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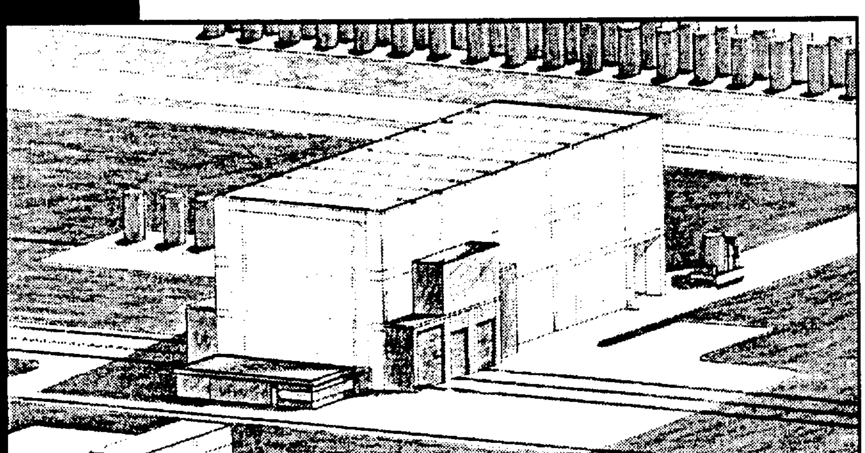
Centralized Interim Storage Facility

Topical Safety Analysis Report



Volume I

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

ABSTRACT

The Centralized Interim Storage Facility (CISF) is designed as a temporary, above-ground away-from-reactor spent fuel storage installation for up to 40,000 metric tons of uranium (MTU). The design is non-site-specific but incorporates conservative environmental and design factors (e.g., 360 mph tornado and 0.75 g seismic loading) intended to be capable of bounding subsequent site-specific factors. Spent fuel is received in dual-purpose canister systems and/or casks already approved for transportation and storage by the Nuclear Regulatory Commission (NRC). A transfer building is provided for shielded transfer of canisters between transport overpacks and storage overpacks for those systems not providing for direct yard transfer. Facility design and operations are intended to be flexible enough to allow for the addition of new vendor system designs, based on reasonable extrapolation of present systems, subsequent to their approval by the NRC. The design, operations and safety analyses are presented in the topical safety analysis report (TSAR). The format for the TSAR follows the suggested format contained in Draft NUREG-1567, *Standard Review Plan for Spent Fuel Dry Storage Facilities.* The content of the TSAR follows that suggested in Regulatory Guide 3.48, *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage)*, as augmented by suggested content contained in Draft NUREG-1567. Based on the analyses presented in the TSAR for a site that falls within the environmental and design parameters established in the TSAR, it is concluded that the CISF can be constructed and operated in a manner that protects the public health and safety.

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ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AISC	American Institute of Steel Construction
ALARA	As Low as is Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ANSI/AISC	American National Standards Institute/American Institute of Steel Construction
ANSI/ASCE	American National Standards Institute/American Society of Civil Engineers
ARI	Air-conditioning and Refrigeration Institute
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
AWS	American Welding Society
AWWA	American Water Works Association
BWR	Boiling Water Reactor
CAA	Controlled Access Area
CAM	Continuous Air Monitor
CAP	Cargo Access Portal
CAS	Central Alarm Station
CCTV	Closed-Circuit Television
CFR	Code of Federal Regulations
CISF	Centralized Interim Storage Facility
CRWMS	Civilian Radioactive Waste Management System
DBE	Design Basis Event
DE	Design Earthquake
DOE	Department of Energy
DOP	Dioctyl Phthalate
DPC	Dual Purpose Canister
DTS	Dry Transfer System
EAL	Emergency Action Level
EOC	Emergency Operations Centers
FSRC	Facility Safety Review Committee

GET	General Employee Training
GSDC	Generic Site Design Criteria
HDPE	High-Density Polyethylene
HEPA	High-Efficiency Particulate Air
HSM	Horizontal Storage Module
HVAC	Heating, Ventilation and Air Conditioning
I&C	Instrument and Controls
IPI	Installed Process Instrumentation
ISFSI	Independent Spent Fuel Storage Installation
LCO	Limiting Conditions for Operation
LWR	Light Water Reactor
M&O	Management & Operating Contractor
MGDS	Mined Geological Disposal System
MPC	Multi-Purpose Canister
MRS	Monitored Retrievable Storage
MTU	Metric Tons of Uranium
NAC	Nuclear Association Corporation
NDRC	National Defense Research Committee
NFPA	National Fire Protection Agency
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
OCRWM	Office of Civilian Radioactive Waste Management
OJT	On-the-Job Training
OSHA	Occupational Safety & Health Administration
PHA	Preliminary Hazards Assessment
PMP	Probable Maximum Precipitation
PRA	Probabilistic Risk Assessment
PVC	Polyvinyl Chloride
PWR	Pressurized Water Reactor
QA	Quality Assurance
QARD	Quality Assurance Requirements and Description
RP	Radiation Protection
RTD	Thermocouples
SAR	Safety Analysis Report

SARA	Superfund Amendments and Reauthorization Act
SAS	Secondary Alarm Station
SNF	Spent Nuclear Fuel
SNSC	Sierra Nuclear Storage Cask
SNTC	Sierra Nuclear Transportation Cask
SNXC	Sierra Nuclear Transfer Cask
SRSS	Square Root of the Sum of the Squares
SSC	Structures, Systems, and Components
TESS	TRW Environmental Safety Systems
TF	Transfer Facility
TFCO	Transfer Facility Crane Operator
TFO	Transfer Facility Operator
TFRO	Transfer Facility Remote Operator
TLD	Thermoluminescent Dosimeter
TSAR	Topical Safety Analysis Report
TSC	Transportable Storage Cask
UBC	Uniform Building Code
UPS	Uninterruptable Power Supply
USQ	Unreviewed Safety Question
WSC	Westinghouse Storage Cask
WTC	Westinghouse Transportation Cask

1. INTRODUCTION AND GENERAL DESCRIPTION OF INSTALLATION

This Topical Safety Analysis Report (TSAR) describes the design and operation of the Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM) Centralized Interim Storage Facility (CISF). The CISF provides federal storage capability for Spent Nuclear Fuel (SNF) under the oversight of the DOE.

The format and content of the TSAR follows Draft NUREG-1567, *Standard Review Plan for Spent Fuel Dry Storage Facilities* (Ref. 1.0-1). Regulatory Guide 3.48, *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage)* (Ref. 1.0-2) was also used as guidance in the development of the TSAR format and content.

The TSAR describes a facility designed to accept commercial spent nuclear fuel contained in dual-purpose (transportation/storage) or multi-purpose (transportation/storage/disposal) cask and canister systems that have been certified by the Nuclear Regulatory Commission (NRC). The CISF will accommodate 40,000 metric tons uranium (MTU) and will have a service life of at least 40 years.

The intent of the TSAR is to provide the NRC Staff with sufficient information to issue a Safety Evaluation Report (SER). This TSAR and the NRC's SER will be incorporated by reference in any subsequent license application. Submitting this TSAR and obtaining NRC staff review ahead of site designation will reduce the time required for license application preparation and reduce licensing risks related to design and safety considerations. Based on the analyses presented in the TSAR it is concluded that the CISF can be constructed and operated in a manner that protects the public health and safety and the environment in accordance with 10 CFR Part 72 (Ref. 1.0-3).

This chapter provides a summary of the Safety Analysis Report. The following information is included: (1) a general description of the CISF; (2) general descriptions of the systems and operations; (3) analysis of CISF operations; (4) identification of agents and contractors; and (5) material incorporated into the TSAR by reference.

1.1 INTRODUCTION

1.1.1 CISF Functions

The function of the CISF is to provide safe temporary storage of SNF. The CISF will receive, handle, and store SNF in a manner that protects the health and safety of the public and workers, and maintains the quality of the environment.

The storage of spent nuclear fuel at the CISF will be based on the use of cask systems that have been previously certified by the NRC. These cask systems include transportable storage casks and canister-based storage systems. It is DOE's intent that all NRC certified dual-purpose (transportation/storage) or multi-purpose (transportation/storage/disposal) cask systems be acceptable for use at the CISF. For the purpose of developing bounding CISF design criteria that will facilitate the use of future NRC certified designs, six cask systems were chosen as the basis for CISF design. These cask systems are described in the vendor SARs that were either docketed by the NRC or under development by the DOE as of June 1, 1996. Table 1.1-1 provides a listing of the vendor cask systems used for the design of the CISF.

Table 1.1-1. Storage Systems Considered in the CISF Design

Name	NRC Docket No.	Type
NUHOMS® MP187/HSM	71-9255 72-11	Dual Purpose Canister (DPC) System
Holtec HI-STAR 100	71-9261 72-1008	Transportable Storage Cask (TSC)
Sierra TranStor™ System	71-9268 72-17	DPC System
Westinghouse Large MPC	Not Docketed	Multi-Purpose Canister (MPC) System
Westinghouse Small MPC	Not Docketed	MPC System
NAC STC	71-9235 72-1002	TSC

SNF arrives by rail car or heavy haul to the CISF in various cask systems already approved by the NRC for transportation and storage. After the appropriate security and receipt inspections, the transporter carrying the cask is taken into the transfer facility. The cask is removed from its transporter and inspected and decontaminated if necessary. Transportable storage cask systems are then transported to the storage area for interim storage.

Canister-based cask systems require transfer of the SNF canister from the transportation cask to the storage cask. These transfers are performed either in the transfer facility or the storage area depending on the cask system design. All transfer and handling activities are accomplished in a dry mode using cask vendor supplied equipment and CISF structures, systems, and components (SSCs). The CISF design as presented in the TSAR does not employ a spent fuel pool or other bare fuel handling capability.

Cask vendor and facility SSCs important to safety are identified in Chapter 3. Vendor SSCs are used to the maximum extent possible in the design of the CISF and are described in the design and licensing basis documents associated with each cask system. The use of previously certified cask systems is an integral part of the CISF design basis. The CISF SSCs important to safety include the concrete and steel structures of the transfer facility, the transfer facility access door blowout panels, and the 225-ton overhead bridge cranes used for cask handling and transfer operations in the transfer facility.

The nominal storage capacity of the CISF is 40,000 metric tons of uranium (MTU) of SNF. The physical, thermal, and radiological characteristics of the SNF to be stored at the CISF are defined in the respective cask vendor SARs.

Because the CISF only receives, transfers, and stores SNF in NRC approved sealed canisters or casks, the quantities of radioactive materials expected to be released in CISF effluents is very small.

DOE will be the applicant/licensee for the CISF. DOE will employ qualified contractors for the design, construction, and operation of the CISF. The activities associated with the CISF will be governed by the applicable portions of DOE's Quality Assurance (QA) program as described in Chapter 15 of the TSAR. The OCRWM QA program is designed to meet the requirements of 10 CFR 72, Subpart G.

The CISF is designed to have a minimum service life of 40 years with only routine maintenance.

1.1.2 Schedule

A summary of the CISF design, construction, and operations schedule is provided in Figure 1.1-1.

1.2 GENERAL DESCRIPTION OF INSTALLATION

The CISF is designed as a stand-alone facility and consists of a transfer facility, storage area, and support facilities. A site layout is provided in Figure 1.2-1, and a site overview is provided in Figure 1.2-2.

1.2.1 Location and Site Characteristics

No location for the CISF has been designated, however the CISF is designed to be located almost anywhere in the United States. Generic site design criteria were chosen to envelop as much of the contiguous 48 United States as practical. Once a site for the CISF is selected, site investigation will be performed to quantify actual site characteristics. If any of these 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.

1.2.2 Principal Design Criteria

The CISF principal design criteria are based on generic site characteristics, the design criteria associated with the vendor systems, and specific discipline criteria required for facility design. As much as practical, the CISF is designed to accommodate each vendor system. The vendor systems evaluated meet most of the current CISF design criteria. However, further evaluations of the cask systems eventually certified by the NRC and available for use at the CISF will be necessary. 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. Table 1.2-1 provides a summary of the CISF principal design criteria.

Table 1.2-1. Summary of CISF Principal Design Criteria

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards & Bases
Type of Fuel	Commercial, light water reactor, spent nuclear fuel	Normal	N/A
Storage Systems	Transportable storage casks and cask/canister systems docketed by the NRC or under development by the DOE as of 6/1/96	Normal	See Table 3.1-1
Fuel Characteristics	Criteria as specified in cask/canister systems in use at CISF	Normal	See Table 3.1-1
Tornado (Wind Load)	Max translational speed: 70 mph Max rotational speed: 290 mph Max tornado wind speed: 360 mph Radius of max rotational speed: 150 ft Tornado pressure drop: 3.0 psi Rate of pressure drop: 2.0 psi/sec Gust factor: 1.0	Accident	NRC RG 1.76 (Ref. 3.3-1) NUREG-0800 (Ref. 3.3-2)
Tornado (Missile)	Automobile, 3968 lb, 28 ft^2 Artillery shell, 276 lb, 8 in Steel sphere, 0.15 lb, 1 in	Accident	NUREG-0800 (Ref. 3.3-2)
Straight Wind	110 mph (3 sec. gust) Exp. Cat. C QA 1 SSCs, IF=1.15 All other SSCs, IF=1.00	Off-normal	ANSI/ASCE 7-95 (Ref. 3.3-3)
Floods	None specified. Classification 1 SSCs are located above maximum flood plain	Accident	NRC RG 3.48 (Ref. 3.3-4)
Precipitation	Cumulative, 5 min: 6.2 in Cumulative, 1 hr: 19.4 in	Normal	NWS Report #52 (Ref. 3.3-5)
Snow and Ice	Loading: 50 lb/ft^2 QA 1 SSCs, IF=1.2 All other SSCs, IF=1.00	Normal	ANSI/ASCE 7-95 (Ref. 3.3-3)

Design Parameter	**Design Criteria**	**Condition**	**Applicable Codes, Standards & Bases**
Seismic (Ground Motion)	Design response spectra anchored at horizontal acceleration of 0.75g	Accident	NRC RG 1.76 (Ref. 3.3-1)
Seismic (Surface Faulting)	No surface faulting	Accident	10 CFR 100, App. A (Ref. 3.3-8)
Volcanic Eruption (Ash Fall)	No volcanic ash fall	Accident	N/A
Explosions	Overpressure at facility due to on-site or off-site explosion not to exceed 1.0 psi	Accident	NRC RG 1.91 (Ref. 3.3-7)

Table 1.2-1. Summary of CISF Principal Design Criteria (Continued)

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards & Bases
Aircraft Impact	None specified	Accident	NUREG-0800 (Ref. 3.3-2)
Proximity to Uranium Fuel Cycle Operations	No uranium fuel cycle operation located in vicinity of CISF	Normal	10 CFR 72 (Ref. 3.2-1)
Ambient Temperature	Normal temperature: 76.0°F Minimum temperature: -40.0°F Maximum temperature: 125°F	Normal	ASHRAE Handbook (Ref. 3.3-9) 10 CFR 71.71 (Ref. 3.3-10)
Solar Load (Insolation)	Horizontal flat surface solar insolation: 2949.4 Btu/day-ft^2 Curved surface solar insolation: 1474.7 Btu/day-ft^2	Normal	10 CFR 71 (Ref. 3.3-10)
Shielding	< 5 rem (Public)	Accident	10 CFR 72.106 (Ref. 3.2-1)
Confinement	As listed in vendor system SARs, Table 3.1-1	N/A	N/A
Radiological Protection	< 25 mrem, whole body < 75 mrem, thyroid (Public) < 25 mrem, other organ	Normal	10 CFR 72.104 (Ref. 3.2-1)
	< 5 rem, whole body (Public)	Accident	10 CFR 72.106 (Ref. 3.2-1)
Nuclear Criticality	As listed in vendor system SARs, Table 3.1-1	N/A	N/A
Decommissioning	Minimize potential contamination Utilize materials & coatings to facilitate decommissioning	Normal	10 CFR 72.130 (Ref. 3.2-1)
Materials Handling & Retrieval Capability	Cask/canister handling systems safe under all facility conditions	Accident, Off-Normal, & Normal	10 CFR 72.128 (Ref. 3.2-1)
	Storage system allows ready retrieval of SNF for further processing	Normal	10 CFR 72.122 (l) (Ref. 3.2-1)

Storage and handling systems shall be designed to allow ready retrieval of SNF, and the cask/canister handling systems shall be designed in accordance with 10 CFR 72.128(a) to ensure adequate safety under normal and accident conditions. As discussed in Chapter 3, the following criteria for SNF cask systems shall also be satisfied.

- Cask systems shall be designed to prevent tipover or drop during transfer and storage operations under normal and accident conditions.

- Cask systems shall be designed and certified to withstand a drop event from heights specified in the TSAR.

- Cask systems designed to transfer SNF canisters external to the transfer facility structure shall be designed to withstand the impact of the postulated tornado missiles during transfer operations.

- Cask systems shall be designed to accommodate remote handling techniques and robotic applications.

- Dose rates (gamma plus neutron) for cask systems at 2 meters from any vertical surface (as stored) shall be less than 10 mr/hr.

- Radiation streaming from storage cask vents and vertical surfaces shall be a small component of total dose rates and shall have an insignificant impact on dose rates at distances greater than 50 meters.

- The air-scattered component of total dose rate at distances greater than 50 meters shall be less than 50 percent.

- For cask systems utilizing canisters, an NRC approved recovery method for the unlikely loss of confinement event shall be provided. The method of recovery must be independent of any bare fuel handling facilities.

- Cask systems utilizing vertical transfer must be qualified for a 6-inch drop of the storage cask or transportation cask lid during transfer operations.

