place reinforced concrete frames form the columns and roof beams of the superstructure. The main building columns is reinforced concrete-tied columns, 4-ft wide × 8-ft deep. A series of reinforced concrete beams are used to tie the frames together and provide additional support for the roof and walls. The main building roof beams that frame into the columns are 4-ft wide × 5-ft deep in the interior of each span. To accommodate increased end moments, the ends of the roof beams taper from 5 to 9 ft at the column faces. Reinforced concrete wall and roof panels fill the areas between the main frames and the beams. Concrete corbels protrude from the columns to provide support for steel crane rail beams for the two 225-ton overhead bridge cranes that run the length of the building. Continuous, reinforced concrete grade beam foundations support the main frames and walls. These foundations are cast in place with the concrete slab-on-grade basemat. Caissons or rock anchors are used to support the grade beams and basemat.

The transfer facility provides protection against natural phenomena and radiation during transfer operations and support for cask handling and canister transfer equipment. The building overall size is approximately 250-ft long × 88-ft wide × 75-ft high. The interior of the transfer facility building is open with partial-height interior concrete walls separating the three operational areas. Two 225-ton overhead bridge cranes will travel the length of the building to handle SNF transportation, transfer, and storage casks. The concrete superstructure of the transfer facility is designed for a full spectrum of normal, off-normal and accident loadings, including seismic and tornado loadings.

The CISF storage pads are conventional cast-in-place reinforced concrete mat foundation structures. They provide a level and stable surface for placement and storage of SNF casks or storage modules. The pads are designed for normal operating loads, severe environmental loads, and extreme environmental loads as specified by ACI 349-90 (American Concrete Institute, 1990) as permitted by NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). As identified in the CISF TSAR, the storage pads are designed as QA–5 structures, Important to Potential Interaction. Construction of the pads is in accordance with ACI 318-95 (American Concrete Institute, 1995) and is of conventional quality. The concrete storage pads are 3-ft thick with No. 11 reinforcing bars spaced at 12 in. on-center and placed parallel to the length and width of the pads, top and bottom. Reinforcing steel is lap spliced for No. 11 bars and smaller. The concrete pads can be joined at the ends by concrete expansion joints to form rows.

Each concrete pad that supports an HSM is approximately 40-ft wide and 101–104 ft long. The pads are spaced so that there is at least 100 ft between the HSM entrance and the facing cask to allow maneuverability of the transfer trailer and hydraulic ram system when performing canister transfer operations. Each concrete pad can contain up to 20 VECTRA NUHOMS® System HSM set back to back. The concrete pads can be joined at the ends by concrete expansion joints to form rows.

The storage pads for the other canister systems are approximately 60-ft wide × 80-ft long. Each pad can support eight storage casks supplied by any of the five cask vendors. The maximum design weight of a loaded cask is 390,000 lb. The storage pads are designed for loading conditions due to incremental cask placement. Variable patterns of cask loading are considered necessary to maximize internal forces and moments for all loading combinations. The concrete pads can be joined at the ends by concrete expansion joints to form rows. The pads are spaced 50 ft apart to allow maneuverability of the transporters during storage operations.

The following discussion covers the reinforced concrete transfer facility and storage pads at the CISF. The CISF TSAR description of the reinforced concrete structures satisfies the requirements of 10 CFR 72.24(b) and (c)(4) in that it provides a description of the structures with special attention to design characteristics. The designs of both reinforced concrete structures were based on standard design of reinforced concrete structures, ACI 349-90 (American Concrete Institute, 1990). Satisfying the requirements of ACI 349-90 ensures that inspection, maintenance, and testing requirements of 10 CFR 72.122(f) are satisfied. The designs provide open space that allows emergency access as required in 10 CFR 72.122(g). The same SSC in the reinforced concrete structures that will be used to prepare the SNF for storage can also be used for retrieval of the SNF as required by 10 CFR 72.122(l). As identified in Chapter 6, Waste Confinement and Management, of the CISF TSAR, the handling and temporary storage of radioactive waste generated at the CISF will be done where the waste is generated, for example, within the transfer facility building. The limited amount of radioactive waste generated at the site will then be disposed of by a contractor. The CISF TSAR has considered requirements for handling and storage of radioactive waste, as required in 10 CFR 72.128.

The CISF TSAR does not provide a detailed description of the off-normal holding area necessary to satisfy the requirements of 10 CFR 72.24(b) and (c)(4).

Vendor-specific concrete storage casks are also a part of the CISF reinforced concrete structures that are important to radiological safety, as described in Subsection 7.4.2, Storage Casks, of the CISF TSAR. As indicated in the CISF TSAR, detailed descriptions of these systems are demonstrated in the cask vendor SARs and are not repeated in the CISF TSAR. No attempt was made to review vendor SARs in detail as part of this review. Demonstration of compliance with the description requirements given in 10 CFR 72.24(b), (c)(4), (f), (g), (l); and 72.128(a), (b) is assumed to be demonstrated in the SARs of individual cask systems and associated NRC CoC evaluations.

5.4.3.2 Design Criteria

Concrete sections for QA–1 and QA–5 structures are designed in accordance with the ultimate strength design method of ACI 349-90 (American Concrete Institute, 1990). Ductility and impact design requirements of ACI 349-90 (American Concrete Institute, 1990), Appendix C, are incorporated into the design. Design of QA–1 embedded plates and concrete expansion anchors is in accordance with the requirements of ACI 349-90, Appendix B. The design criteria are in conformance with the design criteria identified in Chapter 4, Structures, Systems, and Components and Design Criteria Evaluation, of this AR.

Loads and loading combinations used in design of the QA–1 reinforced concrete transfer facility are specified in Subsection 7.4.1.3, Design Analysis, of the CISF TSAR, based on Subsection 3.8.4 of NUREG–0800 (U.S. Nuclear Regulatory Commission, 1981a) and NUREG–1536 (U.S. Nuclear Regulatory Commission, 1997). Loads encountered during normal operation include dead load, live load, hydrostatic fluid pressure, soil pressure, thermal load, and pipe reaction loads. Because the CISF site is assumed to be located on a dry and relatively flat site, no groundwater or net soil pressure loads are assumed to be exerted on the transfer facility. The transfer facility is also located above grade level. Therefore, hydrostatic fluid pressure load and lateral soil pressure load are not considered. Because there is no process piping in the transfer facility there are no applicable pipe reaction loads. A comparison of loads and load combinations identified in Subsection 7.4.1.3, Design Analysis, of the CISF TSAR with those specified in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000) shows that the parameters used for transfer facility design meet the requirements of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). In addition, loads used for transfer facility design are consistent with and meet the requirements of Subsection 6.17.1 of ANSI/ANS 57.9-1992 (American National Standards Institute and American Nuclear Society, 1992).

The design loading combinations for the reinforced concrete storage pads are in accordance with ACI 349-90 (American Concrete Institute, 1990). As defined in Subsection 7.6.1.3, Storage Pad Design Analysis, of the CISF TSAR, these loads are categorized into three levels: normal, severe environmental, and extreme environmental loads. Load values are based on the CISF site design parameters listed in Chapter 3, Principal Design Criteria, of the CISF TSAR. For the analysis and design of the storage pads, there are no permanent hydrostatic loads. Additionally, differential settlement load is considered to be zero. The storage pad dead load is the mass of the reinforced concrete storage pads and the storage casks. The storage pads are designed for loading conditions due to incremental cask placement. Variable patterns of cask loading are considered necessary to maximize internal forces and moments for all loading combinations. Because the storage pads are at the same level as the adjacent ground level, the pads are sloped to facilitate drainage, and the rain, snow, and ice loads are small relative to the casks; these loads are not considered further in the analysis. Special heavy loading conditions resulting from transport of all the types of SNF storage casks on the storage pads are considered. The heaviest cask considered on the storage pad weighs 390,000 lb. The cask weight considered bound the worst-case condition of all vendor designs handled on the storage pads.

There are no tanks or compartments to hold fluids on the storage pads. Therefore, determination of hydrostatic fluid pressure load is not necessary for storage pad structural design and analysis.

Because the CISF site is assumed to be located on a dry and relatively flat site and the storage pads are above grade, no groundwater or net soil pressure loads are exerted on the concrete pads. Thermal loads in the concrete pads consist of thermally induced forces and moments resulting from the temperature gradient between the soil temperature and the temperature of the top of the pad.

Severe environmental loads can be encountered infrequently during the life of the CISF. Wind loads considered for the transfer facility are in accordance with those specified in ANSI/ASCE Standard 7-95 (American National Standards Institute and American Society of Civil Engineers, 1996). Because the storage pads are level with the adjacent ground, wind loads are not considered in storage pad analysis and design.

Extreme environmental loads are those credible but highly improbable (e.g., seismic and tornado) loads. QA–1 and QA–5 structures are designed to accommodate earthquake events in accordance with the requirements of Sections C.1.1 and C.2 of Regulatory Guide 1.29 (U.S. Nuclear Regulatory Commission, 1978a) and Regulatory Guide 1.143 (U.S. Nuclear Regulatory Commission, 1979). As specified in Chapter 3, Principal Design Criteria, of the CISF TSAR, DE loads are based on a 0.75 g maximum peak horizontal seismic acceleration, without ground faulting, applied at the structure foundation/soil interface. Because the storage pads are normally loaded with storage casks, earthquake loads are combined with the cask live loads. The design criteria for the earthquake loading anchored at 0.75 g satisfied the requirements of 10 CFR 72.102(a), (b), and (f).

Subsection 3.3.2 of NUREG–0800 (U.S. Nuclear Regulatory Commission, 1981b) has been used as a basis for determining tornado loads for the CISF. The tornado wind velocity was converted into effective structural pressure load using the procedures of ANSI/ASCE Standard 7-95 (American Society of Civil Engineers, 1995). Tornado-induced differential pressure loads are those exerting an internal pressure loading on structures due to the negative pressure created by the tornado. The magnitude of the design pressure drop, 3.0 psi, is reduced to 1.0 psi for the vented transfer facility, as permitted by Paragraph II(3)(b) of Subsection 3.3.2 of NUREG–0800 (U.S. Nuclear Regulatory Commission, 1981b). Tornado wind loads are not considered in the design of the storage pads as the pads will be at grade and the wind velocity will be zero at this level.

Using the guidance of Regulatory Guide 1.117 (U.S. Nuclear Regulatory Commission, 1978b), protection for all of the tornado missiles specified in Chapter 3, Principal Design Criteria, of the CISF TSAR has been provided for the transfer facility. The canister transfer area and the overhead bridge cranes in the transfer facility are protected from tornado missile strikes. The reinforced concrete walls and roof encompass the entire transfer facility. Tornado missile protection is not required for casks in the shipping and receiving or site transporter areas of the transfer facility because casks in these areas will always be closed and have been designed to withstand a tornado missile strike. Tornado-generated missiles that can enter the exterior doors of the transfer facility are prevented from entering the canister transfer area by the geometry of the walls and openings. Openings in the roof and walls for items such as fans, ducts, cable chases, and others are provided with tornado missile protection barriers where necessary or are protected by the building layout and geometry to prevent penetration of tornado-generated missiles.

Based on this discussion, the staff finds that design criteria for protection against environmental conditions and natural phenomena to satisfy the requirements of 10 CFR 72.122(b)(1) and (2) were identified. In addition, the design criteria for reinforced concrete structures are in conformance with the design criteria identified in Chapter 4, Structures, Systems, and Components and Design Criteria Evaluation, of this AR.

The general design criteria required by 10 CFR 72.120(a) were identified. Detailed design criteria for fabrication, construction, testing, maintenance, and performance requirements must be demonstrated in the site-specific CISF SAR.

Because the off-normal storage area was not classified in the CISF TSAR as important to safety, no specific design criteria have been identified. The staff considers this to be SSC important to safety. Therefore, the design criteria for these SSC must be provided in the site-specific CISF SAR.

Details of the design criteria of the individual storage cask and canister systems reinforced concrete structures are demonstrated in the vendor SARs. No attempt was made to review these documents in detail. 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) is assumed to be demonstrated within the SARs of the individual cask systems and associated NRC CoC evaluations.

As part of the site-specific CISF SAR, it will be necessary to review the unique characteristics of the site with the storage cask and canister systems design criteria to ensure that the assumed site characteristics are bounding.

5.4.3.3 Material Properties

Structural concrete used in construction of the QA–1 transfer facility structures has a specified minimum compressive strength of 5,000 psi based on ACI 349-90 (American Concrete Institute, 1990). All reinforcing steel used in QA–1 structures has a specified minimum yield strength of 60,000 psi (American Society for Testing and Materials, 1990). All reinforced concrete members are designed for ductile behavior and are reinforced to control potential failure of the members by tension failure in the reinforcing steel, not by compressive failure of the concrete. All reinforcing bar development lengths and lap splice lengths are specified in accordance with the requirements of ACI 349-90 (American Concrete Institute, 1990). Development lengths and the splice lengths of reinforcing bars are the length of embedment in the concrete and the amount of overlap at joints necessary to fully develop the strength of the bars under loaded conditions. Applicable ductility and confinement requirements specified by ACI 349-90 (American Concrete Institute, 1990) are satisfied for all QA–1 reinforced concrete structures. All column reinforcing bars are enclosed using closed ties. Adequate reinforcing is provided at construction joints to develop shear-friction forces across the joints.

All structural concrete proposed to be used in construction of the QA–5 storage pads has a minimum design compressive strength of 3,000 psi based on ACI 349-90 (American Concrete

Institute, 1990). All reinforcing steel proposed to be used in the storage pads has a minimum design yield strength of 60,000 psi (American Society for Testing and Materials, 1990).

These material properties and descriptions of the transfer facility and storage pads satisfy the requirements of 10 CFR 72.24(c)(3). The applicable codes and standards were identified as required by 10 CFR 72.24(c)(4).

Because the off-normal storage area was not classified in the CISF TSAR as important to safety, no material properties have been identified. The staff considers this to be SSC important to safety. Therefore, the properties for these SSC must be provided in the site-specific CISF SAR.

Details of the material properties of the reinforced concrete components of the storage cask and canister systems are demonstrated in the cask-specific vendor SARs. No attempt was made to review these documents in detail. Compliance with the material property requirements given in 10 CFR 72.24(c)(3) and(4) is assumed to be demonstrated in the SARs of individual cask systems and associated NRC CoC evaluations.

5.4.3.4 Structural Analysis

Subsection 7.4.1.3, Design Analysis, of the CISF TSAR describes loads, loading combinations, and analysis methods for design of reinforced concrete structures of the transfer facility. As discussed before, the transfer facility has been classified as a QA–1 structure. Loads used in analysis and design of the reinforced concrete structures of the transfer facility include dead load, live load, hydrostatic fluid pressure, lateral soil pressure, thermal loads, pipe reaction loads, wind load, flood load, DE seismic loads, and tornado loads. These loads are categorized into three levels: normal, severe environmental, and extreme environmental loads. Values for these loads are based on the generic site parameters identified in Chapter 2, Site Characteristics, of the CISF TSAR. The design criteria identified in Chapter 3, Principal Design Criteria, of the CISF TSAR are developed from site bounding parameters. Service load combinations represent the expected loading conditions for QA–1 structures during normal facility operations and during severe environmental conditions. These service load combinations are comparable to the Normal Events and Conditions and Off-Normal Events and Conditions specified in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). Wind and flood loads are assumed to act simultaneously, because it is reasonable for flooding to occur with high winds during a storm. Factored load combinations represent the loading conditions that QA–1 structures can experience under extreme environmental conditions. Factored load combinations are comparable to the Accident-Level Events and Conditions loading combinations specified in NUREG–1567. Extreme environmental loads (i.e., seismic and tornado) are not considered to act simultaneously because of the extremely low probability that an earthquake and a tornado will occur at the same time.