1.2.3 Facility Descriptions

The major facilities at the CISF are the transfer facility and the storage area. The transfer facility is a reinforced concrete building approximately 250 ft long by 88 ft wide by 75 ft high. The purpose of the transfer facility is to receive and prepare for storage shipments of SNF in dual purpose cask/canister systems. It will also retrieve SNF from storage and prepare the systems for off-site shipment. The transfer facility is designed to handle canistered fuel only and does not have any routine bare fuel handling capabilities. The transfer facility is designed to withstand all normal operating loads and abnormal loads created by seismic activity, tornadoes, and other natural events.

ALARA principles are incorporated to the maximum extent practical throughout the design to reduce radiation exposure to facility personnel. Overhead bridges cranes are remotely operated from a crane operating room. Gantry-mounted robotic equipment is provided in the shipping/receiving area and stationary-mounted robotic equipment is provided in the canister transfer area. The gantry-mounted robotic equipment is controlled from the crane operating room, and other robotic equipment is remotely operated from shielded rooms.

The storage area is a large area comprised of concrete storage pads and storage casks. The purpose of the storage area is to provide safe storage for SNF in NRC approved cask systems. The storage area will be constructed in stages as necessary, and is designed to store 40,000 MTU of SNF in approximately 5,300 to 7,800 storage casks depending on the vendor systems. The storage area is designed to withstand all normal operating loads and abnormal loads created by seismic activity, tornadoes, and other natural events.

The remainder of the CISF facilities provide support functions such as fuel receipt, fuel inspection, security, and fire protection. Table 1.2-2 provides a list CISF facilities and their functions. The facility locations are provided in Figure 1.2-1.

Table 1.2-2. CISF Facilities and Functions

Facility	Function*
Transfer Facility	Receive and prepare for storage, shipments of canistered SNF
Storage Area	Provide location for safe storage of SNF
Transportation Cask Queuing Area	Provide location for receipt of rail cars or heavy haul transporters
Switchyard	Provides delivery of electric power to CISF
Security Complex	Provide main operation center for site security and emergency vehicles
Inspection Gatehouse	Receive and inspect SNF shipments
Main Gatehouse	Control personnel and vehicle access to the CISF facilities
Concrete Cask Staging Area	Receive and store empty SNF storage casks prior to use
Off-Normal Holding Area	Receive and temporarily store SNF shipments that are not eligible for routine processing
On-Site Receiving Area	Provide temporary location for SNF deliveries waiting to proceed to the Inspection Gatehouse
Transporter Wash Down Station	Remove road dirt from incoming transporters
Receiving Gatehouse	Control access to CISF site
Water Utilities and Fire Protection Area	House major equipment of the potable water and fire protection systems

*Function shown relates to SNF receipt operations. In general, the facilities provide the corresponding function for SNF retrieval and offsite shipment operations

1.2.4 Materials To Be Stored

Only SNF in NRC-approved dual-purpose cask systems will be received at the CISF. This approach is in concert with paragraph A.1.4.2 *Use of Previously Certified Cask Systems* in *Draft NUREG-1567*. This will include commercial light water reactor fuel, PWR and BWR, and possibly non-commercial fuel. However, only fuel in NRC-approved cask/canister systems 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 for those transport/storage systems.

The nominal capacity of the facility is 40,000 MTU. The combination of fuels to be received is impossible to predict. The DOE intends to carry out a program that maximizes the role of the private sector in accepting and transporting SNF, providing storage modes, and ancillary equipment. It is envisioned that vendor teams will negotiate with each utility and a contract awarded. Thus, the types of fuel and their quantities cannot be predicted. Controls regarding fuel types and forms to be received are provided through compliance with the limitations on the Certificates of Compliance for the dual-purpose systems and the limitations included in the license for the CISF.

1.2.5 Waste Products Generated During Operations

Chapter 6 describes the gaseous, liquid, and solid radioactive wastes anticipated at the CISF. Gaseous wastes are not generated at the CISF; however, airborne radioactive contamination can 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's decontamination booth. Low volumes of solid radioactive wastes are expected from routine operations involving contamination surveillance activities and decontamination activities. Potential liquid and solid waste streams are collected and temporarily stored on site for processing and disposal by an off-site contractor.

1.3 GENERAL DESCRIPTION OF SYSTEMS AND OPERATIONS

A general description of the CISF systems and operations is provided in this section. The descriptions provided relate to the receipt, handling, transfer, and storage of SNF. In general, the systems provide the corresponding function for SNF retrieval and off site shipment operations.

1.3.1 CISF Systems

The major systems in the transfer facility include the following: Cask Off-Loading and Loading, Cask Carrier, Transfer Preparation, Canister Transfer, and Storage Mode Preparation. These systems transfer SNF from transportation casks to storage casks during SNF receipt operations, and are used for retrieval operations when SNF is packaged for shipment off site.

The major systems in the storage area include the vendor supplied Cask/Canister Storage and Cask Transporter systems.

1.3.1.1 Cask Off-Loading and Loading System

The purpose of the Cask Off-Loading and Loading System is to unload transportation casks from cask transporters and to reload empty transportation casks onto the transporters for dispatch of the casks from the CISF. Major components include two 225-ton capacity overhead bridge cranes, robotic tools, automated alignment equipment, and vendor-specific lifting equipment.

1.3.1.2 Cask Carrier System

The purpose of the Cask Carrier System is to move transportation and storage casks during cask preparation and canister transfer activities. Major components include lifting devices, and vendor-specific lifting and transfer equipment.

1.3.1.3 Transfer Preparation System

The purpose of the Transfer Preparation System is to prepare transportation casks for transfer of SNF canisters out of the casks, and for preparing the empty transportation casks for shipment from the CISF. Major components include robotic tools, inspection and sampling equipment, and automated alignment equipment.

1.3.1.4 Canister Transfer System

The purpose of the Canister Transfer System is to transfer SNF canisters from transportation casks to storage casks. Major components include automatic alignment devices, and vendor-specific transfer equipment such as the transfer cask, lifting equipment and tools.

1.3.1.5 Storage Mode Preparation System

The purpose of the Storage Mode Preparation System is to prepare storage casks for transfer of SNF canisters into the casks and for preparing the loaded storage casks for storage in the storage area. Major components include robotic tools, automated alignment equipment and vendor specific equipment for the various storage technologies.

1.3.1.6 Cask/Canister Storage Systems

The purpose of the Cask/Canister Storage Systems is to safely store SNF at the CISF until retrieval for shipment off site to a repository. SNF is stored in sealed, metallic canisters inside storage casks or in transportable storage casks, maintaining multiple SNF assemblies in a dry, inert environment. Physical, thermal, and radiological characteristics of the stored SNF are described in the vendor Safety Analysis Reports (SARs) .

1.3.1.7 Cask Transporter Systems

The purpose of the Cask Transporter Systems is to transport storage and transportation casks between the transfer facility and the storage area. Additionally, some Cask Transporter Systems provide canister transfer mating capabilities in the storage area. The major components of these systems are all vendor supplied.

1.3.1.8 Waste Management Systems

The CISF does not have any major radioactive waste management systems. The only radioactive wastes generated are the result of residual quantities of radioactive contamination on SNF casks and canisters. Any airborne radioactive contamination generated is expected to be at levels that are less than those specified by 10 CFR 20 and will be exhausted directly to the atmosphere. HEPA filters are provided for defense in depth and to ensure exposure as low as is reasonably achievable (ALARA). Liquid wastes not satisfying normal CISF discharge limits are treated on site by contracted vendors and released to a permitted National Pollutant Discharge Elimination System (NDPES) outfall. Solid wastes are disposed of by vendors contracted to periodically collect the waste containers for disposal off site.

1.3.1.9 Off-Normal Recovery Systems

Recovery operations during off-normal conditions are provided by the CISF, vendor supplied systems, or other facilities as necessary. For vendor cask systems that store SNF in sealed canisters, recovery of a suspect canister is accomplished by retrieving the cask containing the suspect canister from the storage area and taking it into the transfer facility for corrective action or placing it directly into an empty transportation cask. This procedure applies to all of the cask/canister vendor systems, since the transportation casks in each of the systems provide confinement barriers that would isolate any materials leaking from a canister. cask vendors may provide other NRC-approved recovery methods that do not require bare fuel handling facilities. Recovery operations for metal storage casks is vendor specific. Generally, a metallic suspect cask is taken to the transfer area for corrective action and then returned to the storage area after completion of recovery operations. For the NAC cask, recovery operations include pressurizing the inner lid area, or replacement of seals as may be required. It is not anticipated that any bare fuel transfer operations would be required.

Other off-normal recovery options are site-specific and not addressed in the CISF TSAR. These options depend on existing DOE or commercial facilities that may be located on or near the site eventually designated for the CISF.

1.3.2 CISF Operations

The CISF is designed to receive SNF at the rate of 1200, 1200, 2000, 2000, and 2700 MTU per year for the first five years of operation respectively. The design receipt rate from the sixth year forward is 3000 MTU per year. The storage area capacity is 40,000 MTU, approximately 5,300 to 7,800 storage casks depending on the vendor systems.

Loaded transportation casks and TSCs are received at the CISF via rail car and heavy haul transporters. Security inspections and radiation surveys are performed. If a cask or transporter is contaminated, it is taken directly to the transfer facility for decontamination. If the cask and transporter are not contaminated, road grime is removed from the cask transporter (if necessary) at the Transporter Wash Down Station, and then taken to the transfer facility. Transporter wash downs may also be performed prior to the security inspections if necessary for completion of the security inspections.

All casks are taken to the transfer facility where additional operations are performed to prepare the cask systems for storage. The additional operations that are performed depend on the type of cask system. Transportable Storage Casks are radiologically surveyed and decontaminated (if required). Containment leak checks are performed on the casks prior to placing in storage. Each cask's identity and condition are verified. The site transporter then moves the casks from the transfer facility to the storage area for direct placement into storage. Dual-purpose cask systems that use a common SNF canister and different overpacks for transportation and storage are prepared for transfer operations in the transfer facility. The transportation casks are radiologically surveyed, their cavities are vented and tested, and they are decontaminated (if required). Each cask's identity and condition are verified. Vendor systems that are transferred to the storage mode in the storage area are placed on a site transfer trailer, transported to the storage area, and the canister is transferred to the storage cask. The remaining cask systems are transferred from the transportation cask to the storage cask inside of the transfer facility. A site transporter then moves the storage cask to the storage area.

For SNF retrieval operations the operational sequences for placing the fuel into storage are reversed.

1.4 ANALYSIS OF OPERATIONS

This section provides a summary of the analyses performed for normal operations, off-normal events, and accidents. From these analyses, important to safety design features and operational activities are identified. This section also provides a summary of the CISF safety management program.

1.4.1 Normal Operations - Dose Assessment

An ALARA evaluation was performed and several dose reduction techniques were 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 1 person-rem per year per person to the operations staff to ensure compliance with 10 CFR Part 20 limits and administrative goals. Three of the five vendor systems analyzed currently meet this goal. Additional dose reductions techniques will be identified or additional analysis will be performed to ensure that the use of all vendor system meet the CISF normal operations exposure goals.

1.4.2 Normal Operations - Establishment of the Controlled Area (Site) Boundary

An analysis was performed to identify the location of the controlled area boundary to ensure compliance with 10 CFR 72.104(a) (dose rate < 25 mrem/yr). The dose rates due to direct and air-scattered radiation from 40,000 MTU of SNF in the storage area were calculated at various distances and locations from the storage cask array. The results of the analysis indicate that the controlled area boundary is conservatively estimated to be 2300 feet from the storage array.

1.4.3 Accident Analysis

1.4.3.1 Safety Analysis Process

Section 5.2, Identification of Subjects for Safety Analysis, identifies credible events or accident scenarios which require further analysis in Chapter 12, Accident Analyses. This is done by means of a comprehensive review of design events evaluated at similar facilities and a Preliminary Hazards Assessment (PHA). Chapter 12 documents the analysis of Design Basis Events. Chapter 14, Technical Specifications, completes the CISF design safety basis by defining the operating controls and limits placed on CISF operations and by listing the necessary administrative controls or programs established at the CISF.

1.4.3.2 Safety Analysis Methodology

The Preliminary Hazards Assessment was performed to systematically identify potential radiological hazards to facility workers, the public, and the environment. Existing sources of information were reviewed including the SARs for the cask systems and selected site-specific Independent Spent Fuel Storage Installation (ISFSI) applications. These SARs provide substantial background regarding radiological hazards at comparable facilities. The PHA was performed in a two-step process of hazard identification and hazard evaluation. The first step, hazard identification, was a process of creating lists of areas, hazardous energy sources, processes, and operational subsystems associated with the CISF. From these lists, potential events or accidents were identified. In the second step, the identified events were evaluated to determine if important-to-safety design functions are affected. The events were further evaluated to qualitatively assess frequencies and consequences and to identify defense-in-depth safety features. These defense-in-depth safety features include potential important-to-safety SSCs and administrative controls. Based on the preliminary and qualitative assessment of the frequencies and consequences of these events, certain events were selected and incorporated in the accident analyses.

Design basis events (DBEs) are classified as either normal and off-normal events or accidents. Normal events include such operations as transportation package receipt, inspection, and unloading. The radiological consequences of these operations are below limits and maintained ALARA. Off-normal events are those events which are expected to occur with moderate frequency or on the order of once during a calendar year of CISF operation. In general, the consequences of these events have no radiological safety implications and do not have a significant impact on important-to-safety design functions. Accidents or design events are those events that occur infrequently; however, such an event could reasonably be expected to occur once during the lifetime of the CISF. These events include low probability design basis accidents which establish a conservative design basis for SSCs important to safety. They include such bounding natural phenomena as earthquakes and tornadoes.

1.4.3.3 Results

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

1.4.3.4 Technical Specifications

The CISF technical specifications define the operating controls and limits and the administrative controls. The vendors of individual storage systems have defined operating limits and controls on their systems which are also imposed as appropriate on the storage systems at the CISF. The key CISF operating controls and limits address the monitoring of storage unit temperature, storage unit pressure, hydraulic ram system pressure, and crane lift operations.

The administrative controls presented in this TSAR include the organization and management structure, response plans, procedures, programs, and controls, record keeping requirements, review and audit procedures, and reporting necessary to assure that the operations involved in the storage of spent fuel in CISF are performed in a safe manner.

The important-to-safety design features at the CISF are the transfer facility structure, the two cranes in the transfer facility, and the transfer facility overhead roll up door designed to blow out due to a tornado air pressure differential. Vendor supplied important-to-safety design features include the transportation casks, canisters, storage units, and other equipment as specified in the vendor SARs.

1.4.4 Safety Management

The CISF management policy and highest priority is to ensure that all operations are conducted safely. Implementation of this policy is made through a consolidated safety management program. This program entails radiation protection, conduct of operations, and quality assurance.

1.4.4.1 Radiation Protection Program

The radiation protection program ensures that all operations are performed in a manner that ensures occupational exposures are maintained within prescribed regulatory limits and are ALARA. ALARA considerations have been integrated into the design of the CISF and incorporated into all operating procedures.

1.4.4.2 Conduct of Operations Program

The conduct of operations program ensures that the CISF is operated in a professional and safe manner. Highlights of this program include the following:

- The CISF organization provides clear lines of responsibilities and ensures independence of organizations. This ensures the CISF has an effective organization with appropriate oversight.
- The CISF performs an extensive test program including an operational readiness review prior to beginning normal operations. The test program ensures that the CISF

structures, systems, and components are operated in a dependable manner so as to perform their intended function.

- The CISF maintains a systematic training program to ensure proficiency of all facility personnel.
- The CISF maintains a formal procedure management program that ensures all important-to-safety operations are performed using detailed written, approved, and controlled procedures.
- The CISF has a detailed emergency preparedness program and conducts periodic drills and training. This ensures that CISF personnel are prepared to respond to emergencies as they arise.

1.4.4.3 Quality Assurance Program

The activities associated with the CISF will be governed by the applicable portions of DOE's QA program as described in Chapter 15 of the TSAR. The OCRWM QA program is designed to meet the requirements of 10 CFR 72, Subpart G.

1.5 IDENTIFICATION OF AGENTS AND CONTRACTORS

DOE is responsible for the design, analysis, construction, and operation of the CISF, as well as for providing quality assurance services. DOE's prime CRWMS M&O contractor is TRW Environmental Safety Systems Inc.(TESS). The following organizations are M&O teammates:

- B&W Federal Services
- Duke Engineering & Services, Inc.
- Fluor Daniel, Inc.
- Framatome Cogema Fuels
- Integrated Resources Group
- INTERA, Inc.
- JAI Corporation
- K. Research Associates, Inc.
- Lawrence Berkley Laboratory
- Lawrence Livermore National Laboratory
- Los Alamos National Laboratory
- Morrison-Knudsen Corporation
- Science Applications International Corporation
- Sandia National Laboratories
- Woodward-Clyde Federal Services
- Winston & Strawn
- Cooperating Federal Agency: U.S. Geologic Survey.

Duke Engineering & Services, Inc. has 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 identified in the license application. The storage units that are used in the CISF are designed and made by other organizations and will be purchased by DOE. The storage unit suppliers are responsible for storage unit construction, testing, and delivery to the site. DOE is responsible for confirming that vendor-supplied storage casks are within specification prior to use at the CISF.

Site preparation and other construction related activities will be outlined in the license application once a site is selected.

1.6 MATERIAL INCORPORATED BY REFERENCE

This section provides a tabulation of the safety analysis reports incorporated by reference as part of the TSAR. The report title, number, and date submitted for each topical report is presented in Table 1.6-1.