Seismic loads are determined by multiplying the dead load plus a minimum of 25 percent of the live load on the structure by the acceleration values obtained in the structural response analysis. The amount of live load included in the seismic load contribution is based on the guidance provided in Subsection 3.1.4.2 of ASCE Standard 4-86 (American Society of Civil Engineers, 1986) and the required functionality of the structure to support particular loading conditions. Because the cranes must support casks during a seismic event and remain functional, the full weight of the heaviest cask is included in the live load used to determine the seismic load on the crane support structures.

Transfer facility QA–1 reinforced concrete structures are analyzed and designed to resist the loads and loading combinations specified in Subsections 7.4.1.3.1 and 7.4.1.3.2 (U.S. Department of Energy, 1998c). Static analysis methods are used to determine forces and moments on structural members as a result of applied service loading conditions. Dynamic analysis methods are used to determine structural member forces and moments for factored loading conditions where structural components are subjected to seismic or tornado-generated missile impact loads.

A finite element model was generated for structural analysis of the QA–1 transfer facility structure (U.S. Department of Energy, 1997) using the ANSYS (Swanson Analysis Systems, Inc., 1994a,b,c,d) computer program. The model includes both the primary moment-resisting reinforced concrete frames (columns and beams) that spanned the crane travel area of the building and a series of roof and exterior wall beams running transverse to the moment frames. Reinforced concrete wall and roof panels are also included in the ANSYS model. The wall and roof panels serve as shear panels and bracing for support of the building superstructure, as well as for protection against tornado-generated missiles. Steel beams and reinforced concrete corbels projecting from the main columns are included in the model to provide support for the two 225-ton overhead bridge cranes. Foundation structure grade beams and the floor slab are also included in the model.

Appropriate member and element properties are used in the ANSYS model to represent member sizes, mass distributions, member stiffness, reinforcing layouts and quantities, and eccentricities of loads and member connections. The model accounts for member stiffness and load distributions by using cracked/transformed concrete section properties. The main building columns are modeled as T-sections to account for the added flexural strength provided by the wall panels cast monolithically with the columns.

A dynamic seismic analysis is performed using the ANSYS model and the seismic load input of 0.75 g applied at the building foundation/soil interface. The 0.75-g seismic input is the horizontal acceleration, and the vertical seismic input is 2/3 of the horizontal acceleration, or 0.50 g, as specified by Subsection 2.2.2.2 of ASCE Standard 4-86 (American Society of Civil Engineers, 1986). Analysis methods used to determine seismic loadings from these acceleration input criteria conform to the requirements of ASCE Standard 4-86 (American Society of Civil Engineers, 1986) and Regulatory Guide 1.92 (U.S. Nuclear Regulatory Commission, 1976).

Seismic loads are applied to the ANSYS model simultaneously in the three orthogonal directions (two horizontal and one vertical) at the structure foundation, and the three-dimensional effects of each of these inputs were considered. Figure 1 of Regulatory Guide 1.60 (U.S. Nuclear Regulatory Commission, 1973a) is used to determine seismic shock response spectrum in the two orthogonal horizontal directions, and Figure 2 of Regulatory Guide 1.60 (U.S. Nuclear Regulatory Commission, 1973a) is used to determine seismic shock response spectra in the vertical direction. The values in these figures are scaled based on the DE horizontal acceleration of 0.75 g. Appropriate consideration of the effects of structural member properties on structure frequency, stiffness, and displacement are factored into the seismic analysis. Structural damping of 7 percent is used to determine seismic loads on reinforced concrete structures in accordance with Regulatory Guide 1.61 (U.S. Nuclear Regulatory Commission, 1973b) for the DE loads.

Colinear modal responses to each of the three orthogonal earthquakes are combined using the square root of the sum of the squares (SRSS) method described in ASCE Standard 4-86 (American Society of Civil Engineers, 1986). All seismic responses from modes clustered within a 10-percent range are combined directly by the absolute sum method, and the remaining responses are combined by the SRSS method. These methods provide resultant seismic load forces and moments on each structural member for input into the loading combination analysis.

An additional eccentricity of the mass equivalent to 5 percent of the maximum building dimension at each level under consideration (e.g., roof level) is included in the seismic analysis to account for variations in material densities, member sizes, architectural features, equipment loads, and others. This additional eccentricity is included in Subsection 3.7.2 of NUREG–0800, Section II (11) (U.S. Nuclear Regulatory Commission, 1981c), to account for any accidental torsion.

The full weights of the cranes themselves are considered in determining contributing mass during seismic events. To account for the pendulum effect of the flexible cabling that supports the suspended load on each crane, lateral seismic load contributions from the 225-ton suspended loads are considered similar to lateral effects due to trolley movement. That is, 20 percent of the suspended load is applied horizontally in the direction perpendicular to the crane support beams, and 10 percent of the suspended load is applied horizontally along the longitudinal axis of the crane support beams. The full weight of the suspended load on each crane is considered for vertical participation during seismic events. In the analysis, crane locations are varied to determine the worst-case forces and moments on supporting structures.

Concrete corbels supporting the overhead bridge crane runway steel support beams are designed using the shear-friction method in accordance with Section 11.9 of ACI 349-90 (American Concrete Institute, 1990). Reinforcing steel and ties are provided in the corbels and extend into the columns to provide the necessary tension to resist the shear loads on the corbels.

Subsection 7.4.1.3.3, Structural Analysis and Design, of the CISF TSAR describes the seismic structural response analysis method used to determine seismic load effects on transfer facility QA–1 structures. Results from this analysis show that the allowable column capacity, corrected for slenderness effects, is sufficient to support the worst-case bending moment of 22,292 kip-ft combined with an axial load of 1,224 kips.

The 4 × 5-ft portion of each of the main roof beams has a bending capacity of 5,793 kip-ft about the major axis. Results from the analysis, described in Subsection 7.4.1.3.3, Structural Analysis and Design, of the CISF TSAR, show this capacity is sufficient to support the worst-case moment of 2,970 kip-ft at midspan in the beam and other moments at various sections in the beam. The tapered portion of each roof beam has a major axis bending capacity of 11,185 kip-ft at the 9-ft section where the beam is connected to the column. This capacity is sufficient to support the worst-case bending moment of 9,032 kip-ft at the face of the column, as determined from the analysis described in Subsection 7.4.1.3.3, Structural Analysis and Design, of the CISF TSAR.

Methodology of Subsection 3.5.3 of NUREG–0800 Article II (U.S. Nuclear Regulatory Commission, 1981d) and ACI 349-90 (American Concrete Institute, 1990), Appendix C, has been used to design the reinforced concrete structures to accommodate tornado-generated missile impacts. Analyses for tornado-generated missile impact on reinforced concrete structures are performed using elasto-plastic response analysis methods. Both local and overall effects of missile impact are examined, with appropriate consideration given to impactive and dynamic effects of the loading. Some localized overstressing and damage are permitted for structures subjected to missile impact. The local effects of missile impact are analyzed to ensure that missiles could not penetrate the concrete barriers and secondary missiles could not be generated due to spalling of structural components as a result of the initial missile penetration.

The modified National Defense Research Committee formula, Subsection 6.4.1.2.1 of ASCE–58 (American Society of Civil Engineers, 1980), was used to estimate the required missile barrier thickness to preclude penetration through the concrete barrier and to avoid generation of secondary missiles as a result of spalling. Once the penetration depth of the missile is determined, the concrete thickness required to prevent spalling of the concrete was determined from Subsection 6.4.1.2.1 of ASCE-58 (American Society of Civil Engineers, 1980). The minimum wall and roof thicknesses specified in Subsection 7.4.1.1, Design, of the CISF TSAR are lower boundaries for the CISF missile barrier design.

Analyses of the local penetration, perforation and spalling effects of tornado-generated missile impact will be conducted as part of the site-specific safety evaluation (U.S. Department of Energy, 1998c). Overall effects of missile impact on transfer facility reinforced concrete missile barrier structures are investigated to ensure that the structures retain their integrity and functionality subsequent to a missile strike. Overall effects of a deformable missile, such as a massive automobile striking a reinforced concrete structure, are investigated in accordance with the soft missile impact analysis specified in Subsection 6.4.2.1.2 (page 347) of ASCE-58 (American Society of Civil Engineers, 1980). Overall effects of a nondeformable missile, such as a penetrating armor piercing artillery shell, are investigated in accordance with the hard missile impact analysis specified in Subsection 6.4.2.2 of ASCE–58 (American Society of Civil Engineers, 1980). These analyses will be conducted as part of a site-specific CISF SAR.

When analyzing the transfer facility structure for tornado pressure, a design value for tornado differential pressure of only 1.0 psi is used. The 3.0-psi differential pressure design criteria for the tornado is limited to 1.0 psi by designing at least one of the overhead rollup doors to blow out at 0.15 psi, thus venting the building internal pressure to relieve the 3.0-psi pressure drop.

The minimum thickness of the building exterior concrete walls and interior tornado missile shield walls is 18 in., and the minimum thickness of the concrete roof slab is 14 in. These minimum thicknesses are in accordance with Table 1 and Subsection 3.5.3 of NUREG–0800 (U.S. Nuclear Regulatory Commission, 1981d) for Region I, which represents the worst-case tornado missile impact design loads.

Embedded plates, embedded anchors, and concrete expansion anchors used to attach various SSC to the reinforced concrete structures are designed to satisfy the requirements of governing codes. Concrete expansion anchors for QA–1 applications are the undercut or wedge-type design.

Undercut expansion anchors have a minimum design safety factor of 3.0, and wedge expansion anchors have a minimum safety factor of 4.0. No masonry block walls are used inside the transfer facility.

The QA–5 storage pads are analyzed for the loads specified in Subsection 7.6.1.3.1, Loads, of the CISF TSAR and loading combinations specified in Subsection 7.6.1.3.2, Loading Combinations, of the CISF TSAR, to determine the internal member forces and moments to be used in design of the pads. Appropriate consideration is given to the load distribution on the structure and the end restraint conditions applicable for the structural component being considered. Analyses are performed to determine both the global and local effects of these loadings on overall structural systems and individual structural components. Structural analyses are performed using computer modeling techniques or hand calculations. The section strength required to resist design loads is based on the ultimate strength design method described in ACI 349-90 (American Concrete Institute, 1990).

Using a finite element computer program called ANSYS (Swanson Analysis Systems, Inc., 1994a–d), structural analysis of the storage pads was performed (U.S. Department of Energy, 1998d). The computer analysis of the storage pads considers static and dynamic conditions. Static analyses evaluate the dead and live load combinations. The results of this analysis indicate that the storage pads provide adequate strength to support the design load combinations. Incremental cask loading positions were considered in the loading combinations to maximize internal forces and moments. The computer model considers the pad to be supported by springs at each node at the interface between the soil and the storage pad. These springs represent the soil-to-pad structural interaction in the computer analysis. Spring properties are calculated using the subgrade properties demonstrated in Chapter 2, Site Characteristics, of the CISF TSAR.

Dead load of the cask is applied to the nodes in proportion to the contributing area of the pad covered by the cask and is varied to determine the maximum combined static dead and live load forces and moments in the storage pad concrete and the resulting soil stresses. The maximum bending moment for all static loading combinations is 70.6 kip-ft per ft. The ultimate moment capacity of the storage pads, as determined per ACI 349-90 (American Concrete Institute, 1990), is 216 kip-ft per ft. Therefore, the pad static design is acceptable. Soil-bearing pressures are calculated using deflections of the nodal springs. The applied bearing pressure is a direct function of the displacement at each node. The bearing pressure is the product of the vertical subgrade reaction and the nodal displacement. The maximum soil-bearing pressure is 1.52 kips per ft^2, which is less than the 4.0 kips per ft^2, specified for design in Chapter 2, Site Characteristics, of the CISF TSAR. Therefore, the loads applied to the soil by the concrete pads are acceptable and within the specified capacity of the soil.

Dynamic analysis was performed to determine the storage pad maximum bending moments during seismic events using the ANSYS finite element model. The finite element model is the same as that described for static analysis. The storage casks are conservatively assumed to remain in place on the pads. Dynamic loads on the storage pad are conservatively evaluated using an equivalent static analysis. The DE input acceleration of 0.75 g is applied at the foundation of the storage pad. Analysis for converting the DE acceleration into seismic loadings on structures follows the procedures defined in Section 7.4, Reinforced Concrete Structures—Important to

Radiological Safety, QA–1, of the CISF TSAR. Seismic loads are applied to structures in the three orthogonal directions. Combination of seismic load forces and moments is performed using the SRSS method, or the 100-40-40 percent rule, described in ASCE Standard 4-86 (American Society of Civil Engineers, 1986) to determine the resultant DE loads on structural components. The maximum dynamic cask loadings are established by assuming each cask on the storage pad is about to tip over, thereby, applying concentrated vertical load (weight) over a limited area of its footprint. The direction of this postulated impending cask tip over was selected to maximize the interaction between adjacent casks. The magnitude of the vertical load associated with this condition is established by applying a load coefficient of 1.5 times the peak of the vertical seismic response spectrum. The worst-case bending moment in the storage pad is 193.7 kip-ft per ft. The ultimate moment capacity of the storage pad is 216 kip-ft per ft. Therefore, the dynamic analysis of the pads produces acceptable pad structural behavior. Dynamic soil pressure is calculated to be 5.33 kips per ft^2, which is equal to the allowable dynamic soil pressure of 4/3 × 4,000 psf.

While QA–5 structures are designed for earthquake loadings, the NRC does not require them to be designed to withstand tornado loadings. QA–1 structures adjacent to QA–5 structures are designed to accommodate a tornado missile spectrum representative of those generated by destruction of a nearby structure. As such, designing QA–5 structures for the DE load is the only consideration necessary for extreme environmental loadings on these types of structures. This approach is consistent with the guidance provided by the NRC in Regulatory Guide 1.117 (U.S. Nuclear Regulatory Commission, 1978b).

As pointed out in Chapter 3, Principal Design Criteria, of the CISF TSAR, storage cask systems selected for use at the CISF are designed not to tip over while on the concrete storage pads. Nevertheless, in licensing their systems, cask vendors have been required to evaluate a cask tipover to demonstrate defense-in-depth. In evaluating this event, some cask system vendors have taken credit for the deformation and crushing of the concrete storage pads, using techniques such as those described in Electrical Power Research Institute (EPRI) NP–7551 (Electrical Power Research Institute, 1993). For the purposes of evaluating the tipover event, a more flexible storage pad and subgrade will result in lower deceleration forces on the storage cask. EPRI NP–7551 also points out that the subgrade is much more important than the pad itself in establishing the hardness of the tipover target. The generic foundation parameters and the storage pad configuration will result in a relatively soft tipover target compared to that assumed by existing storage system qualifications. Therefore, lower cask deceleration forces will be calculated for a postulated tipover event, maintaining the storage system qualification evaluation. Final evaluation of this subject is site specific and must be deferred until *in-situ* foundation information is available.

The relationship between the design basis and the design criteria as required by 10 CFR 72.24(c)(2) was established in the CISF TSAR. The applicable codes and standards used in the analysis of the reinforced concrete structures as required by 10 CFR 72.24(c)(4) were fully established in the CISF TSAR. Although the adequacy of the reinforced concrete structures was demonstrated by the analysis results given in the CISF TSAR, margins of safety for the various structural elements have not been identified. The site-specific CISF SAR will have to provide the resulting margins for full compliance with the requirements of 10 CFR 72.24(d). The adequacy of all reinforced concrete systems was demonstrated by analysis as required by 10 CFR 72.24(i).

Protection from environmental conditions and natural phenomena is demonstrated based on the analysis of the reinforced concrete structures given in the CISF TSAR, in compliance with the requirements of 10 CFR 72.122(b)(1) and (2).

Throughout the CISF TSAR, assumptions are made that fire is not a credible event and that explosions are enveloped by other design criteria (i.e., tornado load). As identified previously, the staff concludes that the site-specific CISF SAR must include design parameters for the fire and address the influence of fire on reinforced concrete structures. The staff concludes that the site-specific CISF SAR must assess the potential degradation of material properties under all credible fire events to show compliance with 10 CFR 72.122(c).