Table 1.6-1 Material Incorporated by Reference

Title	Report No.	Date
Safety Analysis Report for Packaging for the Holtec International Storage, Transport and Repository Cask System (HI-STAR 100 Cask System)	HI-941184, Rev. 3 Docket 72-1008	August 31, 1995
Safety Analysis Report for the NAC Storable Transport Cask for use at an Independent Spent-Fuel Storage Installation	NAC-T-90002, Rev. 3 Project No. M-55	July 1994
Safety Analysis Report for the TranStor™ Shipping Cask System.	SNC-95-71SAR, Rev. 0 Docket 71-9268	December 1995
Safety Analysis Report for the NUHOMS®- MP187 Multi-purpose Cask	NUH-05-151, Rev. 1 Docket 71-9255	February 1995
Safety Analysis Report for the Large On-Site Transfer and On-Site Storage Segment - Westinghouse*	MPC-CD-02-016 Rev. 0	May 10, 1996

*Not docketed as of May 1, 1997.

1.7 DRY TRANSFER SYSTEM (DTS)

Separate from the CISF activities, the DOE is developing a Dry Transfer System (DTS). The DTS TSAR is presently under review by the NRC Staff (Ref. 1.7-1).

The DTS is a stand-alone facility designed to enhance commercial nuclear power reactor on-site spent fuel management capabilities by allowing dry transfer of individual spent fuel assemblies between top-loading transportation or storage casks. This enhancement benefits both operating and shutdown reactors. The DTS is expected to have application to DOE sites as well. The spent fuel handling is performed inside a reinforced concrete structure which provides radiation shielding, radioactive material confinement, and decay heat transfer, while meeting all applicable requirements of 10 CFR Part 72.

To add increased flexibility for on-site recovery capability, the DOE will provide a DTS for off-normal recovery at the CISF. The NRC-approved DTS will be incorporated into the CISF license application by reference. Modifications to the approved DTS as a result of CISF site characteristics will be addressed in the CISF license application. The DTS will be operational coincident with the CISF.

1.8 REFERENCES

Section 1.0

1.0-1 Draft NUREG-1567, *Standard Review Plan for Spent Fuel Dry Storage Facilities*. 1996.

1.0-2 Regulatory Guide 3.48, *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage).*

1.0-3 10 CFR Part 72. *Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste.*

Section 1.7

1.7-1 Dry Transfer System Topical Safety Analysis Report (Docket No. 72-1024). DOE. September 1996.

2. SITE CHARACTERISTICS

Generic site design criteria have been developed and used in the non-site-specific design of the CISF. Once a CISF site is selected, the actual site characteristics and parameters will be determined for site-specific design and regulatory review. CISF design products may be used for the site-specific design, if it is demonstrated that the generic site design criteria bound the site-specific values.

This TSAR seeks NRC concurrence that:

- The generic site characteristics selected are appropriate for the purpose of developing the non-site-specific CISF design.
- The NRC guidance documents and industry codes and standards used to develop the generic site characteristics are appropriate.

2.1 GEOGRAPHY AND DEMOGRAPHY OF SITE SELECTED

This section is not applicable to a non-site-specific TSAR. A description of the CISF site and layout is provided in Section 4.1.

2.2 NEARBY INDUSTRIAL, TRANSPORTATION AND MILITARY FACILITIES

Nearby industrial, transportation and military facilities have not been identified for this non-site specific TSAR. The TSAR assumes that the hazards posed by nearby facilities and transportation routes are enveloped by other site hazards such as tornado winds and tornado-generated missiles. Hazards posed by nearby facilities and transportation routes include explosives, fire, toxic gases, corrosive airborne pollutants and impact hazards. In order to ensure that this approach is conservative, the site-specific submittal will assess the hazards presented by nearby industrial, transportation and military facilities, and verify that the design criteria associated with those hazards are bounded by other design criteria.

10 CFR 72.104(a)(3) (Ref. 2.2-1) requires that the evaluation of off-site doses during normal operations and anticipated occurrences must consider radiation from any uranium fuel cycle operations within the region. The CISF design assumes no contribution from nearby uranium fuel cycle operations.

2.3 METEOROLOGY

2.3.1 Regional Climatology

In the absence of site-specific information, bounding design criteria related to maximum and minimum temperatures, extreme winds, tornadoes, hurricanes and tropical storms, precipitation, snow storms and ice storms are evaluated. The criteria and their bases are provided below.

2.3.1.1 Maximum and Minimum Temperatures

The design ambient temperature values are presented in Table 2.3-1. These values are expected to bound most potential CISF sites in the 48 contiguous United States, based on data from the 1993 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbook (Ref. 2.3-1).

Table 2.3-1. Design Ambient Temperature Values

Condition	Temperature
Average annual	76°F
Minimum	-40°F
Maximum	125°F

2.3.1.2 Extreme Winds

The design wind speed (three-second gust, non-tornado) is 110 mph. This value bounds all of the 48 contiguous states, except for the Gulf of Mexico and Atlantic Ocean coastlines and most of Florida, based on the American National Standards Institute/American Society of Civil Engineers (ANSI/ASCE) 7-95 Standard (Ref. 2.3-2).

2.3.1.3 Tornadoes

The design maximum tornado wind speed, rotational plus translational, is 360 mph. This value bounds all potential CISF sites in the 48 contiguous United States and is based on a Category I tornado described in Regulatory Guide 1.76 (Ref. 2.3-3).

2.3.1.4 Precipitation Extremes

The design probable maximum precipitation (PMP) values are presented in Table 2.3-2. These values are expected to bound most potential CISF sites in the 48 contiguous United States, based on data from National Oceanic and Atmospheric Administration

Hydrometeorological Report No. 52 (Ref. 2.3-4), which provides PMP information based on a 100-year recurrence interval.

Table 2.3-2. Design Precipitation Values

Time Period	Precipitation
5 minutes	6.2 inches
1 hour	19.4 inches

2.3.1.5 Thunderstorms and Lightning Strikes

In accordance with 10 CFR 72.122(b)(2), the structures, systems, and components (SSCs) important to safety must be designed to withstand the effects of lightning without impairing their capability to perform safety functions. The fundamental principle in protection against lightning is to provide a low impedance path which a lightning discharge current will follow instead of high impedance paths offered by important-to-safety structures, systems, and components. To satisfy this criterion, the CISF lightning protection system will be designed in accordance with National Fire Protection Association (NFPA) Code 780 (Ref. 2.3-5).

The provisions in the NFPA code are not based upon geographical location. Therefore, this criterion encompasses all of the 48 contiguous United States. However, final lightning protection system design will be site- and structure-specific, as it will depend on the soil and corrosion characteristics of the site, the height of the structure, the structure materials, the roof type and pitch, and the degree of protection offered by other grounded structures in the proximity of the site.

2.3.1.6 Snow and Ice Storms

The design snow and ice load is 50 lb/ft^2. This value bounds most potential sites, based on the ANSI/ASCE 7-95 Standard (Ref. 2.3-2). However, areas northwest of the Great Lakes region and the extreme northeast United States may exceed this value. In addition, ANSI/ASCE 7-95 does not provide values in certain parts of the United States, particularly mountainous areas, due to the degree of local variability.

2.3.2 Local Meteorology

This section is not applicable to a non-site-specific TSAR.

2.3.3 On-site Meteorological Measurement Program

For the site-specific SAR, existing National Weather Service or best available weather data summaries will be used to validate the bounding values used in this TSAR. If sufficient data are not available, the required on-site meteorological measurement program will be described, developed and implemented, commensurate with the degree of risk to the health and safety of the public.

2.3.4 Diffusion Estimates

2.3.4.1 Basis

Assumptions described in Section 2.3.4.2 related to atmospheric diffusion were conservatively selected to bound most sites in the 48 contiguous United States, and should therefore bound site-specific parameters.

2.3.4.2 Calculations

Concentrations of gaseous radionuclides at the site boundary following routine releases and accident releases are based on NRC Regulatory Guide 1.4 (Ref. 2.3-6).

Assumptions related to atmospheric diffusion are:

- Pasquill Stability Class F (moderately stable)
- Average windspeed: 1 m/s
- Wind direction toward closest point of controlled area boundary.

2.4 SURFACE HYDROLOGY

2.4.1 Hydrologic Description

This section is not applicable to a non-site-specific TSAR.

2.4.2 Floods

The CISF design assumes that all SSCs important to safety are located above the probable maximum flood level.

ANSI/American Nuclear Society (ANS)-2.8-1992 (Ref. 2.4-1) defines a flood-dry site as "one where safety-related structures are so high above potential flood sources that safety from flooding is obvious or can be documented with minimum analysis." Once a site is identified, it will be evaluated in accordance with Sections 5.1.3.1 and 5.1.3.2 of ANSI/ANS-2.8-1992 to determine whether or not it is a flood-dry site.

If the site is not clearly a flood-dry site, a detailed flood analysis will be performed as outlined in Sections 2.4.2 through 2.4.9 of NRC Regulatory Guide 3.48 (Ref. 2.4-2). Regulatory Guide 3.48 refers to ANSI/ANS-2.8-1981 (Ref. 2.4-3). The CISF evaluation will appropriately be based on ANSI/ANS-2.8-1992, a more recent version of that standard.

2.4.2.1 Flood History

This section is not applicable to a non-site-specific TSAR.

2.4.2.2 Flood Design Considerations

No flood design considerations are included in the CISF design.

2.4.2.3 Effects of Local Intense Precipitation

The PMP for the purpose of designing runoff and drainage systems is site-specific and will be determined after designation of the site location. For any location, the site drainage facilities will be designed to accommodate the PMP runoff and drainage without flooding any SSCs important to safety.

The design snow and ice loading is provided in Section 2.3.1. As described in Chapter 7, the site structures are designed to accommodate these loads without impacting any SSCs important to safety.

2.4.3 Probable Maximum Flood on Streams and Rivers

This section is not applicable to a non-site-specific TSAR.

2.4.4 Potential Dam Failures (Seismically Induced)

This section is not applicable to a non-site-specific TSAR.

2.4.5 Probable Maximum Surge and Seiche Flooding

This section is not applicable to a non-site-specific TSAR.

2.4.6 Probable Maximum Tsunami Flooding

This section is not applicable to a non-site-specific TSAR.

2.4.7 Ice Flooding

This section is not applicable to a non-site-specific TSAR.

2.4.8 Flooding Protection Requirements

This section is not applicable to a non-site-specific TSAR.

2.4.9 Environmental Acceptance of Effluents

This section is not applicable to a non-site-specific TSAR.

2.5 SUBSURFACE HYDROLOGY

This section is not applicable to a non-site-specific TSAR. This information will be provided following the designation of a CISF site.

2.6 GEOLOGY AND SEISMOLOGY

2.6.1 Basic Geologic and Seismic Information

This section is not applicable to a non-site-specific TSAR. This information will be provided following the designation of a CISF site.

2.6.2 Vibratory Ground Motion

The CISF design is conservatively based on a design earthquake (DE) described in NRC Regulatory Guide 1.60 (Ref. 2.6-1) by design response spectra anchored at a horizontal acceleration of 0.75 g. This earthquake is applied at the structure foundation.

A review of nuclear power plant and DOE site probabilistic seismic hazard assessment information (Ref. 2.6-2, Ref. 2.6-3, Ref. 2.6-4, Ref.2.6-5, Ref. 2.6-6, Ref. 2.6-7) indicates that the generic DE peak horizontal ground acceleration (0.75 g) bounds the peak ground acceleration values at most sites in the 48 contiguous United States, evaluated at a mean annual probability of $1x10^{-4}$ or higher. The generic DE (0.75 g) clearly bounds the 0.25 g DE value appropriate for most sites east of the Rocky Mountain Front. However, there are some sites in the western United States which would exceed the generic DE level.

2.6.3 Surface Faulting

The CISF design assumes that all SSCs important to safety are located away from capable faults.

2.6.4 Stability of Subsurface Materials

The CISF design is based on the soil characteristics in Table 2.6-1.

Table 2.6-1. Soil Characteristics

Foundation Type	Soil Parameters
Spread/Wall Footing (Shallow Foundation)	Allowable soil bearing capacity 2.5 ksf
Mat (Shallow Foundation)	Allowable soil bearing capacity 4.0 ksf Modulus of subgrade reaction 144 kcf
Pile (Deep Foundation)	Allowable soil bearing capacity 10.0 ksf

The foundation design criteria guidelines establish a representative set of values for static design application in accordance with NUREG-0800, Section 3.8.5 (Ref. 2.6-8). The criteria are on the low end of the range of values typically encountered in practice, and should therefore accommodate most suitable sites without undue complications. Criteria for multiple foundation types are provided to permit selection of the most suitable foundation compatible with design loadings.

2.6.5 Slope Stability

For CISF design purposes, a flat site is assumed.

2.6.6 Volcanism

The CISF design assumes that there are no nearby volcanic centers that could impact the CISF through explosive forces, lava flow or ash fall. Therefore, this section is not applicable to a non-site-specific TSAR.

2.7 SUMMARY OF SITE CONDITIONS AFFECTING CONSTRUCTION AND OPERATING REQUIREMENTS

In the absence of site-specific information, the CISF design is based on site characteristics chosen to envelop as much of the contiguous 48 United States as practical. The site-related design criteria are described and tabulated in Chapter 3. Once a site for the CISF is selected, site investigations will be performed to quantify the actual site characteristics. If any CISF design criteria do not conservatively bound the actual site characteristics, then the respective design criteria will be revised, changes to the design incorporated as necessary, the design reverified, and the supporting analysis and changes documented in the site-specific CISF license application.

2.8 REFERENCES

Section 2.2

2.2-1 10 CFR Part 72. *Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste.*

Section 2.3

2.3-1 ASHRAE Handbook. *Fundamentals.* American Society of Heating, Refrigeration and Air Conditioning Engineers. 1993.

2.3-2 ANSI/ASCE 7-95. *Minimum Design Loads for Buildings and Other Structures.* American National Standards Institute and American Society of Civil Engineers. 1995.

2.3-3 Regulatory Guide 1.76. *Design Basis Tornado for Nuclear Power Plants.* Rev. 0. U.S. NRC. April 1974.

2.3-4 National Oceanic and Atmospheric Administration Hydrometeorological Report No. 52. *Application of Probable Maximum Precipitation Estimates - United States East of the 105th Meridian.* National Weather Service. August 1982.

2.3-5 NFPA No. 780. *Lightning Protection Code.* National Fire Protection Association. 1992.

2.3-6 Regulatory Guide 1.4. *Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors.* Rev. 2. U.S. NRC. June 1974.

Section 2.4

2.4-1 ANSI/ANS-2.8-1992. *Determining Design Basis Flooding at Power Reactor Sites.* American National Standards Institute and American Nuclear Society. 1992.

2.4-2 Regulatory Guide 3.48. *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage).* Rev. 1. U.S. NRC. 1989.

2.4-3 ANSI/ANS-2.8-1981. *Determining Design Basis Flooding at Power Reactor Sites.* American National Standards Institute and American Nuclear Society. February 1981.

Section 2.6

2.6-1 Regulatory Guide 1.60. *Design Response Spectra for Seismic Design of Nuclear Power Plants.* Rev. 1. U.S. NRC. December 1973.

2.6-2 NUREG-1488. *Revised Livermore Seismic Hazards Estimates for 69 Nuclear Power Plant Sites East of the Rocky Mountains.* U.S. NRC. April 1994.

2.6-3 *Individual Plant Examination of External Events - Washington Nuclear Plant 2.* Rev. 0. Washington Public Power Supply System. June 1995.

2.6-4 *Individual Plant Examination of External Events Report for Diablo Canyon Power Plant Units 1 and 2 in Response to Generic Letter 88-20 Supplement 4.* Pacific Gas & Electric Co. June 1994.

2.6-5 *Individual Plant Examination of External Events for San Onofre Nuclear Generating Station Units 2 & 3.* Southern California Edison. December 1995.

2.6-6 *Seismic Hazard Evaluation for the Palo Verde Nuclear Generating Station - Wintersburg, Arizona.* Risk Engineering Inc. April 1993.

2.6-7 DOE-STD-1020-94. *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities.* Change Notice No. 1. Department of Energy. 1996.

2.6-8 NUREG-0800. *Standard Review Plan 3.8.5. Foundations.* U.S. NRC. July 1981.

3. PRINCIPAL DESIGN CRITERIA

The purpose of Chapter 3 is to provide the principal design criteria utilized in the design of the CISF.

The storage of spent nuclear fuel at the CISF will be based on the use of cask systems that have been previously certified by the NRC. These cask systems include transportable storage casks and canister-based storage systems. It is DOE's intent that all certified dual-purpose (transportation/storage) or multi-purpose (transportation/storage/disposal) cask systems be acceptable for use at the CISF. For the purpose of developing bounding CISF design criteria that will facilitate the use of future NRC certified designs, six cask systems were chosen as the basis for CISF design. These cask systems are described in the vendor SARs that were either docketed by the NRC or under development by DOE as of June 1, 1996. Table 3.1-1 provides a listing of the vendor cask systems used for the design of the CISF.

This TSAR seeks NRC concurrence that:

- The CISF principal design criteria are acceptable and satisfy the applicable requirements of 10 CFR 72, Subpart F

- The structures, systems and components important to safety are adequately identified

- The classification system is an acceptable method for classifying SSCs.

3.1 STORED MATERIALS

The CISF stores SNF until retrieval for disposal in a repository. The SNF is stored in sealed, metallic canisters inside overpacks or transportable storage casks, maintaining multiple SNF assemblies in a dry, inert environment. The CISF is designed to store between 5,300 and 7,800 casks with a total commercial SNF storage capacity of 40,000 metric tons of uranium (MTU). The number of casks is dependent on cask types stored.

Physical, thermal and radiological characteristics of stored SNF are described in the safety documentation for each cask system listed in Table 3.1-1.