The staff finds that the transfer facility superstructure and the cask system will be able to structurally withstand the 1-psi peak incident pressure associated with an explosion, based on the criteria identified in Regulatory Guide 1.91 (U.S. Nuclear Regulatory Commission, 1978c).

Because the off-normal storage area was not classified in the CISF TSAR, no structural analysis has been presented. The DOE must provide a structural analysis for these SSC to demonstrate compliance with the required regulatory requirements.

Details of the structural analysis of the reinforced concrete components of the storage cask and canister systems are demonstrated in the vendor SARs. No attempt was made to review these documents in detail. Compliance with the structural analysis requirements given in 10 CFR 72.24(c)(2), (4), (d), (i) and 72.122(b)(1), (2), (c) is assumed to be demonstrated in the SARs of individual cask systems and the associated NRC CoC evaluations.

5.4.4 Other Structures, Systems, and Components Important to Safety

The transfer facility contains structural steel components important to safety, classified as QA–1 and described in Subsection 7.5.1, Transfer Facility Steel Structures, of the CISF TSAR, including:

- Transfer Facility structural steel shapes, plates and bolts, and welding material
- Transfer Facility structural blowout panels
- Transfer Facility structural miscellaneous equipment mounting structures, hangers and anchorages
- Transfer Facility structural caissons and/or rock anchors
- Transfer Facility structural rails for overhead bridge cranes
- Transfer Facility cask off-loading and loading 225-ton capacity overhead bridge cranes

In addition to the storage casks, vendor-specific systems also contain other QA–1 SSC that are addressed in Subsection 7.5.2, Other Vendor-Specific Structures, Systems, and Components Important to Safety, of the CISF TSAR. Vendor SARs will contain structural descriptions and evaluations of QA-1, Important to Radiological Safety, steel structures, including

- Transfer Facility cask carrier intermediate lifting devices for storage casks

- Transfer Facility cask off-loading and loading lifting yokes for NUHOMS® MP187/HSM transport cask, Holtec HI-STAR 100 transport casks, TranStor™ transport casks, Westinghouse Large and Small MPC transport casks, and NAC
- Transfer Facility cask carrier transfer cradles for Westinghouse Large and Small MPC transport casks
- Transfer Facility cask carrier upender/downender and equipment for Westinghouse Large and Small MPCtransport casks
- Transfer Facility cask carrier support frame for TranStor™ transport, transfer, and storage casks
- Transfer Facility canister transfer rams for Westinghouse Large and Small MPC canisters
- Transfer Facility canister transfer for TranStor™ transfer cask
- Transfer Facility canister transfer for TranStor™ canister lifting slings
- Storage Facility storage cask transporter NAC STC/Holtec/Sierra transporter, Westinghouse MPC transporter, and NUHOMS® MP187/HSM transfer trailer

5.4.4.1 Description of Other Structures, Systems, and Components Important to Safety

Structural steel beams are provided in the transfer facility along the crane runways to support the rails for two 225-ton capacity overhead bridge cranes. These steel crane runway support beams are classified as QA–1 because they provide support for the QA–1 cranes. The steel crane runway support beams are supported on concrete corbels that protrude from the main reinforced concrete columns of the transfer facility. To provide lateral support for the steel crane runway support beams, tie members are provided between the steel beams and the concrete beams in the transfer facility wall to resist lateral forces on the steel beams due to crane trolley movement and seismic thrust loads.

The CISF TSAR description of the other SSC important to safety in the transfer facility includes only limited details of the bridge crane rails. Details of all other components are not given. It will be necessary to provide the description of the other SSC important to safety in the site-specific CISF SAR to satisfy the requirements of 10 CFR 72.24(b) and (c)(4).

The design of the other SSC important to safety in the transfer facility is based on standard design codes and standards for components; AISC Manual of Steel Construction (American Institute of Steel Construction, 1991), ASME NOG-1 (American Society of Mechanical Engineers, 1995), ANSI/AISC N690 (American National Standards Institute and American Institute of Steel Construction, 1990). Satisfaction of these design requirements provides assurance that requirements concerning inspection, maintenance, and testing as required in 10 CFR 72.122(f) are met. Satisfaction of the design requirements also addresses emergency capability as required in 10 CFR 72.122(g). Verification of the detailed information for other SSC important to safety to satisfy these requirements must be provided in the site-specific CISF SAR.

Vendor-specific systems are also a part of the CISF other steel SSC important to safety, Subsection 7.5.2, Other Vendor-Specific Structures, Systems, and Components Important to Safety, of the CISF TSAR. As indicated in the CISF TSAR, detailed descriptions of these systems are demonstrated in the vendor SARs. No attempt was made to review vendor SARs in detail. Compliance with the description requirements given in 10 CFR 72.24(b), (c)(4); 72.122(f), (g), (l);

and 72.128(a) and (b) is assumed to be demonstrated in the SARs of individual cask systems and the associated NRC CoC evaluations.

5.4.4.2 Design Criteria

Structural steel members for QA–1 SSC will be designed in accordance with elastic allowable strength design methods, as specified in Part 1 of ANSI/AISC N690 (American National Standards Institute and American Institute of Steel Construction, 1990). Loads used in design and analysis of QA–1 transfer facility structural steel are categorized into three levels: normal, severe environmental, and extreme environmental loads. These load values are based on the generic site design parameters identified in Chapter 3, Principal Design Criteria, of the CISF TSAR. Normal loads are those encountered during normal operation: dead, live, hydrostatic fluid pressure, soil pressure, thermal, and pipe reaction loads. Due to the design, no rain, snow, or ice loads; vehicle or heavy floor loads; hydrostatic fluid pressure loads; lateral soil pressure loads; or pipe reaction loads are exerted on QA–1 structural steel members in the transfer facility. Thermal loads on steel structures are the same as defined for reinforced concrete structures. All tanks located in the transfer facility are designed in accordance with mechanical equipment design criteria. As such, determination of hydrostatic fluid pressure loads is not necessary for structural analysis and design of the transfer facility.

Severe environmental loads are loads that could be encountered infrequently during the life of the transfer facility, including wind loads and flood loads. No wind or flood loads are exerted on QA–1 structural steel members inside the transfer facility.

Extreme environmental loads are those loads that are credible but highly improbable, including seismic loads and tornado load. Seismic loads on QA–1 steel structures are the same as are defined for concrete structures in Subsection 7.4.1.3.1.3, Extreme Environmental Loads, of the CISF TSAR. Because the two overhead bridge cranes must support casks during a seismic event, the full weight of the casks is included in the live load used to determine the seismic load on the crane and its support structures. No QA–1 steel structures are subjected to tornado wind, differential pressure, or tornado-generated missile impact loadings. The concrete missile barrier walls of the transfer facility protect all QA–1 SSC inside the transfer facility from missile impact, and the concrete walls are designed to withstand tornado wind and differential pressure loads. Therefore, tornado loadings do not apply to QA–1 steel structures.

Design loads for permanently installed cranes and hoists envelop the full-rated capacity of the equipment, including allowances for impact loads and test load requirements. The rated capacity of the two overhead bridge cranes in the transfer facility is 225 tons each. Crane test loads are considered in the design at 125 percent of the rated capacity of the cranes. The test loads are increased by an additional 25 percent to account for impact. Supporting steel structures for pendant-operated or remote-operated traveling cranes and trolley hoists are designed for 110 percent of the crane rated load capacity to account for impact, as specified by ANSI/AISC N–690, Section Q1.3.2 (American National Standards Institute and American Institute of Steel Construction, 1990). Design loads for motor-operated trolleys and cab-operated traveling cranes are increased by 25 percent of the cranes rated load capacity to account for impact in service and factored load combinations. Minimum lateral design loads on crane runway supports are 20 percent of the sum of the rated hoist capacity plus the weight of the crane trolley, to account for the effects of the moving trolley. The lateral load on crane supports is determined by applying the load at the top of the rail in either direction and distributing it according to the relative stiffness of the end supports. Minimum longitudinal design loads on supports for each crane rail are 10 percent of the maximum crane wheel load. Seismic effects on fully loaded cranes and hoists are described in Subsection 7.5.1.3.1.3, Extreme Environmental Loads, of the CISF TSAR. Consideration of these effects is necessary due to the high frequency of cask lifting in the transfer facility.

As described in Subsection 7.5.1.3.2, Loading Combinations, of the CISF TSAR, loading combinations are used for the design of transfer facility QA–1 structural steel and are determined using Subsection 3.8.4 of NUREG–0800 (U.S. Nuclear Regulatory Commission, 1981a) and NUREG–1536 (U.S. Nuclear Regulatory Commission, 1997) as guides. A comparison of these load combinations shows these combinations are comparable to the requirements of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). These loading combinations are used in conjunction with elastic design methods for structural steel. The required section strength is based on allowable stresses defined in ANSI/AISC N690 (American National Standards Institute and American Institute of Steel Construction, 1990). Because QA–1 structural steel was used only in miscellaneous internal structural applications in the transfer facility, loading combinations for assurance of overall stability against the effects of overturning, sliding, and floating are not applicable to structural steel design. Loading combinations consider two structural loading conditions: service and factored load conditions.

Service load combinations represent the expected loading conditions for QA–1 structures during normal facility operations and during severe environmental conditions. Service load combinations are comparable to the normal events and conditions and off-normal events and conditions loading combinations specified in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

Factored load combinations represent the loading conditions that QA–1 structures could experience under extreme environmental conditions. Factored load combinations were comparable to the accident-level events and conditions loading combinations specified in NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). Extreme environmental loads (i.e., seismic and tornado loadings) were not considered to act simultaneously because of the extremely low probability that an earthquake and a tornado could occur at the same time.

The design criteria identified for other SSC important to safety satisfy the requirements of 10 CFR 72.24(c)(1) and were based on commonly used values. They are in conformance with the design criteria identified in Chapter 4, Structures, Systems, and Components and Design Criteria Evaluation, of this AR. The applicable codes and standards were identified as required by 10 CFR 72.24(c)(4).

The design criteria for the earthquake loading anchored at 0.75 g satisfy the requirements of 10 CFR 72.102(a), (b), and (f).

As identified above, the general design criteria required by 10 CFR 72.120(a) are identified. Detailed design criteria for fabrication, construction, testing, maintenance, and performance requirements must be demonstrated in the site-specific CISF SAR.

Design criteria for protection against environmental conditions and natural phenomena to satisfy the requirements of 10 CFR 72.122(b)(1) and (2) are identified. They are in conformance with the design criteria identified in Chapter 4, Structures, Systems, and Components and Design Criteria Evaluation, of this AR.

The overall design criteria for the storage cask other SSC important to safety are demonstrated in Chapter 3, Principal Design Criteria, of the CISF TSAR. Compliance with details of the design criteria of the individual storage cask and canister systems other SSC important to safety is assumed to be demonstrated in the vendor SARs and the associated NRC CoC evaluations. No attempt was made to review these documents. Documentation 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); and 72.236(b) is assumed to be demonstrated in the SARs of individual cask systems.

5.4.4.3 Material Properties

The transfer facility steel crane runway support beams are constructed using ASTM A36 mild carbon steel rolled shapes, plate sections, or both. Standard carbon steel crane rails are connected by bolts to the top flanges of the steel crane runway support beams. All bolts used for primary structural connections are A325 or A490. A307 bolts are used for attaching ancillary components or equipment to steel structures. Welding electrodes and weld geometry are compatible with the joined materials and design loads.

These material properties and descriptions of transfer facility steel crane runway support beams satisfied the requirements of 10 CFR 72.24(c)(3). The applicable codes and standards are identified as required by 10 CFR 72.24(c)(4). It will be necessary to provide detailed information for all SSC important to safety in the site-specific CISF SAR to fully satisfy the regulatory requirements. As identified in the CISF TSAR, information cannot be provided until the detailed design of these SSC has been completed.

Details of the material properties of the other SSC important to safety of the storage cask and canister systems are demonstrated in the vendor SARs. No attempt was made to review these documents. Compliance with the material property requirements given in 10 CFR 72.24(c)(3) and (4) is assumed to be demonstrated in the SARs of individual cask systems and the associated NRC CoC evaluations.

5.4.4.4 Structural Analysis

Transfer facility QA–1 structural steel components have been analyzed and designed to resist the loads and loading combinations specified in Subsections 7.5.1.3.1, Loads, and 7.5.1.3.2, Loading Combinations, of the CISF TSAR. Static analysis methods are used for determining forces and moments on structural steel members as a result of applied service loading conditions. Dynamic analysis methods are used for determining structural steel member forces and moments for factored loading conditions where structural components are subjected to seismic loads. For determining seismic load effects on structural steel components, a damping value of 4 percent is used for welded structures, and a damping value of 7 percent is used for bolted structures, as required by Regulatory Guide 1.61 (U.S. Nuclear Regulatory Commission, 1973b). No tornado loads are present on QA–1 structural steel components within the transfer facility.

The QA–1 steel crane runway support beams are included in the ANSYS (Swanson Analysis Systems, Inc.,1994a,b,c,d) finite element analysis model described in Subsection 7.4.1.3.4, Analysis Model, of the CISF TSAR. Beams are analyzed and designed for worst-case crane wheel loads, assuming both of the overhead bridge cranes are fully loaded to rated capacity. Loadings on the beams from the cranes are appropriately increased for impact effects as described in Subsection 7.5.1.3.1.1, Normal Loads, of the CISF TSAR for live crane and hoist loads. Both cranes are assumed fully loaded during a seismic event, the full weights of the cranes are considered in contributing mass during seismic events, and the full weight of the suspended load on each crane is considered for vertical participation during seismic events. To account for the pendulum effect of the flexible cabling that supported the suspended load on each crane, lateral seismic load contributions from the 225-ton suspended loads are considered similar to lateral effects due to trolley movement. That is, 20 percent of the suspended load is applied horizontally in the direction perpendicular to the steel crane runway support beams, and 10 percent of the suspended load is applied horizontally along the longitudinal axis of the steel crane runway support beams. This load distribution is in compliance with the requirements of ASME NOG–1 (American Society of Mechanical Engineers, 1995).

The positions of the cranes are varied along the crane runways to determine the worst case for maximum stresses on the steel crane runway support beams. To determine worst-case loadings on the beams, crane lifting trolleys are positioned to one side of each crane with the two cranes adjacent. In addition, the worst-case location of the overhead bridge cranes is determined for the overall structure design. This condition exists when the cranes are positioned adjacent to each other in the center of the building, with the trolleys all the way to one side of both cranes. Reactions from crane loadings on the steel crane runway support beams are transferred into reinforced concrete corbels protruding from the main transfer facility building column faces. The top flanges of the steel crane runway support beams are tied to the transfer facility reinforced concrete structure as required to resist lateral loadings and to prevent lateral buckling of the beams. The steel crane runaway support beams and the cranes have not been designed. Preliminary analysis of the response of the support beams is demonstrated in the analysis of the reinforced concrete transfer facility. It will be necessary to include the analysis of the final design of these steel components in the site-specific CISF SAR.

The relationship between the design basis and the design criteria for other SSC important to safety as required by 10 CFR 72.24(c)(2) has been established in the CISF TSAR. The applicable codes and standards used in the analysis of the other SSC important to safety as required by 10 CFR 72.24(c)(4) are not fully established in the CISF TSAR. Details will have to be provided in the site-specific CISF SAR when the designs are finalized. The adequacy and margins of safety of the other SSC important to safety have not been demonstrated by the analysis results given in the CISF TSAR. The site-specific CISF SAR will have to contain the analysis results and margins of safety for full compliance with the requirements of 10 CFR 72.24(d) and (i) after the design has been completed.

Protection of other SSC important to safety from environmental conditions and natural phenomena is demonstrated based on the analysis of the reinforced concrete structures given in the CISF TSAR, in compliance with the requirements of 10 CFR 72.122(b)(1) and (2).

The staff concludes that the site-specific CISF SAR must assess the potential degradation of material properties of other SSC important to safety under all credible fire events to show compliance with 10 CFR 72.122(c).