Table 3.1-1. Cask Systems

Name	NRC Docket No.	Type	Reference
NUHOMS® MP187/HSM	71-9255 72-11	Dual Purpose Canister (DPC) System	3.1-1 3.1-2 3.1-3
Holtec HI-STAR 100	71-9261 72-1008	Transportable Storage Cask (TSC)	3.1-4 3.1-5
Sierra TranStor™ System	71-9268 72-17	DPC System	3.1-6 3.1-7 3.1-8
Westinghouse Large MPC	Not Docketed	Multi-Purpose Canister (MPC) System	3.1-9 3.1-10
Westinghouse Small MPC	Not Docketed	MPC System	3.1-11 3.1-12
NAC STC	71-9235 72-1002	TSC	3.1-13 3.1-14

3.2 CLASSIFICATION OF CISF STRUCTURES, SYSTEMS AND COMPONENTS

The Office of Civilian Radioactive Waste Management (OCRWM) provides seven classifications of SSCs, based on safety significance. One of those classifications, "Classification 2 - Important to Waste Isolation," is applicable only to a repository. The classifications applicable to the CISF are as follows.

Classification 1 - Important to Radiological Safety (QA 1) - As defined by 10 CFR Part 72 (Ref. 3.2-1), includes those SSCs whose function is (1) to maintain the conditions required to store spent fuel safely, (2) to prevent damage to the spent fuel during handling and storage, or (3) to provide reasonable assurance that spent fuel can be received, handled, packaged, stored and retrieved without undue risk to the health and safety of the public.

Classification 3 - 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 spent nuclear fuel or high-level waste forms.

Classification 4 - Important to Fire Protection (QA 4) - Includes those items whose function is to detect, control or extinguish a fire for protection of Classification 1 SSCs.

Classification 5 - 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 their intended radiological safety function.

Classification 6 - 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 (Ref. 3.2-2).

Classification 7 - 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 (Ref. 3.2-3).

"QA 1, Important to Radiological Safety" includes all SSCs important to safety as defined in 10 CFR Part 72. Important-to-safety SSCs are defined as those SSCs that control impact on confinement, criticality, thermal, radiation and retrievability in compliance with regulatory limits. The use of the word "radiological" eliminates the tendency to include normal occupational safety items under the term "important to safety." The other classifications were selected by OCRWM to emphasize the importance of these activities.

This classification system supports the application of design criteria for SSCs in a graded manner. That is, the severity of the criteria is commensurate with an SSC's importance to safety. It is used to group SSCs by function in order to apply the appropriate design criteria.

For example, QA 7, Important to Occupational Exposure, is applied to all SSCs that may impact radiological exposure. A design criterion for these SSCs is to minimize the potential for radiation exposure in the design of the SSC. Regulatory Guide 8.8 (Ref. 3.2-4) is used for this purpose. Occupational exposures can be minimized by providing equipment with high reliability, low maintenance requirements, and ease of replacement, thereby limiting worker occupational exposures.

After establishing the SSC classifications, design criteria are selected for each. The principal CISF design criteria for QA 1 systems are described in Section 3.3, while the design criteria for other CISF SSCs are discussed in Section 3.5. Table 3.2-1 lists CISF QA 1 SSCs.

Table 3.2-1. CISF QA 1 Structures, Systems and Components

TRANSFER FACILITY	
System	**Component**
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 and/or rock anchors
	Rails for overhead bridge cranes
Cask Off-Loading and Loading	225-ton capacity overhead bridge cranes
	Lifting yokes for NUHOMS® MP187 transport cask
	Lifting yokes for Holtec HI-STAR*
	Lifting yokes for TranStor™ transport casks*
	Lifting yokes for Westinghouse large and small transport casks*
	Lifting yokes for NAC STC*
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 and transfer casks*
	Support frame: TranStor™ transfer and storage casks*
Canister Transfer	Rams for transferring Westinghouse large and small canisters*
	TranStor™ transfer cask*
	TranStor™ canister lifting slings*

*Vendor supplied equipment

Table 3.2-1. CISF QA 1 Structures, Systems and Components (cont'd.)

STORAGE FACILITY	
System	**Component**
Storage Cask	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*
	Westinghouse Small MPC Cask System*
Storage Cask Transporter	NAC STC/Holtec/Sierra transporter*
	Westinghouse MPC transporter*
	NUHOMS® MP187 transfer trailer*

*Vendor supplied equipment

3.3 DESIGN CRITERIA FOR CISF QA 1 STRUCTURES, SYSTEMS AND COMPONENTS

This section lists the principal criteria utilized in the design of CISF QA 1 SSCs. Table 3.7-1 provides a summary of CISF principal design criteria.

3.3.1 Structural

The principal design criteria considered for the design of CISF QA 1 SSCs are developed from generic site characteristics and are used in the determination of structural loads and load combination analyses. Specific load values based on these criteria are developed in Chapter 7.

3.3.1.1 Tornado (Wind Load)

3.3.1.1.1 Criteria

Design Basis Tornado (DBT) parameters are presented in Table 3.3-1.

Table 3.3-1. Design Basis Tornado Parameters

Tornado Parameter	**Value**
Maximum translational speed	70 mph
Maximum rotational speed	290 mph
Maximum tornado wind speed	360 mph
Radius of maximum rotational speed	150 ft
Pressure drop across tornado	3.0 psi
Rate of pressure drop	2.0 psi/sec
Gust factor	1.0

NOTE: The maximum wind speed is the sum of the rotational and translational speeds.

3.3.1.1.2 Basis

Design basis tornado characteristics are based on NRC Regulatory Guide 1.76 (Ref. 3.3-1). The gust factor is specified as 1.0 based on NUREG-0800, the Standard Review Plan for nuclear power plants (Ref. 3.3-2).

3.3.1.2 Tornado (Missile Spectrum)

3.3.1.2.1 Criteria

Three design-basis tornado missiles are defined for use in CISF design and presented in Tables 3.3-2 through 3.3-4.

Table 3.3-2. Massive Tornado Missile

Massive Missile Parameter	**Value**
Type	Automobile
Mass	3,968 lb
Frontal Area	28 ft^2
Horizontal impact speed	126 mph
Vertical impact speed	88.2 mph
Impact Location	30 feet above grade or lower

Table 3.3-3. Penetrating Tornado Missile

Penetrating Missile Parameter	**Value**
Type	Armor piercing artillery shell
Mass	276 lb
Diameter	8 inch
Horizontal impact speed	126 mph
Vertical impact speed	88.2 mph
Impact Location	Unrestricted

Table 3.3-4. Small Tornado Missile

Small Missile Parameter	Value
Type	Solid steel sphere
Mass	0.15 lb
Diameter	1 inch
Horizontal impact speed	126 mph
Vertical impact speed	126 mph
Impact Location	Unrestricted

3.3.1.2.2 Basis

Design-basis tornado missiles are based on Section 3.5.1.4, Spectrum I of NUREG-0800 (Ref. 3.3-2).

3.3.1.3 Straight Wind

3.3.1.3.1 Criteria

Non-tornado wind parameters are presented in Table 3.3-5.

Table 3.3-5. Design-Basis Non-Tornado Wind Parameters

Wind Parameter		Value (ANSI/ASCE 7-95)
Basic Wind Speed		110 mph
Exposure Category		C
Importance Factor for Design	QA 1 SSCs	1.15 (Category IV)
	All other SSCs	1.00 (Category II)

3.3.1.3.2 Basis

The specified criteria are from American National Standards Institute/American Society of Civil Engineers (ANSI/ASCE) 7-95 (Ref. 3.3-3). The wind speed criterion covers all of the 48 contiguous United States, except for a band along the Gulf of Mexico and Atlantic Ocean coastlines, and most of Florida. Exposure Category C is for structures located in open terrain with only scattered obstacles in the vicinity, and is the most conservative classification except for Exposure Category D, which applies to completely flat terrain exposed to wind flowing over a minimum one-mile expanse of water. The most conservative importance factor, which reflects a 100-year mean recurrence interval, is used for QA 1 SSCs, based on Category IV structures which are essential facilities. The importance factor for all other SSCs is 1.0, based on Category II (general facilities).

3.3.1.4 Floods

3.3.1.4.1 Criterion

No criterion is specified. QA 1 SSCs are located above the maximum flood level.

3.3.1.4.2 Basis

No flood-related design criteria are established. If the CISF is sited at a location susceptible to flooding, an analysis will be made in accordance with Regulatory Guide 3.48 (Ref. 3.3-4) for potential flood effects.

3.3.1.5 Precipitation

3.3.1.5.1 Criteria

- Cumulative precipitation in five minutes: 6.2 inches
- Cumulative precipitation in one hour: 19.4 inches.

3.3.1.5.2 Basis

Criteria are based on a review of historical data for the continental United States contained in National Weather Service Report No. 52 (Ref. 3.3-5), and are intended to ensure that CISF drainage areas and drainage systems are adequately designed. Estimates are based on a 100-year recurrence interval. The five-minute precipitation amount is derived from a ratio of 0.32:1 for five-minute precipitation to one-hour precipitation.

3.3.1.6 Snow and Ice

3.3.1.6.1 Criteria

Design basis snow and ice loads are presented in Table 3.3-6.

Table 3.3-6. Design Basis Snow and Ice Loads

Parameter		Value (ANSI/ASCE 7-95)
Basic Load		50 lb/ft^2
Exposure Factor		1.0
Importance Factor for Design	QA 1 SSCs	1.2 (Category IV)
	All other SSCs	1.0 (Category II)

3.3.1.6.2 Basis

Snow and ice loading criteria are taken from ANSI/ASCE 7-95 (Ref. 3.3-3). Category IV, the most conservative category, is for essential facilities; Category II is for general use structures. The exposure factor (1.0) is consistent with Exposure Category C, used for wind loads under conditions of a partially exposed roof.

3.3.1.7 Seismic - Ground Motion

3.3.1.7.1 Criteria

Ground motion design parameters are presented in Table 3.3-7.

Table 3.3-7. Design Earthquake Parameters

Ground Motion Parameter	Value
Design Response Spectra	Regulatory Guide 1.60
Horizontal Acceleration	0.75 g
Point of Application	Shallow Structure Foundation

The design earthquake for QA 1 SSCs is described by NRC Regulatory Guide 1.60 (Ref. 3.3-6) as design response spectra anchored at a horizontal acceleration of 0.75 g. This earthquake is applied at the structure foundation (assuming a shallow foundation).

3.3.1.7.2 Basis

Seismic design requirements for the CISF are specified in 10 CFR 72.102. For the CISF design, a 0.75g horizontal acceleration is used in conjunction with Regulatory Guide 1.60 response spectra. This earthquake is applied at the structure foundation (assuming a shallow foundation).

Given the horizontal acceleration, Regulatory Guide 1.60 sets both horizontal and vertical response spectra, which will be validated against actual site characteristics (and possibly modified) once a site is designated. Lacking site-specific information, there is no basis at this time for specifying any approach other than the generic, accepted NRC design response spectra.

3.3.1.8 Seismic - Surface Faulting

3.3.1.8.1 Criterion

No surface faulting.

3.3.1.8.2 Basis

The CISF design assumes that all SSCs important to safety are located away from capable faults.

3.3.1.9 Volcanic Eruption (Ash Fall)

3.3.1.9.1 Criterion

No volcanic ash fall criteria are specified.

3.3.1.9.2 Basis

The probability of a volcanic eruption in the vicinity of most U.S. nuclear facilities is low enough that no specific design considerations are made for ash fall. This reasoning supports a no-ash fall criterion for the design of a CISF as well. If site-specific characteristics require the consideration of volcanic ash fall loads, they will likely be bounded by other loads such as snow and ice.

3.3.1.10 Explosions

3.3.1.10.1 Criterion

The CISF shall be designed to ensure that overpressures produced by postulated off-site and on-site explosions do not exceed 1.0 psi.

3.3.1.10.2 Basis

Postulated off-site explosions are based on U.S. Atomic Energy Commission Regulatory Guide 1.91 (Ref. 3.3-7) and an explosion involves one of the following transport vehicles: a tractor-trailer carrying 50,000 lbs of TNT, a rail car carrying 132,000 lbs of TNT, or a cargo ship carrying 10 million lbs of TNT.

A vapor explosion involving a 2,000-gallon diesel fuel tanker truck provides the basis for an on-site explosion.

3.3.1.11 Aircraft Impact

3.3.1.11.1 Criterion

No aircraft impact criteria are specified.

3.3.1.11.1.1 Basis

Absence of a design-basis aircraft criterion is consistent with the typical approach taken in nuclear power plant design and licensing. NUREG-0800 (Ref. 3.3-2) provides criteria against which hazards from aircraft can be assessed. Meeting those criteria provides assurance that the probability of off-site release resulting in radiological consequence greater than 10 CFR Part 100 (Ref. 3.3-8) limits due to aircraft impact is very low (less than 10^{-7} per year). Similar arguments would apply to the CISF.

3.3.2 Thermal

Thermal design criteria are derived from generic site characteristics and include ambient temperature and insolation (solar load). These criteria are used in the analysis of CISF SSCs. Design criteria utilized in the thermal performance analyses of cask systems are provided in the vendor SARs listed in Table 3.1-1.

3.3.2.1 Ambient Temperature

3.3.2.1.1 Criteria

The design bases temperatures are provided in Table 3.3-8.

Table 3.3-8. Design Bases Temperatures

Parameter	Value
Normal Temperature	76.0°F
Minimum Temperature	-40.0°F
Maximum Temperature	125°F

3.3.2.1.2 Basis

Ambient temperature values 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 76.0°F is based on the maximum average annual temperature in the 48 contiguous United States, specifically, Miami, Fla., at 75.6°F.

The minimum and maximum temperatures of -40.0°F and 125°F, respectively, bound most potential CISF sites in the 48 contiguous United States. The minimum and maximum median annual extreme ambient temperatures from the 1993 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbook (Ref. 3.3-9) are 116.8°F in Blythe, Calif., and -36.9°F in Bemidji, Minn., respectively. The median value of the maximum temperature experienced each year implies that the maximum temperature during some years is even higher than the median values reported in the ASHRAE handbook. The temperature of -40.0°F is also the minimum guideline temperature used to test packaging for transport of radioactive material as stated in 10 CFR 71.71(c)(2) (Ref. 3.3-10).

3.3.2.2 Solar Load (Insolation)

3.3.2.2.1 Criteria

- Horizontal Flat Surface Solar Insolation: 2949.4 Btu/day-ft^2
- Curved Surface Solar Insolation: 1474.7 Btu/day-ft^2.

3.3.2.2.2 Basis

Solar insolance criteria are based on values specified for testing transportation packages in 10 CFR Part 71.

3.3.3 Confinement

Criteria utilized in the confinement design of the cask systems are provided in the vendor SARs listed in Table 3.1-1.

3.3.4 Radiological Protection

Radiation protection shall be provided in accordance with 10 CFR 72.126(a). The following design criteria shall apply.

- During normal operations and all anticipated occurrences, the annual dose equivalent for any individual located beyond the controlled area shall not exceed 25 mrem to the whole body, 75 mrem to the thyroid or 25 mrem to any other organ, as a result of exposure to planned discharges of radioactive materials (radon and its decay products excepted), to the general CISF environment or to direct radiation from CISF operations.

- The dose in any unrestricted area from external sources shall not exceed 2 mrem in any one hour, per 10 CFR 20.1301(a)(2).

- The maximum individual dose at or beyond the site boundary, resulting from a design-basis accident, shall be less than 5 rem to the whole body or any organ, per 10 CFR 72.106(b).

- No uranium fuel cycle operations are located in the vicinity of the CISF.

The CISF design shall include the means to measure and control contamination of areas requiring access, per 10 CFR 72.126(a)(4). Radiation monitoring and surveys shall be conducted in accordance with 10 CFR 20.1501, and as necessary to comply with the operating limits imposed by the storage system vendor.

The storage area shall be defined as a radiation area requiring radiological control, per 10 CFR 72.126(a). The facility shall be provided with systems for measuring the direct radiation levels in and around areas containing radioactive materials, per 10 CFR 72.126(c)(2).

Occupational radiation exposure protection for the CISF shall be provided in accordance with 10 CFR Part 20 requirements. NUREG-0761 (Ref. 3.3-11) shall be used to establish radiation protection criteria for the transfer facility.

The design of CISF facilities shall include the means to shield personnel from radiation exposure in accordance with 10 CFR 72.126. In normally occupied areas (2000 hr/yr), the shielding design basis shall limit the maximum exposure to an individual worker to 500 mrem/yr (0.25 mrem/hr). In intermittently occupied areas, shielding (along with other radiation protection measures) shall be provided to support achievement of an ALARA goal for average personnel exposure of 1 rem per year. Whenever possible, equipment that normally operates in a radioactive environment shall be designed to allow removal to a non-radioactive environment for maintenance and repair. When this is not possible, the design shall allow for installation of temporary shielding.

The design of concrete radiation shielding shall comply with ANSI/ANS 6.4 (Ref. 3.3-12) and ACI 349 (Ref. 3.3-13) when it provides a critical confinement or structural function. For other radiation shields, ACI 318 (Ref. 3.3-14) shall be considered. Straight-line penetration of shield walls shall be avoided to prevent radiation streaming.

In accordance with 10 CFR 72.106 (b), the CISF shall be designed, constructed and operated to provide shielding and containment for radioactive materials to limit the maximum individual dose at or beyond the site-controlled area boundary to five rem (to the whole body or any organ) as the result of a design-basis accident.

Criteria utilized in the design of cask radiological protection features are provided in the respective vendor SARs listed in Table 3.1-1.

3.3.5 Nuclear Criticality Safety

Criteria utilized in the criticality evaluations of cask systems is provided in the vendor SARs listed in Table 3.1-1.

3.3.6 Decommissioning

The 10 CFR 72.130 criteria are considered in the CISF design, which shall minimize areas of potential radioactive contamination and the generation of radioactive waste and contaminated equipment. Materials and coatings utilized shall facilitate decontamination or the removal of contaminated materials in the areas of possible radioactive contamination. Criteria utilized to facilitate decommissioning of vendor cask systems are provided in the vendor SARs listed in Table 3.1-1.

3.3.7 Material Handling, Storage, and Retrieval Capability

To meet CISF functional requirements to receive, package, transfer, store and retrieve canistered SNF, the following criteria are established for CISF design.

Storage and handling systems shall be designed to allow ready retrieval of SNF, and the cask/canister handling systems shall be designed in accordance with 10 CFR 72.128(a) to ensure adequate safety under normal and accident conditions. The following criteria for SNF cask systems shall also be satisfied.

- Cask systems shall be designed to prevent tipover or drop during transfer and storage operations under normal and accident conditions.

- Cask systems shall be designed and certified to withstand a drop event from heights specified in Table 3.3-9. Height values are based on the lifting operations at the CISF and a review of vendor safety analysis reports listed in Table 3.1-1. For this event, "designed to withstand" is defined as no impact on important-to-safety functions except the following: A partial loss of shielding and confinement system deformation is allowed to the extent evaluated in the reference vendor SARs.

- Cask systems designed to transfer SNF canisters external to the transfer facility structure shall be designed to withstand the impact of the postulated tornado missiles during transfer operations. For this event, "designed to withstand" is defined as no impact on important-to-safety functions except the following: A partial loss of shielding is allowed to the extent evaluated in the reference vendor SARs. Postulated tornado missiles are described in Section 3.3.1.2 of this chapter.

- Cask systems shall be designed to accommodate remote handling techniques and robotic applications.

- Dose rates (gamma plus neutron) for cask systems at 2 meters from any vertical surface (as stored) shall be less than 10 mr/hr.

- Radiation streaming from storage cask vents and vertical surfaces shall be a small component of total dose rates (e.g., area weighted value less than 5% of radial surface dose rate) and shall have an insignificant (i.e., less than 1%) impact on dose rates at distances greater than 50 meters.

- The air-scattered component of total dose rate at distances greater than 50 meters shall be less than 50 percent.

- The surface contamination limit for casks and canisters shall be 30,000 dpm/100 cm^2 prior to placement in storage. Transport cask surface contamination must meet requirements of 10 CFR 71.87 prior to shipment off site.

- For cask systems utilizing canisters, a recovery method for the unlikely loss of confinement event shall be provided. The method of recovery must be independent of any bare fuel handling facilities.

- Cask systems utilizing vertical transfer must be qualified for a 6-inch drop of the storage cask or transportation cask lid during transfer operations.

QA 1 cranes and associated cask/canister lifting equipment shall be designed utilizing NUREG- 0612, Section 5 guidelines (Ref. 3.3-15), NUREG- 0554 guidelines (Ref. 3.3-16) and ANSI/ANS N14.6 (Ref. 3.3-17).

Additional criteria utilized in the design of cask systems are provided in the vendor SARs listed in Table 3.1-1.

Table 3.3-9. Loaded Cask System Maximum Drop Heights

Lift/Drop Heights (distance above grade)	**Cask System Type**								
	Holtec HI-STAR or NAC STC	**VECTRA NUHOMS® MP187 System**		**Westinghouse MPC System**		**Sierra TranStor™**			
Operation	TSC	SC	TC	SC	TC	Can	SC	TC	XC
Maximum Vertical Lift/Drop	80"	N/A	80"	30"	108"	209.25"	12"	80"	218.25"
Maximum Horizontal Lift/Drop	N/A	N/A	60"	70"	108"	N/A	N/A	N/A	N/A

Table 3.3-9 Abbreviations:

Can - Canister
TSC - Transportable Storage Cask
SC - Storage Cask
TC - Transportation Cask
XC - Transfer Cask

3.3.8 Satisfaction of ALARA Goals

In accordance with 10 CFR 20.1101(b), and to the extent practicable, CISF procedures and engineering controls shall be based upon sound radiation protection principles to achieve occupational and public doses that are ALARA. The facility design shall comply with the ALARA criteria of 10 CFR 20.1003 and NRC Regulatory Guide 8.8 (Ref. 3.2-4).

The ALARA principles of time, distance and shielding shall be considered throughout the design of the CISF. For tasks requiring access to areas in the vicinity of transportation and storage casks, system design shall be based on minimizing the time spent near the casks.

Special consideration shall be given to utility SSCs located in radiation areas. Design of these systems shall minimize the number of SSCs and/or the need for maintenance on SSCs that pass through radiation areas. Where utility subsystem components must be routed through radiation areas, ALARA design principles shall be incorporated into system design.

Design criteria incorporating ALARA features into cask systems are provided in the vendor SARs listed in Table 3.1-1.

3.4 DESIGN CRITERIA FOR TRANSPORTABLE STORAGE CASKS AND CASK/CANISTER SYSTEMS

SNF storage at the CISF is based on the use of transportable storage casks and cask/canister systems docketed by the NRC or under development by the DOE as of June 1, 1996. Design criteria for these systems are included by reference in applicable sections. Table 3.1-1 lists the proposed cask/canister systems for CISF use, along with applicable docket numbers and references. Vendor cask principal design criteria are summarized in Tables 3.4-1 through 3.4-15. Generic site principal design criteria (GSDC) are also provided for comparison.

In summary, the cask/canister systems are found to meet the majority of the generic site principal design criteria. The shaded cells indicate parameters that are significantly less conservative than the GSDC. Following designation of a CISF site, further cask/canister system evaluations, design analyses and possible design modifications will be performed to qualify the system for use at the CISF.

The following abbreviations are used in Tables 3.4-1 through 3.4-15.

BOC	Bounded by other criteria
HI-STAR	Holtec International - HI-STAR 100 System
GSDC	Generic Site Design Criteria
CISF	Centralized Interim Storage Facility
MM	Massive missile
MP187	VECTRA NUHOMS® MP187/HSM System
NAC STC	Nuclear Assurance Corporation (NAC) STC System
NC	Not considered
NFPA	National Fire Protection Association
NG	Not given
NS	None specified
PM	Penetrating missile
SM	Small missile
TranStor™	Sierra Transport and Storage Cask System
W-MPC	Westinghouse Multi-Purpose Canister

Table 3.4-1 Cask/Canister Design Criteria - Tornado (Wind Load)

Criterion	CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
Translational Speed (mph)	70	70	70	70	70	70
Rotational Speed (mph)	290	290	290	290	290	290
Max. Wind Speed (mph)	360	360	360	360	360	360
Max. Radius Rotation (ft)	150	150	150	150	150	150
Pressure Drop (psi)	3	3	3	3	3	3
Rate of pressure drop (psi/sec)	2.0	2.0	2.0	2.0	2.0	2.0
Gust Factor	1.0	NC	1.3	1.0	1.32	1.29

Table 3.4-2 Cask/Canister Design Criteria - Tornado (Missile Spectrum)

Criterion	CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
Massive Missile Wgt. (lb)	3968	3960	3960	3960	3967	4000
MM Hor. Vel. (mph)	126	126	126	126	126	132
MM Vertical Vel. (mph)	88.2	NC	88.2	NC	NC	88.3
MM Frontal Area (ft^2)	28	NG	20	NG	20	28
Penetrating Missile Wgt. (lb)	276	276	275	275	276	287
PM Hor. Vel. (mph)	126	126	126	126	126	126
PM Vertical Vel. (mph)	88.2	NC	88.2	NC	NC	88.3
PM Diameter (in)	8	8	8	8	8	8

Table 3.4-2 Cask/Canister Design Criteria - Tornado (Missile Spectrum) (Continued)

Criterion	CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
Small Missile Weight (lb)	0.15	0.148[1]	0.15	0.22[2]	BOC[2]	0.5[2]
SM Hor. Vel. (mph)	126	126	126	126[2]	126[2]	126[2]
SM Vertical Vel. (mph)	126	NC	BOC[3]	NC[2]	NC[2]	88.3[2]
SM Diameter (in)	1	1	1	1[2]	1[2]	1[2]

Table 3.4-3 Cask/Canister Design Criteria - Straight Wind

Criterion	CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
Wind Speed (mph)	110	BOC	105	BOC	BOC	100
Importance Factor	1.15	BOC	NC	BOC	1.07	1.07

Table 3.4-4 Cask/Canister Design Criteria - Floods

Criterion	CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
Water Velocity (fps)	NS	19.6[4]	25.5[4]	NG	15	15
Water Depth (ft)	NS	200	173[5]	NG	50	50

1 Based on weight calculated from density in accident analysis of Ref. 3.1-5, Section 3.G.5.

2 Bounded by penetrating missile analysis.

3 Horizontal velocity used in analysis of small missile, regardless of impact direction.

4 Water velocity required for cask tipover.

5 Maximum permissible depth allowed before external pressure is greater than design pressure of neutron shield.

Table 3.4-5 Cask/Canister Design Criteria - Precipitation

Criterion	CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
5 minute cumulative (in)	6.2	NC	NC	NC	NC	NC
1 hour cumulative (in)	19.4	NC	2.5	NC	NC	NC

Table 3.4-6 Cask/Canister Design Criteria - Snow and Ice

Criterion	CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor	MP187	W-MPC
Load (psf)	50	100	NC[6]	100	110	100
Exposure Factor	1.0	NC	NC	0.8	NC	1.2
Importance Factor	1.2	1.2	NC	1.2	NC	1.2

Table 3.4-7 Cask/Canister Design Criteria - Seismic Ground Motion

Criterion	CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
Horizontal Peak Ground Acceleration, Fraction of 1g	0.75	0.75[7]	0.261[8]	0.38[7]	0.25	0.25[9]

6 Snow and ice are not considered, as it is assumed that the heat from the cask would melt both.

7 Cask does not tip over at the specified value. Vendor states that cask tipover has no adverse consequences.

8 Maximum value cask can withstand before tipping over. Vendor states that cask tipover has no adverse consequences.

9 The large MPC can withstand a 0.404g seismic event without tipping over. The small MPC can withstand a 0.365g seismic event.

Table 3.4-8 Cask/Canister Design Criteria - Seismic Surface Faulting

CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
NS	NC	NC	NC	NC	NC

Table 3.4-9 Cask/Canister Design Criteria - Volcanic Eruption (Ash Fall)

CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
NS	NC	BOC[10]	BOC	NC	NC

Table 3.4-10 Cask/Canister Design Criteria - Ambient Temperature

Criterion	CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
Normal (°F)	76	111	70	75	70	75
Range (°F)	-40 to 125 (all modes)	-20 to 126	-40 to 130	-40 to 125	-40 to 125	-40 to 125

Table 3.4-11 Cask/Canister Design Criteria - Solar Load (Insolation)

Criterion	CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
Horizontal Flat (Btu/day-ft^2)	2949.4	3805[11]	2950	2950	1476	2949.4
Curved Surfaces (Btu/day-ft^2)	1474.7	NC	1475	1475	NC	1474.7

10 An analysis of burial by soil determined that this case is thermally limited, not load limited.

11 Based on a maximum measured solar insolation (1000 W/m^2) as measured by Rapp (cited in Ref. 3.1-5) and a 12-hour solar day.

Table 3.4-12 Cask/Canister Design Criteria - Lightning

Criterion	CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
Applicable Code	NFPA 780	NC	BOC[12]	NG	NG	NG

Table 3.4-13 Cask/Canister Design Criteria - Explosions

CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
NS	BOC[13]	BOC[13]	BOC[13]	BOC[13]	NG

Table 3.4-14 Cask/Canister Design Criteria - Aircraft Impact

CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
NS	NC	NC	NC	NC	NC

Table 3.4-15 Cask/Canister Design Criteria - Proximity to Uranium Fuel Cycle Operations

CISF (GSDC)	HI-STAR	NAC STC	Tran-Stor™	MP187	W-MPC
NS	NC	NC	NC	NC	NC

12 An analysis was performed on the localized temperature increase due to a lightning strike. A 71.6°F temperature increase was determined.

13 The overpressure produced by an explosion or blast force is bounded by the external pressure produced by the depth of the flood water and the tornado wind effect.

3.5 DESIGN CRITERIA FOR OTHER STRUCTURES, SYSTEMS, AND COMPONENTS SUBJECT TO NRC APPROVAL

The classification of SSCs allows the application of design criteria in a graded manner. The system classifies SSCs by function in order to apply the appropriate design criteria. Design criteria for QA 3, 4, 5, 6 and 7 are discussed in this section. The use of specific quality assurance practices for QA 3, 4, 5, 6 and 7 will be determined at the beginning of each phase of work and commensurate with the importance of the item and activity. Criteria used in the design of conventional quality SSCs is also discussed.

3.5.1 QA 3 - Important to Radioactive Waste Control

QA 3 SSCs are designed and constructed in accordance with Sections C.1, C.4 and C.5 of Regulatory Guide 1.143 (Ref. 3.5-1).

3.5.2 QA 4 - Important to Fire Protection

SSCs important to fire protection will comply with the design requirements of ANSI/ANS-57.9 (Ref. 3.5-2) and applicable National Fire Protection Association (NFPA) codes. These SSCs will undergo additional installation verification, maintenance inspections and operational reviews which will provide added assurance that the system will perform as designed. Protection of personnel is also ensured in accordance with NFPA 101 (Ref. 3.5-3). Fire protection system design codes are specified in Chapter 4 of this TSAR.

3.5.3 QA 5 - Important to Potential Interaction

Those SSCs in auxiliary systems that could fail during a design-basis event and impair the capability of other items to perform their intended radiological safety function must be designed to ensure that such failure cannot occur. Such items are classified as QA 5 only because of their location with respect to adjacent QA 1 SSCs. To ensure that failure of these auxiliary system SSCs will not impair the functionality of nearby QA 1 SSCs, supports for the auxiliary system SSCs must be designed to withstand the effects of the design-basis event without failing. Structural support design for such items is discussed in Chapter 7. Other than the supports, no special requirements apply to the design of the systems themselves. Therefore, conventional quality design criteria are used to design these auxiliary systems.

In accordance with the requirements of Sections C.1.1 and C.2 of Regulatory Guide 1.29 (Ref. 3.5-4), structures whose failure could impair other safety-related structures are required to be designed to accommodate a design earthquake. For the CISF, these structures are designated as QA 5 structures. QA 5 structures are not required to be designed to withstand tornado loadings.

3.5.4 QA 6 - Important to Physical Protection of Facility and Materials

10 CFR 72, Subpart H details requirements for a physical security and safeguards contingency plan, and physical protection design. Requirements for a separate detailed physical security plan and a safeguards contingency plan will not be provided until a site-specific SAR is written. Physical protection design requirements and criteria are described in Section 4.9. CISF QA 6 SSCs satisfy the applicable requirements of 10 CFR Part 73.

3.5.5 QA 7 - Important to Occupational Radiological Exposure

Due only to their location, CISF auxiliary systems located in areas of potential radiological exposure, including electrical, communication, fire protection, HVAC and compressed air, are designated as QA 7. Where auxiliary system components must be routed through radiation areas, ALARA design principles are used in accordance with the criteria specified in Section 3.3.8. No special requirements apply to the design of these QA 7 SSCs, other than special routing considerations for avoidance of personnel radiological exposure during plant maintenance and operation and consideration of reduced maintenance in equipment selection. In consideration of reduced maintenance, the design shall consider providing equipment with high reliability, low maintenance requirements and ease of replacement. Therefore, conventional quality design criteria are used to design these SSCs.

3.5.6 Conventional Quality

CISF SSCs not designated as QA 1, 3, 4, 5, 6 or 7 are considered to be of conventional quality. Conventional quality SSCs are designed and constructed in accordance with commercial standards as described below.

The design of conventional quality structures conforms with the requirements of ACI 318-95 (Ref. 3.3-14) for concrete and the AISC Manual of Steel Construction (Ref. 3.5-5) for structural steel.

The design and installation of piping systems at the CISF pertaining to water, compressed air, oil and sewer services shall conform to the requirements of the American Society of Mechanical Engineers/American National Standards Institute (ASME/ANSI) B31.1-1995 Code (Ref. 3.5-6). This code invokes appropriate American Society for Testing and Materials (ASTM) Standards, American Welding Society (AWS) Standards, and American Water Works Association (AWWA) Standards. Additionally, the design and installation of piping systems located inside buildings (including vent and drainage systems) shall conform to the applicable Uniform Building Code (UBC) (Ref. 3.5-7), National Plumbing Code (Ref. 3.5-8), or equivalent building code of the locality, and good work practices.

The design of conventional HVAC systems at the CISF shall conform to the design criteria contained in applicable ASHRAE, Air-conditioning and Refrigeration Institute (ARI), and NFPA standards, which will be selected to satisfy building heating, ventilation, and cooling load requirements.

The design of conventional electrical systems shall conform to ANSI/NFPA 70-1996, National Electric Code (Ref. 3.5-9), ANSI C2-1997 National Electric Safety Code (Ref. 3.5-10), NEMA Standards and applicable state, county, municipal and other local regulations, building and zoning codes. The switchyard and electrical distribution designs shall conform to Institute for Electrical and Electronic Engineers (IEEE) Standard 141-1993, IEEE Recommended Practice for Electric Power Distribution and Industrial Plants (Ref. 3.5-11); IEEE 142-1991, Recommended Practice for Grounding of Industrial and Commercial Power Systems (Ref. 3.5-12); and IEEE 80-1991, Guide for Safety in Substation Grounding (Ref. 3.5-13). Lightning protection for all structures shall comply with NFPA 780-1992, Lightning Protection Code (Ref. 3.5-14).

3.6 PERFORMANCE REQUIREMENTS

The function of the CISF, as an integral part of the CRWMS, is to store SNF resulting from commercial nuclear activities in an NRC-approved storage facility, until removal from the CISF for disposal in a repository. This section provides principal performance requirements imposed upon the design to ensure the facility can function as required.

3.6.1 Receipt Rate Capability

The CISF shall have the capability to receive SNF at the rates (MTU/year) listed in Table 3.6-1.