Details of the structural analysis of the other SSC important to safety of the storage cask and canister systems are demonstrated in the vendor SARs. No attempt was made to review these documents. Compliance with the structural analysis requirements given in 10 CFR 72.24(c)(2), (4), (d), (i) and 72.122(b)(1), (2), (c) is assumed to be demonstrated in the SARs of individual cask systems and the associated NRC CoC evaluations.

5.4.5 Other Structures, Systems, and Components

Review of this section included the structural design, design criteria, and design analysis for miscellaneous QA classification structures in the CISF. These structures were classified as QA–3, QA–4, QA–5, QA–6, and QA–7 and are covered in Subsection 7.6.2, Other QA Classification Structures, of the CISF TSAR. The QA classified SSC reviewed in this section were:

- Miscellaneous Structures in the Transfer Facility (QA–3 to QA–7)
- Fire Protection Pump Building (QA–4 and QA–7)
- Security Complex (QA–6)
- Inspection Gatehouse (QA–6)

Other SSC that were not classified in the CISF TSAR but are identified as part of the facility include the switchgear building, main gatehouse, potable water well house, transporter wash-down station, receiving gatehouse, transportation cask queuing area, on-site receiving area, and concrete cask storage area. These SSC were also considered in this review.

5.4.5.1 Description of Other Structures, Systems, and Components

There are brief descriptions of the other QA classified SSC given in the CISF TSAR. The fire protection pump building is a single-story, slab-on-grade structure. The exterior walls are load-bearing 12-in. concrete block. The roof structure consists of 2-in. lightweight concrete on metal decking over steel beams. The security complex is a slab-on-grade structure with structural steel framing. Because the security complex is a hardened structure, the exterior walls are reinforced concrete block. The inspection gatehouse consists of a concrete apron area, the inspection gatehouse, and a mechanical equipment area. The inspection gatehouse is a slab-on-grade structure with split-face concrete block exterior walls. The CISF also includes structures for the support of platforms, piping, cables, electrical equipment, HVAC equipment, tanks, rails, and other components and equipment. Structural components for these items will be identified in the site-specific SAR and will be classified as QA–3, QA–4, QA–5, QA–6, or QA–7. They are not discussed in this chapter since they have not been explicitly identified in the CISF TSAR.

Located near the reinforced concrete transfer facility is a conventional quality personnel building that contains a canteen, locker rooms, mechanical and electrical equipment rooms, radiation protection facilities, and a cask monitor room. This building is located far enough from the transfer facility to have no effect on the transfer facility design. The switchgear building, main gatehouse, potable water well house, transporter wash-down station, receiving gatehouse, transportation cask queuing area, on-site receiving area, and concrete cask storage area are of conventional quality, and are designed to industrial standards.

The CISF TSAR description of the other SSC at the CISF installation included only limited details. It will be necessary to provide the description of all other SSC in the site-specific CISF SAR to satisfy the requirements of 10 CFR 72.24(b) and (c)(4).

The design of the other SSC is assumed to be based on standard design practice for components. Satisfaction of these design requirements provide assurance that issues concerning inspection, maintenance, and testing as required in 10 CFR 72.122(f) are met. Satisfaction of the design requirements also addresses emergency capability as required in 10 CFR 72.122(g). Verification of the detailed information for other SSC to satisfy these requirements must be provided in the site-specific CISF SAR.

Details of the design, with respect to handling and storing radioactive waste generated at the facility, as required in 10 CFR 72.128, will have to be provided in the site-specific CISF SAR.

5.4.5.2 Design Criteria

QA–3, QA–4, QA–5, QA–6, and QA–7 concrete structures are designed by ultimate strength design methods in accordance with the requirements of ACI 318-95 (American Concrete Institute, 1995). Design of embedments and expansion anchors is in accordance with conventional codes or vendor-supplied design data. Design of QA–3, QA–4, QA–5, QA–6, and QA–7 steel structures is in accordance with elastic design methods specified in AISC Manual of Steel Construction (American Institute of Steel Construction, 1991).

While QA–3 QA-4, QA–5, QA–6, and QA–7 structures are designed for earthquake loadings, the NRC does not require them to be designed to withstand tornado loadings. QA–1 structures adjacent to QA–3 or QA–5 structures are designed to accommodate a tornado missile spectrum representative of those generated by destruction of a nearby structure. As such, designing all QA–3 to QA–7 structures for the DE load is the only consideration necessary for extreme environmental loadings on these types of structures. This approach is consistent with the guidance provided by the NRC in Regulatory Guide 1.117 (U.S. Nuclear Regulatory Commission, 1978b).

Loading combinations for design of QA–3 and QA–5 structures are chosen in accordance with conventional structural design codes and standards, ACI 349-90 (American Concrete Institute, 1990) and ANSI/AISC N690 (American National Standards Institute and American Institute of Steel Construction, 1990). QA–3 structures need only to maintain structural integrity to prevent release of LLWs, and QA–5 structures need only to maintain structural integrity to avoid interaction with nearby QA–1 SSC during a DE. It is sufficient to design QA–1 SSC to conventional code and standard requirements while applying the DE load. This approach is in agreement with the precedent set for design of radioactive waste SSC for nuclear power plants that was delineated in Regulatory Guide 1.143 (U.S. Nuclear Regulatory Commission, 1979).

Loading combinations for design of QA–4, QA–6, and QA–7 structures are selected in accordance with conventional structural design codes and standards. The following codes are used to determine applicable loading combinations for the design of QA–4, QA–6, and QA–7 structures:

- Uniform Building Code (International Conference of Building Officials, 1997)
- ACI 318-95 Building Code Requirements for Reinforced Concrete (American Concrete Institute, 1995)
- AISC Manual of Steel Construction, Allowable Stress Design with Specification for Structural Steel Buildings (American Institute of Steel Construction, 1991)

Where requirements of these codes overlapped or varied, the more stringent loading combinations or conditions are used. The building classification categories from Table 1-1 of ASCE 7-95 (American Society of Civil Engineers, 1996) are used when determining seismic loads for conventional quality structures. Use of the most recent versions of all codes and standards will be required for the site-specific CISF SAR.

The design criteria identified for other SSC satisfied the requirements of 10 CFR 72.24(c)(1) and were based on commonly used values. They are in conformance with the design criteria identified in Chapter 4, Structures, Systems, and Components and Design Criteria Evaluation, of this AR. The applicable codes and standards are identified as required by 10 CFR 72.24(c)(4).

The design criterion for the earthquake loading anchored at 0.75 g satisfies the requirements of 10 CFR 72.102(a), (b), and (f).

The general design criteria required by 10 CFR 72.120(a) have been identified. Detailed design criteria for fabrication, construction, testing, maintenance, and performance requirements must be demonstrated in the site-specific CISF SAR.

Design criteria for protection against environmental conditions and natural phenomena to satisfy the requirements of 10 CFR 72.122(b)(1) and (2) were identified. They are in conformance with the design criteria identified in Chapter 4, Structures, Systems, and Components and Design Criteria Evaluation, of this AR.

5.4.5.3 Material Properties

All structural concrete proposed to be used in construction of these structures has a minimum design compressive strength of 3,000 psi in accordance with ACI 318-95 (American Concrete Institute, 1995). All reinforcing steel proposed to be used in these structures has a minimum design yield strength of 60,000 psi in accordance with ASTM Annual Book of ASTM Standards, Section 1 (American Society for Testing and Materials, 1990).

All structural steel materials proposed for the construction of these structures consists of ASTM A36 rolled shapes, ASTM A500 Grade B tube shapes, ASTM A36 carbon steel, or ASTM A240 Type 304L stainless steel plates, unless otherwise specified. Use of other materials is permissible as needed for specific designs. All bolts proposed for primary structural connections are A325 or A490. A307 bolts are used for attaching ancillary components or equipment to structures but not for primary structural member connections. Welding electrodes and weld details are selected to be compatible with the materials being joined and the design loads.

These material properties and descriptions cover only a limited number of other SSC and these satisfy the requirements of 10 CFR 72.24(c)(3). The applicable codes and standards are identified as required by 10 CFR 72.24(c)(4). It will be necessary to provide detailed information for other SSC in the site-specific CISF SAR to fully satisfy these requirements. As identified in the CISF TSAR, it is not possible at this time to provide the necessary information because the detailed design of these other SSC has not been completed.

5.4.5.4 Structural Analysis

Other SSC are analyzed for the loads specified in Subsection 7.6.2.3.1, Loads, of the CISF TSAR and loading combinations specified in Subsection 7.6.2.3.2, Loading Combinations, of the CISF TSAR, to determine the internal member forces and moments to be used in the design. Appropriate consideration is given to the load distribution on the structure and the end restraint conditions applicable for the structural component being considered. Analyses are performed to determine both the global and local effects of these loadings on overall structural systems and individual structural components. Structural analyses are performed using hand calculations or computer modeling techniques. The section strength required to resist design loads is based on the ultimate strength design methods described in ACI 349-90 (American Concrete Institute, 1990). The detailed design of these structures is site-dependent and will be included as part of a site-specific CISF SAR.

The relationship between the design basis and the design criteria for other SSC as required by 10 CFR 72.24(c)(2) has been established in the CISF TSAR. The applicable codes and standards used in the analysis of the other SSC as required by 10 CFR 72.24(c)(4) are not fully established in the CISF TSAR. Details will have to be provided in the site-specific CISF SAR when the designs are finalized. The adequacy and margins of safety of the other SSC are not demonstrated by appropriate analyses in the CISF TSAR. The site-specific CISF SAR will have to contain the analysis results and margins of safety for full compliance with the requirements of 10 CFR 72.24(d) and (i) after the design has been completed.

The design of other SSC has not been completed so analyses of resistance to environmental conditions and natural phenomena have not been completed. The site-specific CISF SAR will have to provide this information to show compliance with the requirements of 10 CFR 72.122(b)(1) and (2).

The staff concludes that the site-specific CISF SAR must assess the potential degradation of material properties of other SSC under all credible fire events to show compliance with 10 CFR 72.122(c).

5.5 Evaluation Findings

There are several evaluation findings common to all areas of review. Instead of repeating them in each area of review, these findings are given here:

- The staff finds that the relationship between the design basis and the design criteria for reinforced concrete structures satisfies the requirements of 10 CFR 72.24(b), (c)(2 and 4) and 72.40(a)(1).

- The staff finds the design criterion for the earthquake loading anchored at 0.75 g satisfies the requirements of 10 CFR 72.102(a), (b), and (f).

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).

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)

5.5.1 Confinement Structures, Systems, and Components

- The staff has reviewed the information presented in Section 7.2, Confinement SSC, of the CISF TSAR and finds that the design and performance of the confinement SSC satisfy the regulatory requirements of 10 CFR Part 72.

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.

5.5.2 Pool and Pool Confinement Facilities

- This facility does not include a pool and pool confinement facilities in the design. A number of the vendor SARs for the proposed cask systems require, however, that the storage cask and/or canisters use a pool for inspection of damage following an impact or drop event greater than specified heights. If the site-specific operational conditions are shown to exceed these specified heights, allowances for this inspection process will have to be incorporated into the site-specific SAR.

5.5.3 Reinforced Concrete Structures

- The staff has reviewed the information presented in Section 7.4, Reinforced Concrete Structures—Important to Radiological Safety, QA–1, of the CISF TSAR and finds that the design and performance of reinforced concrete structures satisfy the regulatory requirements of 10 CFR Part 72.

- The staff finds the relationship between the design basis and the design criteria for reinforced concrete structures satisfies the requirements of 10 CFR 72.24(c)(2).

- The staff finds the material properties and descriptions of the transfer facility satisfy the requirements of 10 CFR 72.24(c)(3).

- The staff finds that the applicable codes and standards applicable to the transfer facility are identified as required by 10 CFR 72.24(c)(4).

- The staff finds that the adequacy of all reinforced concrete SSC was demonstrated by analysis as required by 10 CFR 72.24(d), (i) and 72.128(a).

- The staff finds that protection of the reinforced concrete structures from environmental conditions and natural phenomena has been adequately demonstrated in accordance with the requirements of 10 CFR 72.122(b)(1) and (2).

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 SSC 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).

5.5.4 Other Structures, Systems, and Components Important to Safety

- The staff has reviewed the information presented in Section 7.5, Other Structures, Systems, and Components Important to Safety, of the CISF TSAR and finds that protection of other SSC important to safety from environmental conditions and natural phenomena was sufficiently demonstrated to satisfy the regulatory requirements of 10 CFR 72.122(b)(1) and (2).

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

- Descriptions of the other SSC 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 SSC 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 SSC 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 SSC important to safety to satisfy the requirements of 10 CFR 72.24(d) and (i)

5.5.5 Other Structures, Systems, and Components

- The staff has reviewed the information presented in Section 7.6, Other Structures, Systems, and Components Subject to NRC Approval, of the CISF TSAR and finds that the design and performance of other SSC satisfy the regulatory requirements of 10 CFR Part 72 as noted in the following findings.

- The staff finds that the proposed office for the NRC inspector satisfies the requirements of 10 CFR 72.82(c)(2).

- The staff finds that the material properties and descriptions of a limited number of other SSC satisfy the requirements of 10 CFR 72.24(c)(3).

- The staff finds that the other SSC slabs were shown to be resistant to environmental conditions and natural phenomena as required by 10 CFR 72.120(a) and 72.122(b)(1 and 2).

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

- Description of the other SSC 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 SSC as required by 10 CFR 72.24(c)(4).
- Analyses demonstrating the adequacy and margins of safety of the other SSC in sufficient detail to satisfy the requirements of 10 CFR 72.24(d) and (i).
- Design details and analyses demonstrating that other SSC 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 storing of SSC sufficient to show compliance with the requirements of 10 CFR 72.128.

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PRELIMINARY

6 THERMAL EVALUATION

6.1 Review Objective

The objective of the review of the thermal evaluation chapter is to ensure the decay heat removal (DHR) system is capable of reliable operation so that the temperatures of materials used for SSC important to safety, fuel assembly, and cladding material remain within allowable limits under normal, off-normal, and accident conditions. Dry fuel assembly transfer systems are evaluated for adequate DHR under normal, off-normal, and accident conditions. Fire hazards analysis and fire protection measures for the CISF are evaluated. The review also determined whether the thermal design of the CISF has been analyzed with acceptable analytical or test methods, or both.

The approach to thermal review and evaluation presented in this chapter builds on the guidance provided for the certification review of casks in NUREG–1538, Chapter 4 (U.S. Nuclear Regulatory Commission, 1998). As the CISF will use cask systems that have been certified by the NRC, key assumptions and bounding environmental conditions were not examined in this review. Because this was not a site-specific TSAR (U.S. Department of Energy, 1998a), a complete evaluation of the thermal characteristics of the cask systems to be used in the CISF 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. The review of the site-specific CISF SAR will evaluate whether the site environmental characteristics are bounded by the design criteria used for the proposed cask system (i.e., the cask/CISF interface requirements).

6.2 Areas of Review

The following areas of review are addressed in Section 6.4, Conduct of Review:

Decay Heat Removal Systems

Material Temperature Limits

Thermal Loads and Environmental Conditions

Analytical Methods, Models, and Calculations

Fire and Explosion Protection

Fire
Explosion

6.3 Regulatory Requirements

This section identifies the applicable regulatory requirements from 10 CFR Part 72 as

- 72.92(a)
- 72.122(c), (d), (h)(1), (2) and (4), and (i)
- 72.128 (a)(4)
- 72.236 (g)

The approach to thermal review and evaluation presented in this chapter builds on the guidance provided for the certification review of casks in NUREG–1538, Chapter 4 (U.S. Nuclear Regulatory Commission, 1998). As the CISF will use cask systems that have been certified by the NRC, key assumptions and bounding environmental conditions were not examined in this review. Because this was not a site-specific TSAR (U.S. Department of Energy, 1998a), a complete evaluation of the thermal characteristics of the cask systems to be used in the CISF was not possible. It was not assumed that compliance with appropriate regulations by any reference to cask-specific information will be evaluated in the cask vendors' SAR review. The review of the site-specific CISF SAR will evaluate whether the site environmental characteristics are bounded by the design criteria used for the proposed cask systems (that is, the cask/CISF interface requirements).

6.4 Conduct of Review

The design of the CISF is based on the use of cask systems certified under 10 CFR Part 72. According to the CISF TSAR (Chapter 8, Thermal Evaluation), thermal evaluation of the CISF relied on the analyses performed by vendors to obtain certification of the candidate cask systems. The design of the CISF was developed to ensure that the receipt, handling, transfer, storage, and monitoring of the vendor cask systems was in accordance with the vendor safety analyses and additional LCOs at the CISF.

6.4.1 Decay Heat Removal Systems

Review of this section included the SNF cladding that must be protected during storage against degradation that could lead to gross fuel rupture [10 CFR 72.122(h)] and decay heat removal systems that should have testability and reliability consistent with importance to safety [10 CFR 72.128(a)]. The transfer facility of the CISF does not provide thermal protection features for the cask systems (Subsection 8.1.2, Features, of the CISF TSAR). The transfer facility is equipped with HVAC system for operational comfort during transfer. The HVAC system is not for off-normal ambient temperature control. SNF storage confinement features provide a passive cooling function for the cask systems by air convection. It was assumed that the thermal safety is demonstrated for all certified CISF cask systems by individual vendor SARs. Demonstration of integrity of fuel cladding throughout the CISF storage period has been or will be shown in these cask-specific SARs. It was also assumed that the temperature distributions and temperature criteria used for evaluating the thermal stresses in all decay heat removal systems including technical specifications were given in the cask-specific SARs. The CISF TSAR specified the periodic surveillance to ensure that no blockage of cooling air will occur in the decay heat removal system. This surveillance will be done daily. The monitoring system will be tested annually to ensure proper functioning (Subsection 4.5.1, Storage Module Thermal and Pressure Monitoring System, of the CISF TSAR).

6.4.2 Material Temperature Limits

Review of this section included an evaluation as to whether the fuel cladding temperature would be sufficiently low to prevent cladding failure for normal conditions during a minimum of 20-yr dry storage, per 10 CFR 72.236(g). Zircaloy fuel cladding temperatures at the beginning of dry storage are typically below 380°C for a 5-yr cooled fuel assembly and 340°C for a 10-yr cooled fuel assembly (U.S. Nuclear Regulatory Commission, 1998). For short-term, off-normal, and accident conditions, a higher temperature limit (below 570°C), specified in the CISF TSAR, is acceptable, following NUREG–1567 (U.S. Nuclear Regulatory Commission, 1998). It was assumed that the cladding temperatures estimated in the specific cask vendor SARs were below these specified limits.

The acceptable temperature limits for other materials that would provide integral confinement, such as cask mechanical seals, was also verified. As this information was cask-specific, the CISF TSAR has referred to specific vendor SARs. It was assumed that this information was provided in the cask-specific SAR.

The CISF TSAR has not provided the calculated maximum temperature of SSC important to safety made of reinforced concrete, namely, transfer facility main structural (Subsection 7.4.1, Transfer Facility, of the CISF TSAR) concrete storage casks (Subsection 7.4.2, Storage Casks, of the CISF TSAR). For calculated concrete temperature of the storage casks, the CISF TSAR (Subsection 8.1.2, Features, of the CISF TSAR) refers to individual vendor cask SARs. It was assumed that compliance of the maximum calculated concrete temperature with the criteria for elevated temperatures of ACI 349-90, section A.4 (American Concrete Institute, 1990), or alternative criteria given in NUREG–1567, section 6.5.2.3 (U.S. Nuclear Regulatory Commission, 2000), had been evaluated in vendor cask SARs. Moreover, the DOE should confirm that the maximum calculated concrete temperature of the transfer facility main structural system meets the criteria for elevated concrete temperature stated in ACI 349-90, section A.4, or the alternative temperature requirements of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000).

For extreme low temperatures of the region in which the CISF would be located, there is a potential for embrittlement of ferritic steels used in SSC important to safety. This issue, however, is related to the site-specific characteristics and, therefore, is not included in the TSAR for the CISF.

6.4.3 Thermal Loads and Environmental Conditions

Review of this section included the design basis thermal loads from the SNF, as well as thermal loads associated with insolation the site parameters that determine the rate at which heat could be removed from the CISF [10 CFR 72.92(a)], and the heat removal system that should accommodate the decay heat of the SNF and the site normal, off-normal, and accident conditions [10 CFR 72.122(b)]. The CISF design criteria for insolation [Subsection 3.3.2.2, Solar Load (Insolation), and Table 3.4-11] and ambient temperatures (both normal temperature and temperature range) (Subsection 3.3.2.1, Ambient Temperature, and Table 3.4-10) were developed following 10 CFR Part 71 for testing transportation packages. Two thermal design features and assumptions were also reviewed. The transfer facility was designed to be equipped with HVAC to prevent exposure to extreme temperatures under normal operating conditions without providing any thermal protection features for the cask systems. The CISF operations described in Chapters 4, Operating Systems, and 5, Operating Procedures, of the CISF TSAR, would not place any cask system in a thermal condition for which it was not certified.

Review of this section assumed that the design criteria and relevant information regarding thermal loading conditions for the thermal performance analyses were available in respective cask vendors' SARs. The required information in the cask-specific SARs includes (i) design basis fuel assembly decay heat; (ii) control components or other assembly hardware of fuel assemblies; (iii) bounding temperature ranges, including ambient temperature conditions and variations of external heat source over time; (iv) assumed temperature and temperature variations with time for normal, off-normal, and accident conditions; and (v) conditions that may result in high temperature gradients or pressures. This information will be or has been reviewed while certifying respective cask systems under 10 CFR Part 72. Therefore, any information for CISF storage and transportation systems that were designed to ensure the stored materials remained within thermal loading conditions under normal, off-normal, and accident conditions was not reviewed.

6.4.4 Analytical Methods, Models, and Calculations

Review of this section included the thermal analysis that would demonstrate the ability to manage design basis heat loads with various materials remaining within the temperature limits for normal, off-normal, and accident conditions; information on temperature and temperature gradient to support the structural analysis; and the codes or analytical methods used for thermal analysis with bases for selected parameters. Review of this section assumed the relevant information about models used in thermal analysis was provided in cask-specific vendor SARs. Appropriateness of these models to simulate the heat transfer mechanisms and to calculate the temperatures at sufficient points to ensure that the hottest fuel cladding and points on other SSC important to safety were included in the analysis would be demonstrated in these SARs. Therefore, any information for CISF thermal models was not provided in this TSAR and was not reviewed.

6.4.5 Fire and Explosion Protection

6.4.5.1 Fire

Review of this section included the fire protection systems of all SSC of the CISF to provide fire detection and suppression, life safety, and firefighting functions to control and extinguish all potential credible fires. Subsections 4.4.2, Electrical System, and 4.4.7, Fire Protection, of the CISF TSAR, along with Appendix 4A, contain information regarding the fire protection systems and fire hazard analysis. In addition, information from parts of Chapters 2, Site Characteristics; 7, Installation Design and Structural Evaluation; and 8, Thermal Evaluation, of the CISF TSAR and the DOE response to RAIs 4-7 through 4-14 (U.S. Department of Energy, 1998b) were also reviewed.

The CISF TSAR describes a fire protection program for protecting SSC important to safety for each facility. The CISF fire protection systems comprise three major systems: yard fire protection (Subsection 4.4.7.2.1, Yard Fire Protection System, of the CISF TSAR), fire protection of the site buildings (Subsection 4.4.7.2.2, Building Fire Protection System, of the CISF TSAR), and transformer fire protection system (Subsection 4.4.7.2.3, Transfer Facility Fire Protection System, of the CISF TSAR). In addition, the following features can be applicable to more than one of the major systems: fire detection and alarm systems, manual fire fighting equipment, life safety features, passive fire protection features, and fire brigades. Fire protection SSC are classified as QA–4 and comply with the requirements of ANSI/ANS 57.9-1992 (American National Standards Institute and American Nuclear Society, 1992), NFPA 101 (National Fire Protection Association, 1997), and other applicable NFPA codes. The main thrust of the fire protection systems is minimization of the amount of combustible material, identification of potential ignition sources, and rapid response to eliminate fires.

The yard fire protection system includes fire protection water storage tanks, fire protection pumps, and a yard distribution system (Subsections 4.4.7.2.1.1 through 4.4.7.2.1.3 of the CISF TSAR). The fire protection water storage tanks will be designed in accordance with NFPA 22 (National Fire Protection Association, 1998a) and will have a capacity of 150,000 gal. each. Two steel, cylindrical-shaped water storage tanks will be placed at the ground level at both sides of the pump building. Each tank will be sized for the maximum anticipated water requirements to extinguish any design-basis fire postulated in the CISF. Specifically, these pumps will be sized to meet the flow and duration requirements specified in NFPA 13 (National Fire Protection Association, 1999a). Water will be pumped from the aboveground storage tanks by an electric or diesel-operated pump system. These pumps will be capable of providing uninterrupted water flow for the duration of a credible fire event. These pumps will be designed as automated systems, with provisions for manual operation. Water is delivered to the yard via a yard distribution system (Subsection 4.4.7.2.1.3, Yard Distribution System, of the CISF TSAR). The yard system is a looped system designed to provide uninterrupted water to the yard in the event of valve or pipe damage.

Fire protection features for site buildings focus on automatic fire suppression features, smoke control, fire detection, manual fire fighting equipment, life safety features, passive fire protection features, and fire brigade involvement (Subsections 4.4.7.2.2.1 through 4.4.7.2.2.7 of the CISF TSAR). Automatic sprinkler systems will be designed in accordance with NFPA 13 (National Fire Protection Association, 1999a) to reflect an acceptable level of protection. Smoke control within buildings will be designed in accordance with NFPA 90A (National Fire Protection Association, 1996) and NFPA 101, which will adequately address both the functional and life safety features of the proposed systems. Because this is a non-site-specific TSAR, any information regarding automatic isolation of the control room on smoke detection at the air intakes due to fire from aircraft crashes is not provided. Fire detection and alarming will be provided in accordance with NFPA 72 (National Fire Protection Association, 1999b). Detectors and alarm scenarios will be incorporated such that efficient and reliable detection and notification of a fire event is possible. In addition to the automatic sprinkler system (where installed), supplemental firefighting may be accomplished via portable fire extinguishers provided in accordance with NFPA 10 (National Fire Protection Association, 1998b). Other features, falling within the realm of passive fire protection, have been addressed and will be provided in accordance with the appropriate NFPA and construction codes. Such features include fire resistance ratings of walls, doors, and such; exit access; and floor layout of occupied buildings. Fire brigade backup was addressed (Subsection 4.4.7.2.2.7, Fire Brigades, of the CISF TSAR) and will be verified once site-specific details are known.

Based on a Fire Hazard Analysis (Appendix 4A, Fire Hazards Analysis and System Evaluation, of the CISF TSAR), the DOE has concluded that an automatic sprinkler system is not required at the transfer facility. The DOE, however, decided to install an automatic, water-based sprinkler system in the personnel building at the transfer facility, since this area will have a high level occupancy, in addition to an automatic fire detection system in the form of a smoke detector.

The Fire Hazard Analysis, presented in Appendix 4A, considered the combustible materials within the transfer facility to be (i) diesel fuel in the tank of a storage cask transporter, (ii) hydraulic fluid in a storage cask transporter and in the Westinghouse ram device, (iii) lubricating oil in air compressors and crane hoists, and (iv) trash and solid radwaste (i.e., swipes, paper towels, and rubber gloves). However, no basis has been provided in the Fire Hazard Analysis for ignoring other significant sources of combustible materials. For example, the fuel tanks of railway locomotives and trucks that bring the SNF transportation casks through rollup overhead doors into the shipping and receiving area of the transfer facility were not considered. Additionally, the tires of these trucks can be a significant source of fuel. Further, electrical and other insulation could be a source of fuel. The site-specific SAR should provide details of all potential sources of fuel, including the fuel storage capacities of these locomotives and trucks and the maximum number of trucks and/or locomotives that can be in the shipping and receiving area at any time. A fire analysis should also be provided that demonstrates that all QA–1 SSC in the transfer facility will be able to withstand and continue their respective safety functions in the event of a fire postulated from these combustible materials. The analyses should provide the flame height, duration, and temperature at different heights of the facility, dispersion of smoke generated from this fire, and any effects on the operation of the cranes and the facility roof and walls including canister transfer operation. The building design should also demonstrate that any spill of diesel fuel from the tanks of the locomotives and the trucks will not flow into the other parts of the transfer facility causing a very large pool fire.

In addition, the site-specific CISF SAR must provide the fire rating of the walls, doors, and other barriers for the transfer facility, the Security Complex, and the Water Utilities and Fire Protection structures.

NFPA 801 (National Fire Protection Association, 1998c) is applicable to all facilities that handle nuclear materials. As the CISF will be used for handling SNF, NFPA 801 and all its requirements should be applicable to the CISF. NFPA 801 addresses the requirements for fire protection at facilities handling radioactive materials to reduce the risk of fires and explosions. Because nuclear materials will be handled in the transfer building, the fire protection system should be designed in accordance with NFPA 801. Additionally, it is expected that the postulated fire in the shipping and receiving area will be fueled by large quantities of diesel; a foam-water sprinkler may be necessary. However, the fire analysis to be submitted by the site-specific applicant should be able to demonstrate that all QA–1 SSC will be able to continue their safety functions in the event of a fire without any help from the detection and suppression systems, in accordance with 10 CFR 72.122(c).

Additionally, NFPA 220 (National Fire Protection Association, 1999c), as referenced in NFPA 801 (National Fire Protection Association, 1998c), provides definitions for standard types of building construction based on combustibility and the fire resistance rating of a building's structural elements. The fire ratings of the walls, doors, and other barriers should be in accordance with the ratings. The site-specific SAR should provide information on the fire ratings based on NFPA 220.
As the CISF will use only the NRC-certified cask and canister systems, verification that the credible site fire will not exceed the fire assumptions made in the fire analysis of the casks has been referred to vendor cask SARs.

The review confirmed that material containing radioactivity, such as HEPA filters, would be stored in closed metal containers in areas free from ignition sources or combustibles. More details regarding review of this issue are given in Chapter 14, Waste Confinement and Management Evaluation, of this AR.

Qualification and training of individuals in operating and maintaining the fire protection systems are given in Chapter 13, Conduct of Operations, of the CISF TSAR. Details of this review are given in Chapter 10, Conduct of Operations Evaluation, of this AR. The hazards evaluation is adequate for identifying the hazards in the respective areas.

The CISF TSAR assumes that vegetative cover and surface soil characteristics do not provide fuel to support a fire. Because the site for the CISF has not been selected, the TSAR does not discuss the potential fire hazards from nearby industrial, transportation, and military facilities.

The CISF TSAR did not provide information regarding any postulated fire within the transfer cells, fire suppression system(s) to fight this fire, and any precautions taken or provisions designed to prevent any criticality hazard associated with fire protection. The site-specific CISF SAR must provide this information and an accompanying analysis of the criticality hazard.

6.4.5.2 Explosion

Review of potential impact to SSC important to safety from a credible explosion off-site or on-site of the CISF included Subsections 7.4.1.3.1.1, Normal Loads, and 12.2.4, Explosion, of the CISF TSAR (U.S. Department of Energy, 1998a).