Table 3.6-1 CISF Receipt Rate Capability

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

The CISF shall have the capability to receive casks and canisters containing commercial SNF at the annual rates (casks/year) specified in Table 3.6-2.

Table 3.6-2 CISF Receipt Rate Capability by Cask Type

	Receipt Rate (casks/year)							
Year	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 21 PWR 40 BWR	Total		
1	86	90	176	160	72	232	0	0
2*	76	86	162	195	35	230	0	0

* Receipt rate by cask type for years 3 through 6+ to be determined.

3.6.2 SNF Receiving Mode

The CISF shall be designed to receive, handle, transfer, store and ship SNF contained in transportable storage casks and cask/canister systems docketed by the NRC or under development by DOE as of June 1, 1996. These systems are listed in Table 3.1-1.

3.6.3 Storage Capacity

The CISF shall have a SNF storage capacity of 40,000 MTU.

3.6.4 Facility Service Life

The CISF shall have a maintainable service life of 40 years.

3.7 SUMMARY OF CISF PRINCIPAL DESIGN CRITERIA

Table 3.7-1 provides a listing of principal design criteria for the CISF.

Table 3.7-1. Summary of CISF Principal Design Criteria

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards & Bases
Type of Fuel	Commercial, light water reactor, spent nuclear fuel	Normal	N/A
Storage Systems	Transportable storage casks and cask/canister systems docketed by the NRC or under development by the DOE as of 6/1/96	Normal	See Table 3.1-1
Fuel Characteristics	Criteria as specified in cask/canister systems in use at CISF	Normal	See Table 3.1-1
Tornado (Wind Load)	Max translational speed: 70 mph Max rotational speed: 290 mph Max tornado wind speed: 360 mph Radius of max rotational speed: 150 ft Tornado pressure drop: 3.0 psi Rate of pressure drop: 2.0 psi/sec Gust factor: 1.0	Accident	NRC RG 1.76 (Ref. 3.3-1) NUREG-0800 (Ref. 3.3-2)
Tornado (Missile)	Automobile, 3968 lb, 28 ft^2 Artillery shell, 276 lb, 8 in Steel sphere, 0.15 lb, 1 in	Accident	NUREG-0800 (Ref. 3.3-2)
Straight Wind	110 mph (3 sec. gust) Exp. Cat. C QA 1 SSCs, IF=1.15 All other SSCs, IF=1.00	Off-normal	ANSI/ASCE 7-95 (Ref. 3.3-3)
Floods	None specified. Classification 1 SSCs are located above maximum flood plain	Accident	NRC RG 3.48 (Ref. 3.3-4)
Precipitation	Cumulative, 5 min: 6.2 in Cumulative, 1 hr: 19.4 in	Normal	NWS Report #52 (Ref. 3.3-5)
Snow and Ice	Loading: 50 lb/ft^2 QA 1 SSCs, IF=1.2 All other SSCs, IF=1.00	Normal	ANSI/ASCE 7-95 (Ref. 3.3-3)
Seismic (Ground Motion)	Design response spectra anchored at horizontal acceleration of 0.75g	Accident	NRC RG 1.76 (Ref. 3.3-1)
Seismic (Surface Faulting)	No surface faulting	Accident	10 CFR 100, App. A (Ref. 3.3-8)
Volcanic Eruption (Ash Fall)	No volcanic ash fall	Accident	N/A
Explosions	Overpressure at facility due to on-site or off-site explosion not to exceed 1.0 psi	Accident	NRC RG 1.91 (Ref. 3.3-7)

Table 3.7-1. Summary of CISF Principal Design Criteria (cont'd.)

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards & Bases
Aircraft Impact	None specified	Accident	NUREG-0800 (Ref. 3.3-2)
Proximity to Uranium Fuel Cycle Operations	No uranium fuel cycle operation located in vicinity of CISF	Normal	10 CFR 72 (Ref. 3.2-1)
Ambient Temperature	Normal temperature: 76.0°F Minimum temperature: -40.0°F Maximum temperature: 125°F	Normal	ASHRAE Handbook (Ref. 3.3-9) 10 CFR 71.71 (Ref. 3.3-10)
Solar Load (Insolation)	Horizontal flat surfacc solar insolation: 2949.4 Btu/day-ft^2 Curved surface solar insolation: 1474.7 Btu/day-ft^2	Normal	10 CFR 71 (Ref. 3.3-10)
Shielding	< 5 rem (Public)	Accident	10 CFR 72.106 (Ref. 3.2-1)
Confinement	As listed in vendor system SARs, Table 3.1-1	N/A	N/A
Radiological Protection	< 25 mrem, whole body < 75 mrem, thyroid (Public) < 25 mrem, other organ	Normal	10 CFR 72.104 (Ref. 3.2-1)
	< 5 rem, whole body (Public)	Accident	10 CFR 72.106 (Ref. 3.2-1)
Nuclear Criticality	As listed in vendor system SARs, Table 3.1-1	N/A	N/A
Decommissioning	Minimize potential contamination Utilize materials & coatings to facilitate decommissioning	Normal	10 CFR 72.130 (Ref. 3.2-1)
Materials Handling & Retrieval Capability	Cask/canister handling systems safe under all facility conditions	Accident, Off-Normal, & Normal	10 CFR 72.128 (Ref. 3.2-1)
	Storage system allows ready retrieval of SNF for further processing	Normal	10 CFR 72.122 (l) (Ref. 3.2-1)

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3.2-2. 10 CFR Part 73. *Physical Protection of Plants and Materials.*

3.2-3. 10 CFR Part 20. *Standards for Protection Against Radiation.*

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4. OPERATING SYSTEMS

Chapter 4 describes the main operating functions of the CISF and the systems needed to perform these functions. The chapter follows NUREG-1567; and also, includes a description of the facility layout and principal features in accordance with Regulatory Guide 3.48. General arrangements of the main building are presented in this chapter. The major systems necessary for handling SNF and the supporting auxiliary systems are described.

This TSAR seeks NRC concurrence that:

- The major spent fuel handling functions and the design characteristics of the systems needed to perform these functions are adequately described.
- Safety system design includes a description that shows accommodation of environmental conditions, natural phenomena, off-normal conditions and accidents.
- The design shows how storage confinement, criticality safety, heat removal, radiation protection and retrieval are maintained throughout the lifetime of the facility.
- The designs for auxiliary systems are sufficiently described to show satisfaction of the important support functions.

4.1 INSTALLATION DESIGN

This section provides a description of the CISF layout and the major buildings, structures and SNF storage areas. It also identifies the major operating functions performed at the CISF and the appropriate TSAR section providing detailed information for each operating function.

4.1.1 Location and Layout of Facility

The CISF design is based on generic site characteristics chosen to envelop as much of the 48 contiguous United States as is practical. Therefore, the CISF can be located in almost any area of the United States. Generic site design criteria and assumptions concerning the CISF site are presented in Chapter 2. The facility layout is shown in Figures 4.1-1 through 4.1-3.

4.1.2 Principal Features

A description of the principal facility features is presented below, including a description of the major buildings and areas. The operating systems contained within these structures are described in the remaining sections of Chapter 4. The spent fuel handling systems are described in Section 4.2, and other operating systems, which include building ventilation, electrical, compressed air, water supply, waste water collection, communication and fire protection systems, are described in Section 4.4. Section 4.3, Pool and Pool Facilities, is not applicable to this TSAR.

4.1.2.1 Site Boundary

The site boundary is shown in Figure 4.1-1. The site area is approximately 1,200 acres and is owned by DOE. The buildings and structures for the facility are situated near the center of the property.

4.1.2.2 Controlled Area

The controlled area is the area within the site boundary identified in Figure 4.1-1. In this area, DOE has the authority to determine all activities, including exclusion or removal of personnel and property.

4.1.2.3 Controlled Access Area

The controlled access area is the area inside the double fence identified in Figure 4.1-1. Access to this area of the facility is controlled to protect individuals from exposure to radiation and radioactive materials. For this facility, the controlled access area per 10 CFR 73 and the restricted area per 10 CFR 20 are the same. All personnel entering these areas are trained in radiological safety or are escorted by someone trained in radiological safety. The physical barriers for the CISF controlled access area and for the access control subsystems and procedures are described in Section 4.9. The radiation protection criteria are defined in Chapter 9.

4.1.2.4 Storage Area and Concrete Storage Pads

The storage area provides storage space for SNF received at the CISF during its operation. Figure 4.1-3 shows the layout of the storage area, which accommodates 40,000 metric tons of uranium (MTU) of SNF. Storage is provided for both vertical cask and horizontal storage module modes of storage. A 200-foot (minimum) buffer is provided between the unrestricted area and the closest cask in storage, and a 2,300-foot (minimum) distance is provided to the site boundary from stored SNF. These distances minimize the radiation impacts of CISF operations upon the CISF employees and the public.

The portion of the storage area labeled "Initial Storage Area" will be constructed prior to commencement of CISF operations. This allows ongoing storage pad construction to maintain a 650-foot separation from stored SNF, thereby keeping radiation dose to construction personnel ALARA.

4.1.2.5 Transfer Facility

As the focal point for handling SNF at the CISF, the transfer facility provides the SSCs needed to receive and transfer shipments of canistered SNF. Figures 4.1-4 through 4.1-9 show the facility's general arrangement and section views. The transfer facility is a fully enclosed building with a slab-on-grade floor. The building is constructed of reinforced concrete and is approximately 250 feet long by 88 feet wide by 75 feet high. The shipping/receiving area of the facility is approximately 120 feet wide. The interior of the building is open, with partial-height interior concrete walls separating the three operational areas. Two 225-ton overhead bridge cranes travel the length of the building to handle SNF transportation and storage casks. The concrete superstructure is designed for a full spectrum of normal, operating and environmental loadings, including seismic and tornado loadings. Since the transfer facility is intended for continuous operations, the overhead bridge cranes are designed to accommodate seismic forces while fully loaded. The structural design for the transfer facility is presented in Chapter 7.

Attached to the transfer building is a small support building, shown in Figure 4.1-4. This building houses locker rooms, equipment rooms for electrical and mechanical components, and a room for monitoring parameters of casks in the storage area, such as temperature and seal pressure. The cask monitoring room houses computers and instrumentation for remote monitoring of storage casks. The support building also includes radiation protection (RP) facilities. Rooms are provided for an RP office, a counting laboratory and an RP equipment storage and personnel dosimetry issue room. Personnel access to the transfer facility is controlled in this support building. Personnel contamination monitoring equipment is located at the access door to the transfer facility to allow workers to check for contamination before exiting the transfer facility.

4.1.2.6 Transportation Cask Queuing Areas

The transportation cask queuing areas are located between the transporter wash-down station and the transfer facility. Queuing spaces are provided for 10 rail cars and 10 heavy haul transporters, simultaneously. Rail SNF deliveries await entrance to the transfer facility on the tracks to the transfer facility. Heavy haul SNF delivery transporters will park in a paved area next to the rail tracks. Outgoing rail and heavy haul transporters are queued on the exit side of the transfer facility. The queuing area will be a restricted area whenever a loaded cask is present. ALARA precautions are to be directed by site RP staff, and radiation areas will be marked as required. The distance from the cask queuing area to the unrestricted area is greater than 200 feet, to ensure dose rate limits are met.

4.1.2.7 Switchyard

In the switchyard, power is transmitted to the CISF through a transmission line from the utility grid. The line terminates in the CISF switchyard and is connected to the site main transformer through a switchyard circuit breaker and associated disconnect switches. A 4.16kV electrical switchgear is located in the switchgear building at one end of the switchyard. The general arrangement and section views of the switchgear building are provided in Figure 4.1-10.

4.1.2.8 Security Complex

The security complex, the main operation center for site security personnel, controls the site emergency vehicles and provides a secured, controlled entry for personnel, visitors and vehicles into the protected area. The building houses security personnel and contains the necessary equipment to search and badge personnel and to inspect vehicles.

Figure 4.1-11 shows the general arrangement of the security complex and the protected badging area. The facility is a rectangular, single-story structure with approximately 12,000 square feet of floor space.

4.1.2.9 Inspection Gatehouse

The inspection gatehouse is located outside of the controlled access area and is enclosed by an extension of the fence surrounding the controlled access area. The inspection gatehouse provides an area to receive and inspect SNF shipments made by heavy haul and rail. The inspection gatehouse also provides final clearance for shipments off site. Access to the CISF site is controlled by motorized rolling gates at roadway and railway penetrations. The general arrangement and section views of the inspection gatehouse are shown in Figure 4.1-12.

4.1.2.10 Main Gatehouse

Personnel and vehicular access to the CISF is controlled and monitored at the main gatehouse, which is located at the control area boundary of the CISF. The general arrangement and section views of the main gatehouse are shown in Figure 4.1-13.

4.1.2.11 Water Utilities and Fire Protection

Water utilities include potable water, fire protection, sewer and waste water systems. The major equipment supporting the potable water system and the fire protection system is located in the water utilities and fire protection area, as designated in Figure 4.1-1.

The potable water system is the primary water utility for the CISF. The system includes a yard well house, underground piping, a submersible well pump, a ground water storage tank and other supporting equipment. The general arrangement and section views of the potable water well house are provided in Figure 4.1-14. Information on the water supply systems is provided in Section 4.4.4.

The yard fire protection system distributes water to the automatic sprinkler systems and interior standpipe systems for building fire protection, and to fire hydrants provided throughout the site. A dedicated fire water storage and distribution system is used. The yard fire protection system consists of redundant water storage tanks, a pumphouse with redundant fire pumps, underground supply piping and a looped distribution system, and yard hydrants. The general arrangement and section views of the fire protection pump building are shown in Figure 4.1-15. Information on the fire protection system is provided in Section 4.4.7. The sewage and waste water systems are described in Section 4.4.5.

4.1.2.12 Concrete Cask Staging Area

Empty SNF storage casks are received and stored in the concrete cask staging area, located near the transfer facility next to the queuing area, while they await CISF use.

4.1.2.13 Off-Normal Holding Area

The off-normal cask holding area is outside the transfer facility and is shown in Figure 4.1-1. This area is set aside to receive and temporarily store SNF shipments that do not meet the security requirements for CISF processing. Casks not satisfying normal receipt requirements are also temporarily stored in this area.

4.1.2.14 On-Site Receiving Area

The on-site receiving area is located just outside the inspection gatehouse. New SNF deliveries which arrive while a previous shipment is undergoing security inspection will remain in the on-site receiving area until taken to the inspection gatehouse.

4.1.2.15 Transporter Wash-Down Station

The transporter wash-down station removes road dirt from incoming transporters and transportation casks to maintain transfer facility cleanliness and to support security inspections. The general arrangement of the transporter wash-down station is provided in Figure 4.1-16.

4.1.2.16 Receiving Gatehouse

Access to the CISF for radioactive shipments is provided by two gatehouses, the receiving gatehouse and the inspection gatehouse. The receiving gatehouse, the first of the two encountered, is located at the controlled area boundary of the CISF and is staffed only when deliveries are expected. The general arrangement and section views of the receiving gatehouse are provided in Figure 4.1-17. Its purpose is to monitor and approve access to the CISF site for incoming deliveries.

4.1.2.17 Site Utility Supplies and Systems

The purpose of site utility services is to provide operational support for the CISF. These utility services include the following systems.

- Electric power delivery
- Water and sewer
- Fire protection
- Communications.

4.1.2.17.1 Electric Power Delivery

One transmission line serves the CISF. Electrical service is distributed to the site facilities from the electrical switchgear building located in the switchyard. Information on the CISF electrical system is provided in Section 4.4.2.

4.1.2.17.2 Water and Sewer

The water and sewer utilities consist of those systems necessary to provide water supply, sewage and conventional waste water collection and disposal to the CISF. Major systems include the potable water, conventional waste water and sanitary waste systems, which are described in more detail in Sections 4.4.4 and 4.4.5.

4.1.2.17.3 Fire Protection

The fire protection system provides storage and distribution of water for extinguishing fires at the facility. Information on the fire protection system is provided in Section 4.4.7.

4.1.2.17.4 Communications and Alarms

The communication systems at the facility provide on-site and off-site communications. Four primary communication systems include the facility telephone system, the public address system, alarms and two-way radios. Information on the communication systems is provided in Section 4.4.6.

4.1.2.18 Storage Tanks

This section provides information on the location of chemical, gas or liquid holding tanks or storage systems. No chemical storage tanks are presently identified at the CISF.

Two 150,000-gallon fire water storage tanks are located on the CISF site. These tanks are located in the water utilities and fire protection area shown in Figure 4.1-1. Additional information on the fire water storage tanks is provided in Section 4.4.7.

Two diesel fuel storage tanks are located at the facility. One is located in the security complex and provides fuel to a 500 kVA diesel generator, which in turn provides emergency power to the security system. The other is a small, dedicated fuel tank that provides fuel for the diesel driven fire protection pump. This tank is located in the fire protection pump building (Figure 4.1-15). Additional information on the security system diesel generator is provided in Section 4.9, and diesel driven fire protection pump information is provided in Section 4.4.7.

The CISF design also includes several storage tanks associated with the water supply and waste water collection systems. A potable water storage tank is located next to the potable water well house. Information on the water supply system is provided in Section 4.4.4. The underground tanks associated with the waste water system are described in Section 4.4.5.

4.1.2.19 Stacks

No stacks are associated with the CISF. The exhaust vent for the transfer facility ventilation system is located on the side of the transfer facility. The HVAC area is shown in Figure 4.1-8.

4.1.2.20 Temporary Facilities

Temporary facilities provide office space, warehouses, maintenance and storage areas, space for vendors and other similar CISF functions. Temporary facilities are located in Figure 4.1-1.

4.2 SPENT FUEL HANDLING SYSTEMS

This section identifies the CISF SNF handling systems. Information is presented regarding system function, major components, design bases and design features, and associated safety features. The SNF systems are designed to accommodate any type of vendor SNF casks or canisters approved by the NRC and expected to be processed at the facility.