The CISF TSAR has considered 1 psi (6.9 kPa) as the peak positive incident overpressure, following Regulatory Guide 1.91 (U.S. Nuclear Regulatory Commission, 1978), as the peak positive incident overpressure below which no significant damage would be expected to occur to structures designed for a design basis tornado. As the transfer facility superstructure is designed for a design basis tornado with a wind speed of 360 mph, this structure can withstand the explosion overpressure. Blast-induced ground motions are bounded by the earthquake criteria established for the CISF. Additionally, each cask system is designed for a pressure drop of 3 psi caused by a tornado wind, which provides an extra margin of protection against an explosion. Specific cask vendor SARs indicate that these systems can withstand a 1-psi (6.9 kPa) pressure wave associated with a design basis explosion.

6.5 Evaluation Findings

6.5.1 Decay Heat Removal Systems

- The staff has reviewed the design of the decay heat removal systems of the CISF TSAR and finds that the design and performance of the decay heat removal systems satisfy the requirements for the decay heat removal systems under 10 CFR 72.122 and 72.128.

6.5.2 Material Temperature Limits

- The staff has reviewed the information presented in the CISF TSAR regarding material temperature limits and finds that the material temperature limits satisfy the regulatory requirements of 10 CFR 72.128(a)(4) and 72.236(g).

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 SSC 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.

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 SSC important to safety should meet the maximum temperature requirements stated in the CISF TSAR.

6.5.3 Thermal Loads and Environmental Conditions

- The staff has reviewed the information presented in the Thermal Loads and Environmental Conditions section of the CISF TSAR and finds that the design basis thermal loads and thermal performance analyses satisfy the regulatory requirements for the thermal loads and environmental conditions under 10 CFR 72.92 and 72.122.

6.5.4 Analytical Methods, Models, and Calculations

- No information for CISF thermal models was provided in the CISF TSAR. Relevant information is available in cask-specific vendor SARs. The staff has reviewed the information presented in the Analytical Methods, Models, and Calculations section of the CISF TSAR and finds that the thermal analysis will satisfy the requirements for the analytical methods, models, and calculations under 10 CFR 72.122 and 72.128.

6.5.5 Fire and Explosion Protection

- The staff has reviewed the information presented in the Fire and Explosion Protection section of the CISF TSAR.

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 NFPA 801 Standard (National Fire Protection Association, 1998c)

- Fuel capacities of locomotives and trucks that bring the transportation casks to the shipping and 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 and 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 fire fighting attempts

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

6.6 References

American Concrete Institute. 1990. *Code Requirements for Nuclear Safety-Related Concrete Structures*. ACI 349-90. Farmington Hills, MI: American Concrete Institute.

American National Standards Institute and American Nuclear Society. 1992. *Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)*. ANSI/ANS 57.9-1992. La Grange Park, IL: American National Standards Institute and American Nuclear Society.

National Fire Protection Association. 1996. *Standard for Installation of Air Conditioning and Ventilating Systems*. NFPA 90A. Quincy, MA: National Fire Protection Association.

National Fire Protection Association. 1997. *Life Safety Code*. NFPA 101. Quincy, MA: National Fire Protection Association.

National Fire Protection Association. 1998a. *Standard for Water Tanks for Private Fire Protection*. NFPA 22. Quincy, MA: National Fire Protection Association.

National Fire Protection Association. 1998b. *Standard for Portable Fire Extinguishers*. NFPA 10. Quincy, MA: National Fire Protection Association.

National Fire Protection Association. 1998c. *Standard for Fire Protection for Facilities Handling Radioactive Materials*. NFPA 801. Quincy, MA: National Fire Protection Association.

National Fire Protection Association. 1999a. *Standard for Installation of Sprinkler Systems*. NFPA 13. Quincy, MA: National Fire Protection Association.

National Fire Protection Association. 1999b. *National Fire Alarm Code*. NFPA 72. Quincy, MA: National Fire Protection Association.

National Fire Protection Association. 1999c. *Standard on Types of Building Construction*. NFPA 220. Quincy, MA: National Fire Protection Association.

U.S. Department of Energy. 1998a. *Topical Safety Analysis Report of Centralized Interim Storage Facility*. Vol. 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. 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.

U.S. Nuclear Regulatory Commission. 1998. *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. Washington, DC: U.S. Nuclear Regulatory Commission.

7 SHIELDING EVALUATION

7.1 Review Objective

The primary objective of this review is to determine whether the shielding design features of the CISF meet NRC criteria for protection against direct radiation from the material to be stored. In particular, this evaluation establishes the validity of dose rate estimates made in the DOE TSAR (U.S. Department of Energy, 1998a). These estimates in turn are used in the radiation protection review, as described in Chapter 11, to determine compliance with regulatory limits for allowable dose rates and conformance with criteria for maintaining radiation exposures ALARA.

The scope of this chapter is limited to evaluating the shielding for the SNF to be stored. Other radiation sources at the CISF for which shielding may be required are addressed in Chapters 11, Radiation Protection Evaluation, and 14, Waste Confinement and Management Evaluation, of this AR. Because this was not a site-specific TSAR, a complete evaluation of the shielding was not possible. Moreover, it was assumed that compliance with appropriate regulations by any reference to cask-specific information would be evaluated in the cask vendor SARs review. License conditions that must be addressed are identified.

7.2 Areas of Review

The following areas of review are addressed in Section 7.4, Conduct of Review:

Demonstrated Radiation Sources

Gamma Sources
Neutron Sources

Storage and Transfer Systems

Design Criteria
Design Features

Shielding Composition and Details

Composition and Material Properties
Shielding Details

Analysis of Shielding Effectiveness

Computational Methods and Data
Dose Rate Estimates
Confirmatory Calculations

7.3 Regulatory Requirements

This section identifies the applicable requirements from 10 CFR Part 72 for the shielding evaluation as

- 20.1201(a)(1)(i) and (ii)
- 20.1301(a)(1) and (2)
- 20.1302(b)(1)
- 72.24(c)(3) and (e)
- 72.104(a)(1–3)
- 72.126(a)(6)
- 72.128(a)(2)

7.4 Conduct of Review

The review of the shielding evaluation of the CISF TSAR included Chapter 9, Radiation Protection, of the CISF TSAR and the DOE responses to NRC RAIs 9-1 through 9-12 (U.S. Department of Energy, 1998b). Chapter 9 of the CISF TSAR describes the radiation protection features of the CISF that ensure the radiation exposures to workers and the public can meet NRC regulatory criteria and will be maintained ALARA. This chapter evaluated the shielding design features for protection against radiation doses to the public and to workers from the CISF operations. In the absence of any site-specific information, the shielding evaluation in the CISF TSAR deferred the determination of the minimum distance between the CISF and the boundary of the controlled area to the site-specific CISF SAR.

7.4.1 Demonstrated Radiation Sources

Section 9.2, Radiation Sources, of the CISF TSAR and the DOE responses to RAIs 9-1 through 9-9 demonstrated information on the radiation sources present at the CISF site. To evaluate whether radiation protection systems were adequate, the description of the physical and chemical form, source geometry, radionuclide content, and estimated curie value and bases for estimation were reviewed. The information on radiological source terms came from the Westinghouse Large MPC SAR (Westinghouse Government and Environmental Services Co.,1996).

7.4.1.1 Gamma Sources

The source term for the SNF was calculated using a Westinghouse Large MPC storage cask with 40,000 megawatt d/MTU burnup PWR fuel enriched to 3.75 wt % after 5 yr of decay. This fuel does not necessarily have the largest radioactive source term of all the fuels that will be stored on the site, but, based on the dose calculations using this fuel and cask type, a set of limiting conditions can be defined based on dose rates at a given distance from any surface of the cask. All casks that will be stored at the CISF must be as conservative or more conservative than these limiting conditions to be accepted at the site. These limiting conditions are specified in Subsection 7.4.2.2, of this AR. Of the casks identified to be used at the CISF, the Westinghouse Large MPC storage cask has the highest radial dose rates and the highest axial dose rate. The radiation source spectra was taken from the Westinghouse Large MPC SAR that was calculated using the SAS2H and ORIGEN-S modules of the SCALE code (Oak Ridge National Laboratory, 1994) and is shown in Table 7-1.

Table 7-1. Normalized active fuel region photon source term (based on Table 9.2-2 of Centralized Interim Storage Facility Topical Safety Analysis Report)

PWR Peak Assembly—5-Yr Decay

PRELIMINARY

			Normalized		Assembly Total	
Group	**Energy Range (MeV)**	**Average Energy (MeV)**	**Gammas/s**	**MeV/s**	**Gammas/s**	**MeV/s**
1	8.0–10.0	9.000	1.73×10^{-11}	1.56×10^{-10}	1.19×10^{5}	1.07×10^{6}
2	6.5–8.0	7.250	8.13×10^{-11}	5.90×10^{-10}	5.60×10^{5}	4.06×10^{6}
3	5.0–6.5	5.750	4.15×10^{-10}	2.39×10^{-9}	2.86×10^{6}	1.64×10^{7}
4	4.0–5.0	4.500	1.03×10^{-9}	4.66×10^{-9}	7.13×10^{6}	3.21×10^{7}
5	3.0–4.0	3.500	6.01×10^{-6}	6.01×10^{-6}	1.18×10^{10}	4.14×10^{10}
6	2.5–3.0	2.750	3.81×10^{-5}	3.81×10^{-5}	9.55×10^{10}	2.63×10^{11}
7	2.0–2.5	2.250	1.02×10^{-3}	1.02×10^{-3}	3.13×10^{12}	7.04×10^{12}
8	1.66–2.0	1.830	3.40×10^{-4}	3.40×10^{-4}	1.28×10^{12}	2.34×10^{12}
9	1.33–1.66	1.495	1.68×10^{-2}	1.68×10^{-2}	7.73×10^{13}	1.16×10^{14}
10	1.0–1.33	1.165	5.07×10^{-2}	5.07×10^{-2}	3.00×10^{14}	3.49×10^{14}
11	0.8–1.0	0.900	4.68×10^{-2}	4.86×10^{-2}	3.72×10^{14}	3.35×10^{14}
12	0.6–0.8	0.700	2.63×10^{-1}	2.63×10^{-1}	2.59×10^{15}	1.81×10^{15}
13	0.4–0.6	0.500	5.98×10^{-2}	5.98×10^{-2}	8.23×10^{14}	4.12×10^{14}
14	0.3–0.4	0.350	3.80×10^{-3}	3.80×10^{-3}	7.49×10^{13}	2.62×10^{13}
15	0.2–0.3	0.250	4.02×10^{-3}	4.02×10^{-3}	1.11×10^{14}	2.77×10^{13}
16	0.1–0.2	0.150	8.89×10^{-3}	8.89×10^{-3}	4.08×10^{14}	6.13×10^{13}
17	0.05–0.1	0.075	5.29×10^{-3}	5.29×10^{-3}	4.86×10^{14}	3.64×10^{13}
18	0.01–0.05	0.030	7.15×10^{-3}	7.15×10^{-3}	1.64×10^{15}	4.92×10^{13}
Total			**1.00**	$\mathbf{4.70 \times 10^{-01}}$	$\mathbf{6.89 \times 10^{15}}$	$\mathbf{3.24 \times 10^{15}}$

In addition to the fuel region source term, photons are also produced from the activation of the fuel assembly top and bottom end fittings, primarily from Co-60. This source term has also been taken from the Westinghouse Large MPC SAR, where it is calculated using the flux activation technique described by Luksic (1989). The source term used for dose calculations assumes a decay time of 5 yr and is shown in Table 7-2.

7.4.1.2 Neutron Sources

The neutron source term has also been taken from the Westinghouse Large MPC SAR and is calculated using the same fuel characteristics, computer codes, and assumptions as the gamma source term. The primary source of neutrons from the fuel is from the spontaneous fission of Cm-244. The calculated neutron source term is shown in Table 7-3.

Table 7-2. Pressurized water reactor end fitting activation source term (based on Table 9.2-5 of the CISF TSAR)

Energy Range (MeV)	Average Energy (MeV)	Gamma Fraction	Gammas/s per Storage Cask
Top End Fitting			
1.0–1.33	1.165	0.780	1.595×10^{14}
1.33–1.66	1.495	0.220	4.501×10^{13}
Bottom End Fitting			
1.0–1.33	1.165	0.780	1.485×10^{14}
1.33–1.66	1.495	0.220	4.189×10^{13}

Table 7-3. Normalized active fuel region neutron source term (based on Table 9.2-3 of the CISF TSAR)

Group	Energy Range (MeV)	Average Energy (MeV)	Normalized	Neutrons/s
1	0.1–0.4	0.25	3.78×10^{-02}	2.06×10^{8}
2	0.4–0.9	0.65	1.93×10^{-01}	1.05×10^{9}
3	0.9–1.4	1.15	1.77×10^{-01}	9.67×10^{8}
4	1.4–1.85	1.625	1.31×10^{-01}	7.15×10^{8}
5	1.85–3.0	2.425	2.33×10^{-01}	1.27×10^{9}
6	3.0–6.43	4.715	2.10×10^{-01}	1.15×10^{9}
7	6.43–20.0	13.215	1.84×10^{-02}	1.01 × 108
Total			**1.000**	**5.46×10^{9}**

7.4.2 Storage and Transfer Systems

The shielding used in the storage and transfer systems is discussed in Subsection 9.3.3, Shielding, of the CISF TSAR. All SNF that will be located on the CISF site will reside within one of three types of casks, transportation, transfer, or storage. The CISF may use a variety of storage casks and, as such, the shielding requirements for the casks are based on dose rates outside the cask instead of strict material thickness requirements.

7.4.2.1 Design Criteria

The shielding at the CISF is designed to meet the following regulatory criteria:

- 10 CFR 20.1201, which requires that radiation workers at the site receive a TEDE of less than 5 rem/yr

- 10 CFR 20.1301, which requires that members of the public receive a TEDE of less than 100 mrem/yr

- 10 CFR 72.104, which requires that members of the public receive a dose equivalent of less than 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ

The transportation and storage casks used on the site will be limited to those that have been approved by the NRC. Transportation casks will be limited to dose rates of 200 mrem/hr contact and 10 mrem/hr at 2 m from any surface of the cask, as required by 10 CFR Part 71.

In addition to these regulatory annual dose requirements, the shielding has also been designed to meet ALARA objectives. Examples of the use of the ALARA principle in the design of the facility include (i) the placement of operations personnel in shielded, remote operating stations; (ii) use of shielded transporters to move casks to the storage areas; and (iii) the use of temporary shielding where feasible.

Transfer casks will provide sufficient shielding to reduce the radiation levels to an average of 10 mrem/hr at 2 m from the cask. Most transfers will occur in the transfer facility having thick concrete walls to provide further shielding to the public and workers outside of the transfer area.

7.4.2.2 Design Features

The calculation of annual dose at the edge of the restricted area has been carried out using a Westinghouse Large MPC cask, although other casks may be used at the site. This cask consisted of layers of steel surrounded by a thick concrete shell with an air vent in the center of the lid. The calculation of the dose from this cask takes credit for the shielding provided by the assemblies themselves, including the SNF, plenum, and end fittings. The components of the SNF, plenum, and end fittings (including the unoccupied volume) are smeared for calculational purposes into a uniform composition within the occupied volume. This smearing is not expected to have a significant effect on the results of the dose calculations. Temporary shielding will be used whenever possible during the receipt of fuel and transfer into storage casks.

If other casks are used at the CISF facility, the site-specific CISF SAR must demonstrate that the following dose limits are not exceeded by the alternate casks:

- Total dose rate (neutron plus gamma) does not exceed 10 mrem/hr at 2 m from any vertical surface

- Radiation streaming from storage cask vents and vertical surfaces does not exceed an area-weight value of 5 percent of radial surface dose rates and does not contribute more than 1 percent of the total dose rate at 50 m

- Total axial dose rate (neutron plus gamma) does not exceed 650 mrem at any point on the top surface of the cask on 5.1 mrem/hr averaged over the top of the cask

7.4.3 Shielding Composition and Details

Subsection 9.3.3.3.2, MPC Source and Shielding Configuration, of the CISF TSAR, describes the composition of shielding materials for the dose assessment performed for the Westinghouse Large MPC storage cask. The data have been taken from the Westinghouse Large MPC SAR.

7.4.3.1 Composition and Material Properties

Shielding materials have been described by their physical dimensions, material compositions, and densities. The shielding materials consist of standard materials and are primarily the steel and concrete that make up the walls and lids of the casks. Although the off-site dose assessment is performed for only the Westinghouse Large MPC storage cask, other casks may be used on the site as long as cask surface dose rates are below the limits described previously.

The basis of the shielding composition and material properties has been taken from the Westinghouse Large MPC SAR.

7.4.3.2 Shielding Details

The casks were modeled explicitly in the computer simulations (Civilian Radioactive Waste Management System Management & Operating Contractor, 1998a,b). All penetrations and voids that present a potential pathway for radiation streaming were explicitly modeled or were demonstrated to have a negligible effect on dose.

The shielding calculations were performed for an array of 6,000 storage casks. These modeled casks were arranged in a 40 × 150 cask rectangle in the storage area on-site. However, Section 1.2, General Description of Installation, of the CISF TSAR indicates that up to 7,800 casks will be stored at the CISF facility. Any changes in the number or arrangement of casks from that used in the shielding calculations will require an assessment of how the dose rates around the storage array will be affected. The minimum distance from the storage area to the edge of the controlled area will be 700 m.

7.4.4 Analysis of Shielding Effectiveness

7.4.4.1 Computational Methods and Data

Subsection 9.3.3.3, Storage Area Shielding, of the CISF TSAR describes the computational methods and data used to calculate the effectiveness of the shielding. Analyses were conducted to determine the effectiveness of the shielding of the transfer, transportation, and storage casks. Because the CISF facility may use a variety of cask types, analyses were performed based on the maximum dose rates that casks will be allowed to have based on the criteria described in Subsection 7.4.2 of this AR.

Calculation of the effectiveness of shielding were performed using one or more of the following methods or codes. The computer code MCNP 4A (Oak Ridge National Laboratory, 1995a) was used to calculate radial and axial neutron fluxes and dose rates, air-scattered gamma dose rates, and air-scattered neutron dose rates from the storage casks. This is a three-dimensional particle transport code that can be used for neutron, photon, and electron particle transport. The ENDF/B-IV cross sectional library was used with the MCNP 4A code. The computer code QAD-CGGP (Oak Ridge National Laboratory, 1995b) was used to calculate the radial and axial gamma fluxes from the storage cask. QAD-CGGP uses a point kernel ray-tracing technique for gamma ray calculations. MCNP 4A and QAD-CGGP are standard dose assessment computer codes that are commonly used to make these types of dose calculations. Hand calculations were used to estimate dose rates at distances from the transport and transfer casks. These calculations simply used the dose rate limits on the casks to calculate doses at greater distances and behind simple shields. The methods used to calculate the effectiveness of shielding materials in the CISF TSAR are appropriate for the situations being modeled.

The DOE used flux-to-dose-rate conversion factors from ANSI/ANS 6.1.1-1977 (American National Standards Institute and American Nuclear Society, 1977) to convert calculated photon and neutron fluxes to dose rates where necessary. These conversion factors were considered acceptable.

7.4.4.2 Dose Rate Estimates

Section 9.4, Direct Radiation Dose Rate Within the Controlled Area, and Subsection 9.6.1, Site Boundary Dose, of the CISF TSAR describe the dose rate estimates made at various locations on the site and at the edge of the controlled area along with the response of RAIs 9-3, 9-7, 9-8, and 9-12 (U.S. Department of Energy, 1998b).

The transfer casks will limit the dose rate to an average of 10 mrem/hr at 2 m from the surface of the cask. These transfers primarily will occur within the thick concrete walls of the transfer facility, and doses directly behind walls of the transfer facility have been shown to be substantially less than 0.25 mrem/hr (the limit for unrestricted areas within the controlled area) based on calculations assuming an average gamma energy of 0.5 MeV. Doses at the edge of the uncontrolled area from transfer operations have not been calculated, although they are not expected to be significant. Dose rates are calculated or estimated at various locations and distances around the cask to calculate worker dose from transfer operations.

The transportation casks are limited by regulations in 10 CFR Part 71 to a maximum contact dose rate of 200 mrem/hr and a maximum dose rate of 10 mrem/hr at 2 m. The off-site doses from these casks have not been calculated. However, there will be a small number of transportation casks with fuel inside at the site at any given time, so the increase in dose to the off-site public from these casks under normal operating conditions is not expected to be significant. Based on the hand calculations, the CISF TSAR indicates that the queuing area will require temporary access control to a distance of 50 m when transportation casks are being stored to maintain dose rates below 0.25 mrem/hr. Dose rates are calculated or estimated at various locations and distances around the cask to calculate worker dose from receipt and transfer operations.

The storage cask shielding analysis is much more complex. To show that the site will not exceed the public dose limits given in 10 CFR 72.104, the licensee has modeled the site using the Westinghouse Large MPC storage cask for every cask on site. This storage cask has a maximum radial dose rate of 10 mrem/hr at a distance of 2 m from the cask, a maximum axial dose rate of 650 mrem/hr on contact with the axial vent, an average dose rate of 5.1 mrem/hr over the top of the cask, and negligible contributions from air vents on the side of the cask. Therefore, all storage casks that will be accepted on the CISF site will be required to meet the criteria defined by the Westinghouse Large MPC storage cask.

Dose rates were calculated at locations in the middle of both the midarray and array-end sides of the cask array for a variety of distances. It has been determined that the midarray location provides the greatest dose rate from the cask array. Analyses showed that the minimum distance from the array to limit the dose rate to less than 2 mrem/hr is 50 m. This will be the minimum restricted area setback distance. The dose rate falls to less than 0.25 mrem/hr at a distance of 200 m. Therefore, 200 m will be the minimum distance to the unrestricted area. The controlled area boundary will be set at a minimum of 700 m from the nearest storage cask to ensure that the dose in an uncontrolled area does not exceed 25 mrem/yr (Gillespie, 1998).

Dose rates are calculated or estimated at various locations and distances around the cask to calculate worker dose from storage and maintenance operations.

The NRC staff review of the shielding calculations (U.S. Department of Energy, 1997) identified the following concerns that should be addressed in the site-specific CISF SAR:

- Assumption 6 in Part III of the dose analysis (Calculation CCC000000–01717–0200–00005 Rev. 01, ISF Storage Area Radiation Analysis) that scattering of radiation from the surfaces of the storage casks can be neglected needs to be justified. Neglecting all casks on site beyond the third row of casks because there is not a direct path for the radiation to stream is a nonconservative assumption. Although this dose is likely to be smaller than the direct component of dose, it is not possible to say that this dose will be negligible without calculations to provide justification.

- The assumption that the calculated dose from the center end casks at distances of 600 m and greater may be neglected should be justified. Although the exposure fractions for half of the center end casks are negligible (<0.01), the other half average about 0.05 and may not be negligible (see page 18 of Part III of the ISF Storage Area Radiation Analysis—Boundary Dose Analysis). A numerical comparison between the dose rates from these casks and the dose rate from the front three rows of casks is necessary to determine whether it is appropriate to neglect these casks.

- The assumption that the effects of ground scatter back into the air are negligible in calculating the dose at the site boundary from the radial contribution to dose should be justified. For the neutron calculation in MCNP on page II-181 of Part I of the ISF Storage Area Radiation Analysis—Boundary Dose Analysis, the ground plane below which soil should be located has been defined as a void, which eliminates particles so they can make no further contribution to dose. The soil should be incorporated into the MCNP model to accurately model neutrons scattering into the soil but eventually returning to the air. The QAD model used for the gamma contribution to dose neglects this effect of the soil as well, because it utilizes a point kernel technique to solve the problem. Therefore, buildup factors are calculated based on the beam being surrounded on all sides by air. However, the higher density soil below the beam will scatter more photons into the beam and will therefore increase the apparent buildup factor.

- Additional justification is needed for neglecting the bottom air inlet vents in the calculation of dose to the public. Simply providing the area-weighted radial dose contribution at the vent opening is not sufficient because the average energy of the gammas escaping from the vent opening will be higher than the average energy of the gammas penetrating the concrete shield. This is because (i) most of the photons escaping from the concrete shield will have scattered several times while traveling through the shield, thereby reducing their energy, whereas the photons streaming through the bottom vents will have scattered fewer times, and (ii) the primary source of the photons escaping the bottom vents is the bottom fitting of the assembly. This source is mostly Co-60, which emits gammas at the energies of 1.17 MeV and 1.33 MeV. In comparison, only about 1.5 percent of the gammas released by the fuel region of the assemblies are 1.33 MeV or higher, according to Table 9.2-2 of the CISF TSAR. The higher energy bottom vent gammas are more penetrating in air than the lower energy radial gammas and, therefore, more of a threat to an off-site individual. In addition, according to Section 7.5 of Calculation CCC000000–01717–0200–00005 Rev. 01, ISF Storage Area Radiation Analysis Part 1, the calculation of the area weighted dose rate contribution of the bottom vents to the radial doses to demonstrate that the bottom air inlet vents can be neglected compares the bottom vent dose rate to the peak radial dose rate, assuming that this dose rate is present over the entire radial area of the cask. However, as shown on page II-164 of the same document, the average dose rate over the entire radial area of the cask is considerably lower than the peak dose rate.

Additionally, the on-site and off-site dose calculations do not account for casks that are received at the site, but cannot be immediately transferred to the storage area and must be queued for some period of time.

7.4.4.3 Confirmatory Calculations

Independent confirmatory calculations were performed by NRC reviewers using the computer code MCNP 4A. These calculations were made based on the same number of casks that will be stored on the site as the applicant's analysis (i.e., 6,000). NRC calculations confirm that the midway location provides the greatest dose rate to an off-site receptor, which is in agreement with the licensee calculations. The maximum dose at the nearest uncontrolled area was calculated using the maximum dose rates for casks allowed to be stored on the site (as described in Subsection 7.4.4.2 of this AR) and conservative energy distributions and off-center dose profiles. The independent dose calculations also included the side vent openings and the ground scatter that were neglected in the licensee evaluation to ensure that these vents do not have an effect on dose. The calculations performed by the NRC reviewers confirmed that the maximum dose rate at the nearest uncontrolled area would be less than 25 mrem/yr, as required by 10 CFR 72.104.

7.5 Evaluation Findings

To determine whether the radiation shielding at the CISF site is acceptable, the topics identified in the individual areas above must be addressed in the site-specific application.

7.5.1 Demonstrated Radiation Sources

- The staff has reviewed the information presented in Section 9.2, Radiation Sources, of the CISF TSAR and finds that the information provided was sufficient to evaluate the design of the shielding to determine whether the facility will meet the requirements of 10 CFR 72.126(a)(6).

7.5.2 Storage and Transfer Systems

- The staff has reviewed the information presented in Subsection 9.3.3, Shielding, of the CISF TSAR. The staff finds that the information provided is sufficient to satisfy the requirements for storage and transfer systems under 10 CFR 72.24(c) and is adequate for meeting the objective of maintaining exposures ALARA for compliance with 10 CFR 72.24(e). Further, the design of the storage and transfer systems is adequate to limit radiation exposure in accordance with 10 CFR 72.104, 72.126, and 72.128.

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 Westinghouse Large 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.

7.5.3 Shielding Composition and Details

- The staff has reviewed the information presented in Subsection 9.3.3.2, MPC Source and Shielding Configuration, of the CISF TSAR.

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.

7.5.4 Analysis of Shielding Effectiveness

- Independent calculations performed by the NRC reviewers using the computer code MCNP 4A and including the side vents, which were neglected by the licensee, confirmed that the maximum dose rate at the nearest uncontrolled area would be less than 25 mrem/yr, as required by 10 CFR 72.104.

- The staff has reviewed the information presented in Subsections 9.3.3.3, Storage Area Shielding, and 9.6.1, Site Boundary Dose, of the CISF TSAR.

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), and 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

7.6 References

American National Standards Institute and American Nuclear Society. 1977. *Neutron and Gamma Ray Flux-to-Dose-Rate Factors*. ANSI/ANS 6.1.1-1977. Washington, DC: American National Standards Institute.

Civilian Radioactive Waste Management System Management & Operating Contractor. 1998a. *Interim Storage Facility Radiation Analysis. Part I—Boundary Dose Analysis*. CCC000000–01717–0200–00005, Rev. 01. Vienna, VA: Civilian Radioactive Waste Management System Management & Operating Contractor.

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PRELIMINARY
8 CRITICALITY EVALUATION

8.1 Review Objective

The objective of this review and evaluation is to ensure that the stored materials remain subcritical under normal, off-normal, and accident conditions during all operations, transfers, and storage at the site. Because this was not a site-specific TSAR (U.S. Department of Energy, 1998), a complete evaluation of the criticality was not possible. Compliance with appropriate regulations by reference to cask-specific information will be evaluated in the cask vendor SAR reviews.

8.2 Areas of Review

The following areas of review are addressed in Section 8.4, Conduct of Review:

Criticality Design Criteria and Features

Criteria
Features

Stored Material Specifications

Analytical Means

Applicant Criticality Analysis

8.3 Regulatory Requirements

This section identifies the applicable regulatory requirements from 10 CFR Part 72 for the criticality evaluation as:

- 72.40(a)(13)
- 72.124(a) and (b)

8.4 Conduct of Review

The criticality evaluation performed in Chapter 10, Criticality Evaluation, of the CISF TSAR relies on the criticality analyses performed in the individual cask SARs. The CISF facility will utilize only casks that have been certified by the NRC for use at a storage facility. The certification of individual cask systems will involve evaluation for critical safety under normal and accident conditions. The CISF TSAR only evaluates whether a storage array of dissimilar storage casks will present a greater potential for criticality than individual cask SARs evaluated.

8.4.1 Criticality Design Criteria and Features

The criticality design criteria and features are described in Section 10.1, Criticality Design Criteria and Features, of the CISF TSAR. CISF site design features and criticality safety evaluation assumptions are presented to demonstrate consistency with cask system vendor cask system design and licensing bases.

8.4.1.1 Criteria

Criticality safety will be demonstrated for all CISF transportation and storage systems by cask vendor analyses. The criticality safety criterion must be satisfied for all systems, assuming a number of similar units are stored in an array. Criticality safety evaluations further assume limiting fuel characteristics that were stipulated in the respective cask system vendor SARs. These SARs must be approved by the NRC prior to use at the CISF facility.

8.4.1.2 Features

CISF storage and transportation cask systems are designed to ensure that the stored materials remain subcritical under normal, off-normal, and accident level conditions during all site operations, transfers, and storage. The primary cask criticality control design features are basket geometry and neutron absorber materials. The CISF will implement array limitations as specified in the vendor SARs.

CISF design and operational control features preclude events or conditions that may degrade cask system SNF basket geometry or other package criticality control design features of primary importance, such as reflector characteristics or the continued effectiveness of supplemental neutron absorber materials. SNF basket criticality control design feature integrity has been demonstrated for all cask systems proposed to be used at the CISF site under all normal, off-normal, and accident level conditions.

Package confinement systems will be protected from damage, and mechanical closure confinement systems will be monitored. SNF cavity confinement features provide a defense-in-depth criticality control function by significantly reducing the risk that any hydrogenous neutron moderator will be introduced into the SNF basket cavity of any package received. Other features that help to preclude criticality include

- Seismic design of transfer facility crane and structure
- Seismic design requirements imposed on storage systems
- Tornado missile protection of transfer facility operations area
- Crane design features that satisfied single-failure proof criteria and reduced potential for drop events
- Vehicular barriers and speed-limiting features and controls
- Dry site criteria
- CISF storage array design maintained within vendor design analysis for all cask systems

8.4.2 Stored Material Specifications

Information about the stored material specifications has been provided in Section 10.2, Stored Material Specifications, of the CISF TSAR. SNF characteristics considered in cask system criticality safety evaluations were summarized in the respective vendor SARs. It was assumed that packages received at the CISF were loaded in accordance with vendor SAR and regulatory requirements.