4.2.1 Transfer Facility

This section describes the transfer facility systems and associated operations. The transfer facility is the primary facility for handling SNF casks and canisters at the CISF and consists of three operational areas.

- Shipping/receiving area
- Canister transfer area
- Site transporter area.

The transfer facility shipping/receiving area is used to receive and prepare for shipment all SNF transportation casks arriving at and departing from the CISF. Rail and truck shipments of SNF transportation casks enter the shipping/receiving area through rollup overhead doors. Three rail/truck lanes are provided in this area to meet the expected CISF SNF throughput requirements. Each rail line serving the transfer facility is equipped with a derailer to prevent inadvertent vehicular impacts. Overhead bridge cranes unload the transportation casks from their transporters and, after appropriate contamination surveys and decontamination activities (if necessary), carry the transportation casks into the canister transfer area. Empty transportation casks are dispatched from the shipping/receiving area.

The shipping/receiving area also serves as a staging area for handling casks that do not require canister transfer in the transfer facility. These casks are unloaded from their transporters in the shipping/receiving area and, after appropriate contamination surveys and decontamination activities (if necessary), they are picked up by a site transporter for transport to the storage area.

The canister transfer area is used to prepare casks for unloading and loading operations and to transfer SNF canisters from transportation casks to storage casks. This area is designed to fully protect open transportation and storage casks from the effects of extreme environmental phenomena, such as tornado-generated missile strikes. Vendor-designed canister transfer equipment is used to perform canister transfer operations. Detailed design of transfer facility SSCs will be coordinated with vendor designs to ensure transportation, transfer and storage casks will not tip over during any design conditions. The canister transfer area includes space for at least three lines of canister transfer. It can be configured to accommodate handling demands for the various types of vendor casks arriving at the CISF. Significant flexibility is included in the transfer facility arrangement to accommodate varying degrees of SNF throughput and cask vendor technologies.

The site transporter area is used to stage concrete storage casks for transfer operations. Empty storage casks are brought into the site transporter area by a site transporter, where they are picked up by the overhead bridge cranes for loading with SNF canisters. Once loaded, the storage casks are moved back to the site transporter area by the overhead bridge cranes, where they are picked up by the site transporter and taken to the CISF storage area.

During SNF retrieval operations, these same areas of the transfer facility are used in reverse to remove SNF canisters from storage casks and transfer them to transportation casks for shipment off site.

The transfer facility provides the necessary SSCs to accomplish the following functions.

- Handle cask systems
- Prepare loaded casks for storage
- Transfer loaded storage casks into storage
- Retrieve storage casks from storage
- Prepare casks for transport
- Provide operations support
- Provide protective services
- Process site-generated radioactive waste
- Process other site-generated waste.

To accomplish the above functions, the transfer facility operational systems include the following.

- Cask off-loading and loading system
- Cask carrier system
- Transfer preparation system
- Canister transfer system
- Storage mode preparation system.

ALARA principles are incorporated to the maximum extent practical throughout the design to reduce radiation exposure to facility personnel. Overhead bridges cranes are remotely operated from a crane operating room. Gantry-mounted robotic equipment is provided in the shipping/receiving area and stationary-mounted robotic equipment is provided in the canister transfer area. The gantry-mounted robotic equipment is controlled from the crane operating room, and other robotic equipment is remotely operated from shielded rooms. Standard computer controls, which are adapted for specific transfer facility tasks, are used for the robot operating systems. Cameras are used throughout the transfer facility to aid crane and robotic equipment operators in performing tasks via use of closed-circuit television (CCTV) monitors. Special alignment devices and automated bolt/stud tensioners are provided for performing repetitious tasks in the shipping/receiving area and in the canister transfer room. All robotic equipment and automated component handling devices are similar in design to existing equipment used throughout the manufacturing industry. All automated and remote handling equipment will be included in pre-operational testing and operation testing programs, described in Chapter 13.

Where hands-on worker tasks must be performed, shielded control console and monitoring areas are provided in the canister transfer area to allow workers to retreat from radiation areas and still observe and control cask handling and canister transfer operations. A remote monitoring room is also provided near the shipping/receiving area as a place for workers to retreat from radiation areas. Where tasks do not lend themselves to the use of automation, long-handled tools and local shielding are provided in the design to limit worker radiation dose.

4.2.1.1 Cask Off-loading and Loading System

The cask off-loading and loading system is located in the transfer facility shipping/receiving area. It provides the necessary equipment to unload transportation casks from transporters and to reload empty transportation casks onto transporters for dispatch of the casks from the CISF. Equipment is provided for removing or attaching such items as impact limiters, personnel barriers and cask tiedowns from the transportation casks.

4.2.1.1.1 Operating Function

When a transportation cask is received at the CISF, it is taken to the transfer facility shipping/receiving area via one of the three rail/truck lanes provided. Once inside the shipping/receiving area, the impact limiters and personnel barriers are removed and the cask is checked for possible surface contamination. The casks are then removed from their transporters by the overhead bridge cranes, and prepared either for unloading of SNF canisters or for direct storage in the storage area, depending on the type of cask received. Empty casks are prepared for transport from the CISF by the cask off-loading and loading system and dispatched from the transfer facility. During canister retrieval operations, this system loads transportation casks containing loaded canisters onto transporters for shipment from the CISF. The focus of operations for the CISF off-loading and loading system is the gantry-mounted robot. The gantry-mounted robot is used to:

- Remove personnel barriers and impact limiters
- Take contamination swipes
- Install and remove lifting trunnions and trunnion retention blocks
- Install and remove lifting slings or yokes
- Install and remove transportation cask venting and sampling equipment.

4.2.1.1.2 Major Components

The cask off-loading and loading system consists of the following major components.

- Two 225-ton capacity overhead bridge cranes with 25-ton auxiliary hoists

- Crane operating consoles for remote operation

- One gantry-mounted robot, including gantry frame, platform and robotic arms

- Robot operating consoles for remote operation
- Robot end-effector manipulated tools (wrenches, swipe pads, clamping jaws)
- Cameras for observing off-loading and loading activities
- CCTV monitors and equipment
- Automated support, alignment and bolt/stud tensioner devices for installing and removing trunnions and retainer blocks
- Automated support, alignment and bolt/stud tensioner devices for removing and installing vents and sampling ports
- Automated alignment and bolt/stud tensioner devices for removing and installing personnel barriers
- Automated alignment and bolt/stud tensioner devices for removing and installing impact limiters
- Equipment storage racks for tools and equipment
- Inspection and sampling equipment including purge gas sample analyzers
- Gas inerting system for filling annulus around canisters in casks
- Platforms and ladders for crane maintenance
- Necessary vendor-specific equipment (lifting yokes).

4.2.1.1.3 Design Description

Two 225-ton capacity overhead bridge cranes are provided in the transfer facility, allowing simultaneous SNF handling operations in various areas of the transfer facility and providing redundancy of cask handling equipment in the event that one crane is out of service. Either crane can service any part of the transfer facility. The service area covers the entire floor area of the transfer facility, with setback allowances from the edges and sides due to hook approach restrictions. The capacity of the cranes is sized to allow handling of the heaviest transportation and storage cask designs specified in the design basis, which is bounded by the 195-ton Westinghouse concrete storage cask (Ref. 4.2-1).

Both cranes run on a common set of rails, which provide a crane span of approximately 70 feet and a travel distance of approximately 230 feet. Each crane has a 25-ton capacity auxiliary hoist used for handling of impact limiters, personnel barriers and other ancillary equipment. The main hook hoist blocks swivel to accommodate cask rotation. Platforms and ladders are provided for crane maintenance. The cranes are remotely operated using computer-assisted controls from a crane operating room located along one side of the transfer facility, to ensure crane operator personnel radiation dose is kept ALARA. Cameras are provided on the cranes and throughout the transfer facility to aid crane operators in observing crane activities.

The overhead bridge cranes and associated cask lifting equipment are supplied in accordance with the guidelines specified in:

- NUREG-0612 (Ref 4.2-2)
- NUREG-0554 (Ref. 4.2-3)
- ASME NOG-1 (Ref. 4.2-4)
- ANSI-N14.6 (Ref. 4.2-5).

The minimum safety factors, requirements for load path and safety feature redundancy, and other design criteria set forth in these documents are met.

Design considerations for the gantry-mounted robot are as follows. The gantry support frame for the robotic equipment spans the three rail/truck lanes. The gantry frame can travel the width of the shipping/receiving area on rails installed in the floor, allowing the gantry to move perpendicular to the travel direction of the overhead bridge cranes. Two robotic arms are supported on a platform suspended by three sets of dual cabling from the gantry frame. This configuration provides six degrees of translational and rotational movement of the platform. The cabling supporting the platform provides significant stiffness and stability to allow the robotic arm to perform precise and accurate tasks. The robotic arm has an end effector for grasping various tools such as socket wrenches, swipe pads, clamping jaws and other devices that substitute for human-manipulated tools. The robotic arm has elbow joints to allow it to access any position on a cask, and drive motors to move the arm and rotate the end effector. The robotic arm is capable of manipulating components up to approximately 250 pounds when fully extended. Figure 4.2-1 shows the gantry-mounted robot configuration.

Specific automated equipment for each cask type will be provided for alignment and bolt/stud tensioning for trunnions, retainer blocks, vents and sample ports, personnel barriers, and impact limiters. This equipment will be designed to provide hands-free operation; specific design details will be developed during final design.

Equipment storage racks are provided for tools and equipment. A variety of hand tools, long-handled tools and robot effector manipulated tools are provided to accommodate removal and reinstallation of impact limiters and personnel barriers, disassembly and assembly of trunnion blocks, attachment of lifting slings and other required tasks.

Inspection and sampling equipment is provided to check for possible surface contamination on incoming and outgoing transportation casks and to test for SNF confinement integrity. This includes various tools for taking swipes, equipment for sampling gas purged from the transportation casks, and equipment for analyzing the results of swipe tests and gas purge samples for possible contamination.

A gas inerting system is provided for filling transportation casks prior to shipment or, in the event of an off-normal condition where a canister cannot be removed from an incoming transportation cask, refilling the cask with inert gas for further recovery operations. This system includes gas supply and distribution equipment.

4.2.1.1.4 Safety Considerations

The bridge cranes are QA 1, QA 5 and QA 7. All crane components are designed to be fail-safe in the event of loss of power, so that the load cannot be dropped or inadvertently moved. Thus, power to the cranes is not required to be QA 1. The cranes are designed to withstand the effects of the generic site earthquake. Since a large number of casks are handled in the transfer facility on a continuous basis, the design assumes that an earthquake occurs while a cask is being lifted by a crane. As such, the overhead bridge cranes are designed to accommodate seismic loadings while both of the cranes are fully loaded with the heaviest cask included in the design basis. In addition, assurance is made that the cranes will remain on their rails and functional after the earthquake has subsided.

During all off-loading and loading operations, transportation casks are lifted only to the minimum height necessary to allow removal from or placement on the transporters. Storage casks are only lifted approximately six inches above the floor, just enough to accommodate cask movement operations. Dedicated travel paths are defined for each cask type to minimize potential for inadvertent interactions with other SSCs. Load indicator devices are provided on the crane lifting mechanisms so that significant changes in the supported load can be detected, to indicate inadvertent forces or load binding.

The gantry frame and robotic equipment perform tasks that replace hands-on worker tasks, and are seismically designed as QA 5 components to protect against potential interactions with QA 1 SSCs. The gantry frame and robotic equipment and accessories are also designated as QA 7 because they are located in a radiation area. Automated components such as alignment and bolt/stud tensioners are designated as QA 5 and QA 7.

Equipment storage racks and tools are seismically designed as QA 5 components to prevent them from falling onto QA 1 SSCs, and designated as QA 7 because they are located in radiation areas. Inspection and sampling equipment is QA 5 and QA 7. Gas inerting system equipment is also QA 5 and QA 7.

4.2.1.2 Cask Carrier System

The cask carrier system provides components for supporting transportation, transfer and storage casks during various phases of handling operations in the transfer facility.

4.2.1.2.1 Operating Function

The cask carrier system provides SSCs for moving, supporting or restraining transportation and storage casks during cask preparation activities and transfer of canisters. Lifting devices are provided for supporting Westinghouse and TranStor™ concrete storage casks during lifting and movement by the overhead bridge cranes. These lifting devices allow a common mating interface between the different storage cask configurations and the overhead bridge crane hooks.

4.2.1.2.2 Major Components

The following major components are included in the cask carrier system.

- Lifting devices for storage casks
- Transfer cradles for the transportation casks
- Upender and downender devices and associated rails and drive mechanisms
- Frames for supporting transportation, transfer and storage casks during transfer operations.

4.2.1.2.3 Design Description

Concrete storage casks are placed on the lifting devices so that the devices support the storage casks from the bottom. The lifting devices extend upward along the sides of the storage casks and form a connection point above the casks for attachment of the overhead bridge crane hook. Use of the lifting devices allows the overhead bridge cranes to move the storage casks from the site transporter area into the canister transfer room, in order to prepare the casks to receive loaded SNF canisters. Once the casks are loaded, the lifting devices provide for movement of the storage casks back into the site transporter area.

4.2.1.2.4 Safety Considerations

The lifting devices are classified as QA 1 - Important to Radiological Safety. As such, the lifting devices are designed to ensure that casks cannot be dropped during any design conditions. The lifting devices are also designed as QA 5 to protect against potential interactions with QA 1 SSCs. Criteria for below-the-hook lifting devices are used for design of these devices. SSCs in the cask carrier system are also classified as QA 7, because they are located in radiation areas.

4.2.1.3 Transfer Preparation System

The transfer preparation system, located in the transfer facility canister transfer area, provides the necessary equipment for preparing transportation casks for canister transfer.

4.2.1.3.1 Operating Function

The transfer preparation system provides SSCs for preparing transportation casks for SNF canister transfer out of the casks, and for preparing the empty transportation casks for shipment from the CISF. Transportation cask lids are removed and installed by SSCs provided in this system, and venting and sampling is performed for casks requiring canister transfer in the transfer facility. Depending on the type of vendor system being handled, transportation casks and either transfer or storage casks are mated and supported in preparation for canister transfer out of the transportation casks. Unloaded transportation casks are also prepared for dispatch from the CISF by SSCs provided in the transfer preparation system. Only the Westinghouse and TranStor™ system designs require SSCs in this system. All transfer preparation activities take place in the environmentally protected canister transfer area of the transfer facility, since the casks may be vulnerable to environmental phenomena when cask lids are removed. Robotic arms are used for various operations in the transfer preparation system. Each robotic arm has an end effector for grasping various tools to perform the following tasks.

- Position alignment devices and automated bolt/stud tensioners
- Perform transportation cask lid removal and installation operations
- Assist transportation cask lid seal inspection and replacement as necessary
- Install, remove and operate transportation cask venting and sampling equipment
- Assist radiological surveys and decontamination operations
- Install and remove canister lifting devices and pintles
- Assist installation and removal of lifting slings.

4.2.1.3.2 Major Components

The major components in this system include the following.

- Retractable platforms for accessing tops of casks
- Robotic arms (stationary mounted)
- Robot operating consoles for remote operation
- Robot end-effector manipulated tools such as wrenches, swipe pads and clamping jaws
- Inspection and sampling equipment including purge gas sample analyzers
- Automated support, alignment, and bolt and stud tensioner devices for removing and installing transportation cask lids
- Automated support, alignment, and bolt and stud tensioner devices for removing and installing vents and sampling ports
- Miscellaneous shielding (stationary and movable)
- Miscellaneous hand and long-handled tools
- Cameras for observing transfer preparation activities

- CCTV monitors and equipment.

4.2.1.3.3 Design Description

Working platforms are provided around the tops of the transportation and storage casks. These platforms are retractable to allow ease of moving transportation and storage casks in and out of the canister transfer area using the overhead bridge cranes. Shielding is integral with the platforms. Movable shielding is also provided. The retractable platforms mate to walkways along the sides of the canister transfer room walls.

Stationary-mounted robotic arms are provided for performing activities on both the Westinghouse and TranStor™ transportation casks. The robotic arms are similar to those described for the cask off-loading and loading system, except that they are mounted on the walls and platforms surrounding the cask laydown positions. The robots are used in conjunction with cameras provided in the canister transfer room.

Specific automated equipment for each cask type is provided for alignment and bolt/stud tensioning for cask bolt lids and transportation cask sample ports. This equipment is designed to provide hands-free operations. Specific design details for this equipment will be developed during final design.

4.2.1.3.4 Safety Considerations

Platforms, robotic equipment, automated bolt/stud tensioners, monitoring equipment and other SSCs in the transfer preparation system are classified as QA 5. SSCs classified as QA 5 are designed to protect against potential interactions with QA 1 SSCs. Supports for QA 5 SSCs are designed to accommodate the design earthquake and other loadings, ensuring that these SSCs cannot fail and impact nearby QA 1 SSCs such as the transportation and transfer casks. Structural design of supports for QA 5 SSCs is described in Chapter 7.

SSCs in the transfer preparation system are also classified as QA 7, because they are located in radiation areas. Design of these SSCs minimizes potential for radiological exposure of personnel operating and maintaining this equipment.

Equipment used to verify SNF cask and canister identity and condition is also classified as QA 6. This equipment is subject to special design considerations because of its relation to special nuclear material accountability.

4.2.1.4 Canister Transfer System

The canister transfer system is located in the transfer facility canister transfer area, where space is available for at least three separate lines of canister transfer system SSCs. General arrangements shown in Figure 4.1-4 depict one line of horizontal transfer and two lines of vertical transfer as an example of a potential arrangement for housing the canister transfer system SSCs.