8.4.3 Analytical Means

Information about the analytical means of the criticality analysis is demonstrated in Section 10.3, Criticality Assessment, of the CISF TSAR. No criticality analyses have been performed beyond those presented in the cask system vendor SARs. Array interaction between dissimilar storage systems has been evaluated in this section to ensure compliance with the criticality safety criterion.
Based on the following reasons, the criticality assessments in the cask system vendor SARs are considered bounding for situations that might be encountered at the CISF:

- All transportation and storage casks that have been licensed by the NRC have been shown to remain appropriately subcritical in a worst-case flooding situation and with worst-case array spacing. The CISF facility will maintain the casks in a dry condition and will maintain relatively large distances among the casks in storage.

- The storage casks have a large capacity for storing SNF and, therefore, the effect of surrounding the single cask with an infinite array of casks is generally negligible and within the nominal statistical variation of the reference calculations.

- The neutronic characteristics of the SNF package units received at the CISF site are similar, that is, relatively high enrichment fresh fuel characteristics are assumed for loaded SNF, uranium mass loadings are similar between designs, and fuel basket design features are sufficient to maintain $k_{eff} \leq 0.95$ in all designs under all conditions.

Therefore, the neutronic interaction among dissimilar cask systems within the array will not cause an increase in k_{eff} above the analyses performed in the vendor cask SARs.

8.4.4 Applicant Criticality Analysis

The applicant has not performed any criticality analyses beyond those conducted in the cask SARs.

8.5 Evaluation Findings

- Evaluation of criticality at the CISF installation, as provided in the CISF TSAR, 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.

8.5.1 Criticality Design Criteria and Features

- The staff has reviewed the information presented in Section 10.1, Criticality Design Criteria and Features, of the CISF TSAR and finds that the requirements for criticality design criteria and features will be satisfied under 10 CFR 72.40 (a)(13) and 10 CFR 72.124. This is based on using only transportation and storage casks that have been approved by the NRC for the licensed purpose.

8.5.2 Stored Material Specifications

- The staff has reviewed the information presented in Section 10.2, Stored Material Specifications, of the CISF TSAR and finds that the information satisfies the requirements for stored material specifications under 10 CFR 72.124. This is based on using only transportation and storage casks that have been approved by the NRC for the licensed purpose.

8.5.3 Analytical Means

- The staff has reviewed the information presented in Section 10.3, Criticality Assessment, of the CISF TSAR and finds that the information satisfies the requirements for analytical means under 10 CFR 72.124. This is based on using only transportation and storage casks that have been approved by the NRC for the licensed purpose.

8.5.4 Applicant Criticality Analysis

- The applicant has not performed criticality analyses for the proposed CISF because the cask vendors perform the criticality analyses for the CISF that could increase the reactivity beyond the conditions analyzed in the cask SAR. This provides reasonable assurance that the activities authorized by the license can be conducted in compliance with 10 CFR 72.40(a). This also provides reasonable assurance that a criticality event will not occur in accordance with 10 CFR 72.124. This assurance is provided by using only transportation and storage casks that have been approved by the NRC for the licensed purpose.

8.6 Reference

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.

PRELIMINARY

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 finds that the information satisfies the requirements for radionuclide confinement analysis. 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.

- Confirmation that the vendor SARs include analytical calculations of SNF characterization.

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 procedures specified in the SARs satisfy the requirements for confinement monitoring under 10 CFR 72.122(h)(4), and 72.128(a)(1).

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).

- Information specifying how frequently the additional confinement monitoring features added to the CISF design monitoring features would be used.

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. This should satisfy the requirements for protection of stored materials from degradation 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.

PRELIMINARY

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. Tthe 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. 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). 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. The 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 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 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 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 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 days 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, seem to indicate that the DOE has made appropriate commitments to test all systems important to safety. The testing objectives have been 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 ensure that the 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 assure 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, also is 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
- On-the-job training and qualifications
- Continuing training
- Special training

- Technical training
- Personnel certification requirements
- Initial training
- 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 ensures 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. 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 applicant did not provide information of the selection and training of security guards. Information should be provided which describes the process by which the security guards will be selected and qualified as required by 10 CFR 73.55(b)(4)(ii) and 10 CFR 73, Appendix B.

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 applicant stated that important to physical protection of facility and materials SSC are designed to satisfy the requirements of 10 CFR Part 72, subpart H, for a physical security and safeguards contingency plan and physical protection design. Physical protection design requirements and criteria are described in Section 4.9, Physical Protection, of the CISF TSAR. A complete review of Subsection 4.9.4, Physical Protection Plan Components, of the CISF TSAR was not conducted since a separate detailed physical security plan and standard safeguard contingency plan will be provided in the site-specific CISF SAR. Design criteria for physical protection of the CISF are identified and satisfy the requirements of 10 CFR 72.182(a). Information regarding the adequacy of the physical protection system to perform its intended function must be submitted with the site-specific CISF SAR. Note that the latest revision of DOE/RW 033P no longer contains a QA–6, Important to Physical Protection of Facility and Materials, and the site-specific SARs must reflect this change.

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 finds 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 indicates 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 operate the CISF 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 finds 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). The 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, the applicant can conduct these activities at the CISF 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 DOE has presented an acceptable program for the development, management, and use of procedures and records. An 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 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, the applicant can conduct the proposed activities at the CISF 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, and finds that the applicant has presented an acceptable program for the selection, training, and certification of personnel. A plan and program for training personnel has been submitted that specifies 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 assurance that the physical condition and general health of certified personnel would provide for operations in accordance with the requirements of 10 CFR 72.194. Based on an evaluation of the program for personnel selection, training, and certification, the applicant can conduct the proposed activities at the CISF 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.

- A description of the process by which the security guards will be selected and qualified as required by 10 CFR 73.55(b)(4)(ii) and 10 CFR 73, Appendix B.

10.5.5 Emergency Planning

- The staff has reviewed the information presented in Section 13.5, Emergency Planning, of the CISF TSAR, and finds 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, the applicant can conduct the proposed activities at the CISF in accordance with 10 CFR 72.40.

10.5.6 Physical Security and Safeguards Contingency Plans

The site-specific CISF SAR must provide the following:

- Information regarding the adequacy of the physical protection system to perform its intended function must be submitted with the site-specific CISF SAR.

- The latest revision of DOE/RW 033P no longer contains a QA–6, Important to Physical Protection of Facility and Materials, and the site-specific SAR must reflect this change.

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.

PRELIMINARY

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)
- 72.106(b)
- 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 finds 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 finds that the radiation protection design features of the ISFSI have been adequately described in accordance with 10 CFR 72.24. 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 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. Further, 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 finds 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). Further, 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. The cumulative effects of the combined operations of nearby facilities could not be evaluated to determine if they follow 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 finds that the program has been described adequately in accordance with 10 CFR 72.24. The Health Physics Program is adequate to ensure that radiation exposures will be ALARA in accordance with 10 CFR 20.1101. In addition, the Health Physics Program will minimize contamination in accordance with 10 CFR 20.1406. The Health Physics Program will use controls as necessary to limit intakes of radionuclides in compliance with 10 CFR 20.1702. Finally, 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.

PRELIMINARY

12 QUALITY ASSURANCE EVALUATION

12.1 Review Objective

The objective of this review and evaluation is to determine whether the operator of the CISF has a QA program that complies with the requirements of 10 CFR Part 72, Subpart G. Development of the design of the CISF was performed in accordance with a QA program established in conformance with the requirements of 10 CFR Part 72, Subpart G, and approved by NRC. Because the TSAR (U.S. Department of Energy, 1998) is not site-specific, a complete review of the principal criteria as specified in NUREG–1567 (Nuclear Regulatory Commission, 2000) is not possible. The additional information that must be included in the site-specific SAR of the CISF is identified.

The quality assurance classifications of CISF structures, systems, and components are based on definitions developed by the Office of Civilian Radioactive Waste Management (OCRWM) for the CISF. The OCRWM classification categories include

- Important to Radiological Safety (QA–1)—Includes those SSC whose function is

    - to maintain the conditions required to store SNF safely
    - to prevent damage to the SNF during handling and storage
    - to provide reasonable assurance that SNF can be received, handled, packaged, stored, and retrieved without undue risk to the health and safety of the public.

- Important to Waste Isolation (QA–2)—Is applicable only to a geologic repository.

- Important to Radioactive Waste Control (QA–3)—Includes those items associated with the control and management of site-generated liquid, gaseous, and solid radioactive waste; does not include SNF or high-level waste forms.

- Important to Fire Protection (QA–4)—Includes those items whose associated with detecting, controlling or extinguishing a fire for protection of classification QA–1 SSC.

- Important to Potential Interaction (QA-5)—Includes those items whose continued function is not required, but whose consequential failure during a design basis event could impair the capability of other items to perform intended radiological safety functions.

- Important to Physical Protection of Facility and Materials (QA–6)—Includes those items associated with security safeguard systems to protect from acts of radiological sabotage and to prevent the theft of special nuclear material in accordance with 10 CFR Part 73.

- Important to Occupational Radiological Exposure (QA–7)—Includes those items associated with exposure control as well as effluent and area radiation monitoring in accordance with 10 CFR Part 20.

This list has been updated since the CISF TSAR was published and no longer includes the QA–6 category. Consequently, to be in compliance with DOE/RW 0333P, the classification of the various CISF SSCs should be updated in the site-specific CISF SAR.

12.2 Regulatory Requirements

This section identifies that the applicable regulatory requirements from 10 CFR Parts 21 and 72 for QA are:

- 21.21
- 72.24
- 72.40
- 72.122
- 72.140
- 72.142
- 72.146
- 72.148
- 72.150
- 72.152
- 72.154
- 72.156
- 72.158
- 72.160
- 72.162
- 72.164
- 72.166
- 72.170
- 72.172
- 72.174
- 72.176
- 72.232
- 72.234

12.3 Conduct of Review

As indicated in Section 15 of the TSAR, the NRC has issued a 10 CFR Part 71 Subpart H QA program approval to the DOE Office of Civilian Radioactive Waste Management (Docket 71-0786, expiration date July 31, 2005). Based on review of the QA program, the staff has determined that the design of the CISF was conducted by an organization with a QA program meeting the requirements of Subpart H of 10 CFR Part 71, which, in accordance with 10 CFR 72.140(d), also satisfies the requirements of Subpart G of 10 CFR Part 72 when records are maintained in accordance with 10 CFR 72.174 and the NRC is notified of the intent to use the Part 71 program for storage activities. Because the TSAR is not site-specific no further QA program review was conducted.

12.4 Evaluation Findings

The site specific SAR for the CISF must contain information to satisfy the requirements of 10 CFR Part 72, Subpart G. In addition, the classification of the various CISF SSCs should be updated in the site-specific CISF SAR

12.5 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.

PRELIMINARY

13 DECOMMISSIONING EVALUATION

13.1 Review Objective

The objective of this review of the decommissioning plan description for the CISF is to determine if it provides reasonable assurance that the applicant can prepare a decommissioning plan consistent with NRC requirements. Nothing in this review considers, or involves the review of, ultimate disposal of SNF. Because the TSAR (U.S. Department of Energy, 1998) is not site-specific, a complete review of the principal criteria as specified in NUREG–1567 (Nuclear Regulatory Commission, 2000) is not possible. The additional information that must be included in the site-specific SAR of the CISF is identified.

13.2 Regulatory Requirements

This section identifies and presents a summary of 10 CFR Part 72 relevant to the review areas addressed by this chapter. The applicable regulatory requirements from 10 CFR Part 72 for decommissioning are:

- 72.24
- 72.30
- 72.40
- 72.54
- 72.98
- 72.100
- 72.130

13.3 Conduct of Review

A decommissioning plan was not submitted with the TSAR. However, DOE committed to submit such a plan with the CISF license application.

13.4 Evaluation Findings

The site specific SAR for the CISF must contain information to satisfy the decommissioning requirements of 10 CFR Part 72.

13.5 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.

PRELIMINARY
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).

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.

The site-specific SAR should consider how the large quantity of casks (enough to contain 40,000 metric tons of uranium) could affect the probability of occurrence and consequences of off-normal events and accidents at the CISF.

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

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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 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.

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.

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

$$R \geq kW^{\frac{1}{3}} \quad (15\text{-}1)$$

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 *in situ* 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 vendor 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).

The site-specific SAR should

- Consider how the large quantity of casks (enough to contain 40,000 metric tons of uranium) could affect the probability of occurrence and consequences of off-normal events and accidents at the CISF.

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 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.

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 found 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 found 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.

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

- 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 and found 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 a 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 under 10 CFR 72.24, 72.90, 72.92, 72.94, 72.106, 72.122, 72.124, 72.128, and 72.236.

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).

- A discussion of the program to maintain the area in the vicinity of the storage pads free of any combustible material.

- 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).

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 under 10 CFR 72.24, 72.106, 72.122, 72.126, and 72.236.

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.

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PRELIMINARY

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 should ensure 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 should provide 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.

PRELIMINARY

APPENDIX A

SUMMARY OF 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 off-normal holding area storage capacity and design specifications are acceptable

- 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

- Confirmation that the CISF storage area does not require a fire protection loop to suppress or mitigate a fire because the storage area does not have significant quantities of combustibles other than the diesel fuel stored in the site transporter fuel tanks and nearby vegetation.

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.5.5.2 Pool and Pool Confinement Facilities

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

- This facility does not include a pool and pool confinement facilities in the design. A number of the vendor SARs for the proposed cask systems require, however, that the storage cask and/or canisters use a pool for inspection of damage following an impact or drop event greater than specified heights. If the site-specific operational conditions are shown to exceed these specified heights, allowances for this inspection process will have to be incorporated into the site-specific SAR.

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.10.5.4 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 description of the process by which the security guards will be selected and qualified as required by 10 CFR 73.55(b)(4)(ii) and 10 CFR 73, Appendix B.

A.10.5.6 Physical Security and Safeguards Contingency Plans

The site-specific CISF SAR must provide the following:

- Information regarding the adequacy of the physical protection system to perform its intended function must be submitted with the site-specific CISF SAR.

- The latest revision of DOE/RW 033P no longer contains a QA–6, Important to Physical Protection of Facility and Materials, and the site-specific SAR must reflect this change.

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.12.4 Quality Assurance Evaluation

The site-specific CISF SAR must provide the following:

- Information to satisfy the requirements of 10 CFR Part 72, Subpart G. In addition, the classification of the various CISF SSCs should be updated in the site-specific CISF SAR

A.13.4 Decommissioning Evaluation

The site-specific CISF SAR must provide the following:

- Information to satisfy the decommissioning requirements of 10 CFR Part 72.

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 Conduct of Review

The site-specific CISF SAR should

- Consider how the large quantity of casks (enough to contain 40,000 metric tons of uranium) could affect the probability of occurrence and consequences of off-normal events and accidents at the CISF.

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 discussion of the program to maintain the area in the vicinity of the storage pads free of any combustible material.

- 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).

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 Adiabatic 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

PRELIMINARY

APPENDIX B

SUMMARY OF 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:

- Cask-specific information is presented as stated in the DOE documents. Most of these casks were not approved by NRC at the time of the submittals, and the licensing status of the casks continues to evolve. In addition, the name and ownership of the casks in some cases has changed and may change in the future. Therefore, new submittals must account for these changes.

- 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.2.5.6 Geology and Seismology

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

- Confirmation that the stability evaluations for the specific cask systems identified for use at the CISF in the site-specific CISF SAR account for the peak earthquake horizontal acceleration.

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.4.5.3.3 Thermal

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

- Confirmation that the design criteria of the specific cask systems identified for use at the CISF in the site-specific CISF SAR bound the CISF thermal performance design criteria to satisfy the requirements of 10 CFR 72.120(a).

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

- Confirmation that the vendor SARs include analytical calculations of SNF characterization.

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).

- Information specifying how frequently the additional confinement monitoring features added to the CISF design monitoring features would be used.

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 must 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 Adiabatic 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.