4.2.1.4.1 Operating Function

The canister transfer system provides SSCs for transferring SNF canisters from transportation casks to storage casks during initial storage operations. This system also provides for transferring SNF canisters from storage casks to transportation casks during SNF retrieval operations, when the SNF is packaged for shipment off site.

Canister transfer operations are significantly different for the two types of vendor systems handled. For the Westinghouse Large/Small MPC System designs, canister transfer is performed directly from a transportation cask to a storage cask using a ram device. The transportation cask and the storage cask are positioned horizontally during canister transfer in the Westinghouse design. For the Sierra TranStor™ System design, a transportation cask and a storage cask are positioned vertically next to each other in the canister transfer area, and a separate transfer cask is used to lift the canister out of the transportation cask and place it in the storage cask.

4.2.1.4.2 Major Components

The major components of the canister transfer system include the following.

- Cameras for observing canister transfer activities
- CCTV monitors and equipment
- Alignment systems
- Rams for transferring large and small canisters
- Tools for opening and closing cask doors
- Transfer cask
- Canister lifting slings
- Tools for opening and closing transfer cask doors.

4.2.1.4.3 Design Description

Canister transfer is a relatively clean operation that does not require rigorous confinement for contamination control, since very little contamination is anticipated for sealed canisters. Vendor casks are used to shield transfer operations, so that little additional shielding is required to be provided by transfer facility SSCs. Because of the large number of casks being handled, canister transfer operations are performed remotely to maintain worker radiation dose ALARA.

Cameras and audio monitors are provided for remote control and monitoring of canister transfer operations by CCTV. Operation of the overhead bridge cranes to lift transfer casks and canisters is performed from the shielded crane operator room. Remotely operated alignment systems ensure proper alignment of casks and canisters during transfer operations. This equipment is controlled remotely from the remote console rooms located along the walkways at the end of the canister transfer room. Hydraulic rams and cask shield doors are also controlled from the remote console rooms. Design of the automation equipment to ensure remote operation of vendor transfer equipment will be completed during final design.

4.2.1.4.4 Safety Considerations

Canister transfer activities are protected from environmental phenomena by the robust design of the canister transfer area. This area is designed to withstand design earthquake and tornado loadings as well as a spectrum of other normal, severe and extreme loadings. Detailed design of transfer facility SSCs will be coordinated with vendor designs to ensure transportation, transfer and storage casks will not tip over during any design conditions.

Cameras, CCTV monitors and equipment, and alignment systems provided in the canister transfer system are classified as QA 5 to protect against potential interaction of these items with QA 1 SSCs. Supports for QA 5 SSCs are designed to accommodate the design earthquake and other loadings, ensuring that these SSCs cannot fail and impact nearby QA 1 SSCs such as transportation, transfer and storage casks. Structural design of supports for QA 5 SSCs is described in Chapter 7.

SSCs in the canister transfer system are also classified as QA 7, because they are located in radiation areas. Design of these SSCs minimizes potential for radiological exposure of personnel operating and maintaining this equipment.

Equipment used to verify SNF cask and canister identity and condition is classified as QA 6. This equipment is subject to special design considerations because of its relation to special nuclear material accountability.

4.2.1.5 Storage Mode Preparation System

The storage mode preparation system is located in the transfer facility canister transfer area. It provides SSCs for preparing storage casks for SNF canister transfer into the casks and for preparing the loaded storage casks for storage in the storage area.

4.2.1.5.1 Operating Function

Functions of the storage mode preparation system include preparing storage casks to receive loaded SNF canisters, surveying canisters and storage casks for contamination, performing any necessary decontamination, installing storage cask closure lids, and removing loaded storage casks from the canister transfer area.

In order to prepare storage casks to receive canisters, the storage casks are brought into the canister transfer area by the overhead bridge cranes using lifting devices provided in the cask carrier system. Cask lids are removed, and the casks are prepared for either horizontal or vertical canister transfer.

Once canisters have been transferred to the storage casks, the casks are surveyed for contamination and decontaminated as required. Closure lids are then installed on the storage casks, and the loaded casks are picked up by the overhead bridge cranes and moved into the site transporter area of the transfer facility. Once the loaded storage casks are placed on the floor of the site transporter area, the crane hook is removed. The casks are then moved to the storage area by the site transporters. Robotic arms are used for various operations in the storage mode preparation system, including the following tasks.

- Position alignment devices and automated bolt/stud tensioners
- Perform storage cask lid installation and removal operations
- Assist radiological surveys and decontamination operations
- Remove or install canister lifting devices and pintles
- Assist in removal and installation of lifting slings.

4.2.1.5.2 Major Components

The major components of this system include the following.

- Retractable platforms for accessing tops of casks
- Robotic arms (stationary mounted)
- Robot operating consoles for remote operation
- Robot end-effector manipulated tools such as wrenches, swipe pads and clamping jaws
- Automated support, alignment, and bolt and stud tensioner devices for removing and installing storage cask lids
- Miscellaneous shielding (stationary and movable)
- Miscellaneous hand and long-handled tools
- Cameras for observing storage preparation activities
- CCTV monitors and equipment.

4.2.1.5.3 Design Description

Retractable working platforms are provided around the tops of the storage casks, and are similar to those described for the transfer preparation system. Shielding is integral with the platforms; movable shielding is also provided. Retractable platforms mate to walkways along the sides of the canister transfer room walls for ease of worker access.

Stationary-mounted robotic arms are provided for activities on both the Westinghouse and TranStor™ storage casks. The robotic arms are similar to those described in the transfer preparation system. Cameras are provided to aid operators in remotely operating the robots, using control consoles and CCTV monitors located in the shielded remote console rooms at one end of the canister transfer room.

As part of the automated operations for ALARA radiation dose minimization, automated bolt tensioner devices are provided for aligning, removing, retaining and installing storage cask lids and their associated bolts. These automated devices are very similar to those described for transportation cask lids in the transfer preparation system.

4.2.1.5.4 Safety Considerations

Platforms, robotic equipment, automated bolt/stud tensioners, monitoring equipment and other SSCs in the storage mode preparation system are classified as QA 5. SSCs classified as QA 5 are designed to protect against potential interactions with QA 1 SSCs. Supports for QA 5 SSCs are designed to accommodate the design earthquake and other loadings, ensuring that these SSCs cannot fail and impact nearby QA 1 SSCs such as the storage and transfer casks. Structural design of supports for QA 5 SSCs is described in Chapter 7.

SSCs in the storage mode preparation system are also classified as QA 7, because they are located in radiation areas. Design of these SSCs minimizes potential for radiological exposure of personnel operating and maintaining this equipment.

Equipment used to verify SNF cask and canister identity and condition is classified as QA 6. This equipment is subject to special design considerations because of its relation to special nuclear material accountability.

Materials used for bolting or welding lids on storage casks are classified as QA 1.

4.2.2 Storage Area

Storage area systems and operations are described in this section. The main function of the storage area is to provide storage space for SNF received at the CISF. The storage area is designed for the transfer, storage and retrieval of commercial SNF in NRC-approved, dual-purpose cask or canister systems. The storage area is constructed in stages, as needed, to support CISF operational throughput requirements, and is contained within the double fence of the controlled access area. (See Figures 4.1-1 and 4.1-3.) Storage area systems and components are QA 7 because of the potential for radiological exposure of personnel working in the area.

The number of individual vertical concrete casks, TSCs, or HSMs that will be placed in the storage area depends on a number of variables. The relative mix of different kinds of transportation and storage systems deployed in the CRWMS, as well as the type (PWR or BWR) and design of SNF assemblies contained in these systems, will affect the number of canisters required to accommodate 40,000 MTU.

Using the projected number of cask deliveries during the first years of CISF operation, it is estimated that between 5,300 and 7,800 canisters will be required to store 40,000 metric tons of uranium (MTU). Based on the receipt rate capability presented in Chapter 3, it is also estimated that the time required to receive and store a total of 40,000 MTU is approximately 15 years.

The non-site-specific storage area is designed to provide space for 6,000 canisters stored in 5,600 vertical casks and 400 horizontal storage modules. Figure 4.1-1 shows the storage area configuration. Modular reinforced concrete pads are provided within the controlled access area fence of the storage area to support casks and storage modules.

To provide the storage function for SNF, the storage area includes the following systems.

- Concrete pad structures
- Cask storage systems
- Cask transporter systems
- Other support and auxiliary systems.

These storage area systems are described in the following sections.

4.2.2.1 Concrete Pad Structures

Concrete pads are provided throughout the storage area to support concrete storage casks, TSCs and HSMs.

4.2.2.1.1 Operating Function

The concrete pads are cast-in-place modular, reinforced concrete structures. These pads are arranged to efficiently store the large number of storage casks anticipated for the CISF and to allow access to each storage mode with the site transporters provided for carrying each vendor design. Each pad is designed to support the weight of the loaded storage casks and to support the loaded transporters and towed trailers during storage operations.

4.2.2.1.2 Major Components

Two sizes of modular concrete pads are required for storage. One size supports storage of vertical concrete casks and TSCs, and the other supports storage of HSMs.

4.2.2.1.3 Design Description

The tops of the concrete pads are at grade level to aid in maneuvering the loaded storage cask transporters onto and off of the pads. This profile also provides a gentle slope to facilitate drainage of rain water. The concrete pads are constructed of three-foot thick reinforced concrete and designed to support the storage units. Pad spacing facilitates easy access to the casks by maneuvering the transporter equipment in the storage area. The design of the concrete pads is described in Chapter 7.

Each concrete pad that supports the vertical casks, such as the TranStor™, the NAC STC, the HI-STAR 100 and the Westinghouse systems, is approximately 60 feet wide by 80 feet long. These pad modules are arranged in rows, spaced 50 feet apart to allow maneuverability of the transporters during storage operations. Each pad can support up to eight vertical concrete casks (Westinghouse or TranStor™ designs), eight TSCs (HI-STAR 100 or NAC STC designs), or any combination of casks for a total of eight. Casks are placed vertically on the pads 20 feet apart, center-to-center in double rows. Multiple concrete pad modules can be joined at the ends by concrete expansion joints to form rows. Refer to Figure 4.1-3 for an illustration of pad module configuration.

Each concrete pad supporting an HSM is approximately 39.6 feet wide (maximum for BWR canisters) and 101 to 104 feet long. In front of each HSM entrance are two 20-foot-wide approach aprons, 18 inches and eight inches thick, respectively. The pads are spaced so that there are least 100 feet between the HSM entrance and the facing cask, to allow maneuverability of the transfer trailer and hydraulic ram system during storage operations. Each concrete pad can contain up to a total of 20 NUHOMS® HSMs set back-to-back. There is a six-inch air gap between each HSM on the pad, and a two-foot thick concrete shield wall on each end HSM outer side wall. Multiple HSM concrete pad modules can be joined at the ends by concrete expansion joints to form rows. Refer to Figure 4.1-3 for an illustration of the HSM pad module configuration.

4.2.2.1.4 Safety Considerations

The concrete pad structures are QA 5. The pads are designed to accommodate a design-basis earthquake and other loadings and remain functional. This ensures that the pads will not fail and impact nearby QA 1 SSCs, such as the storage casks or modules. Structural design of the storage pads is described in Chapter 7.

4.2.2.2 Cask Storage Systems

Six storage vendor cask systems were evaluated for storage in the CISF storage area. These cask systems contain SNF in sealed canisters or individual SNF assemblies in casks with dual-sealed lids. Each vendor system is designed to safely store SNF until it is retrieved for off-site shipment.

4.2.2.2.1 Operating Function

The overall function of the cask systems used at the CISF is to safely provide interim storage of SNF. These cask systems provide a convenient means to place set quantities of SNF into dry storage in a way that allows easy retrieval of the SNF for off-site shipment.

Sealed canisters containing SNF assemblies are designed for storage in accordance with 10 CFR 72, and for transportation in accordance with 10 CFR 71. The main function of sealed SNF canisters is to accommodate SNF assemblies (both BWR and PWR), and provide containment and criticality control during normal operation and postulated design-basis accident conditions for on-site storage.

Storage casks are designed in accordance with 10 CFR 72, and provide vertical or horizontal on-site storage of the sealed SNF canisters. The storage modes are vertical concrete cask or horizontal concrete module designs. The main function of the storage casks is to provide safe, long-term storage of many types of SNF assemblies contained inside sealed canisters.

The storage cask designs function to passively cool the SNF canisters by air convection. The storage casks also provide the capability for canister transfer from their associated transportation casks.

TSCs are designed for storage in accordance with 10 CFR 72, and for transportation in accordance with 10 CFR 71. They are placed directly into storage upon receipt and preparation at the CISF. The TSCs are vertical metal cask designs whose main function is to provide safe, long-term storage of many types of spent fuel assemblies contained inside sealed canisters or open bare-fuel baskets. The TSC's webbed-fin cask design passively cools the SNF contained inside.

4.2.2.2.2 Major Components

The vendor cask systems currently considered for use at the CISF are:

- Holtec International - HI-STAR 100 System
- Nuclear Assurance Corporation (NAC) STC System
- VECTRA NUHOMS® - MP187/HSM System
- Westinghouse Large/Small MPC System
- Sierra Nuclear Corporation (SNC) - TranStor™ System.

4.2.2.2.3 Design Description

All of the cask storage systems provide passive cooling during interim storage. They vary in storage characteristics with respect to monitoring, radiation protection, instrumentation, surveillance and maintenance requirements.

Contamination and direct radiation of the cask systems is limited by requiring surveys and decontamination as needed prior to a cask leaving the transfer facility. The cask systems require monitoring of air outlet temperatures. In addition, the NAC STC System requires inner-lid seal pressure monitoring. The cask systems have the capability for continuous monitoring to determine the need for corrective action to maintain safe storage conditions. Refer to Section 4.5 and Chapter 14 for identification of the requirements and descriptions of in-storage surveillance and monitoring.

Table 4.2-1 summarizes key cask storage system parameters, which are taken from the vendor system SAR references.

Table 4.2-1 - CISF Storage Modes

Parameter	HI-STAR	NAC STC	TranStor™	HSM	W-S/MPC	W-L/MPC
Storage mode contents	MPC	Bare-fuel basket	DPC	DPC	MPC	MPC
Storage mode type	Cylindrical metal cask	Cylindrical metal cask	Cylindrical conc. cask	Concrete module	Cylindrical conc. cask	Cylindrical conc. cask
Construction	Multiwall - metal	Multiwall - metal	Cast concrete	Modular concrete	Modular concrete	Modular concrete
Storage orientation	Vertical	Vertical	Vertical	Horizontal	Vertical	Vertical
Lateral dimensions (feet)	8.0 Diameter	8.3 Diameter	11.3 Diameter	19.8 / 9.7 L / W	12.2 Diameter	13.6 Diameter
Height (feet)	16.9	16.1	17.7	15	20.5	20.5
Max. weight (loaded) (lbs)	Not known[1]	232,950	290,000	305,680	340,000	390,000
Max. weight (unloaded) (lbs)	Not known[1]	193,300	213,620	236,000	259,800	306,110
Heat removal (watts)	36,480	22,100	26,000	24,000	13,440	23,500
Storage surveillance/monitoring requirement	Visual	Visual & pressure	Visual & temp.	Visual & temp.	Visual & temp.	Visual & temp.

The following sections provide descriptions of each of the vendor cask storage systems and a description of storage cask spacing configurations.

4.2.2.2.3.1 Holtec HI-STAR 100 System (Ref. 4.2-6)

An MPC is shipped to the CISF inside a HI-STAR 100 transportation cask from the Holtec International - HI-STAR 100 System. The HI-STAR 100 is a metal, cylindrical multi-wall cask that contains a sealed canister. The cask is designed for both transportation and storage. No transfer activities are required at the CISF before the HI-STAR 100 is placed into storage. The storage cask orientation is vertical. The cask has a maximum diameter of approximately eight feet and an overall height of approximately 17 feet. Its shielding material is primarily carbon steel, along with Holtite-N neutron shielding material within its radial cavities. Its

[1]Holtec HI-STAR maximum weights are proprietary information. Weights are assumed to be comparable to those of the NAC STC and less than the bounding weights of the Westinghouse Large MPC.

total weight containing a loaded canister is proprietary, but is assumed to be less than the Westinghouse Large MPC bounding weight. Cask closure features consist of one bolted lid with two metallic o-ring seals. The cask is lifted by using four lifting trunnions located at 90° on top of the cask and by using two rotating trunnions located at 180° on the bottom of the cask. Heat dissipation from the SNF is passive, due to a webbed-fin design. The HI-STAR 100 is designed to remove up to approximately 36,480 watts of decay heat while in storage.

4.2.2.2.3.2 NAC STC System (Ref. 4.2-7)

Individual SNF assemblies are shipped to the CISF inside an NAC STC transportable storage cask from the NAC STC System. The NAC STC is a metal, cylindrical multi-wall cask that contains a bare-fuel basket (no sealed canister). The cask is designed for both transportation and storage; therefore, it requires no bare-fuel transfer at the CISF prior to placement into storage. The cask storage orientation is vertical. The cask has a maximum diameter of approximately eight feet and an overall height of approximately 16 feet. Its shielding material is primarily stainless steel, along with secondary chemical lead inner gamma and BISCO (NS4FR) outer neutron shielding material. Its total weight containing a loaded canister is approximately 233,000 pounds, or 193,300 pounds when empty. Cask closure features consist of two redundant bolted lids with three metallic o-ring seals. The cask is lifted by using two top and two bottom lifting trunnions. Heat dissipation from the SNF is passive, due to a webbed-fin design. The NAC STC is capable of removing up to approximately 22,100 watts of decay heat while in storage.

4.2.2.2.3.3 VECTRA NUHOMS® MP187/HSM System (Ref. 4.2-8 and 4.2-9)

A DPC is shipped to the CISF inside a MP187 transportation/storage cask from the VECTRA NUHOMS® MP187/HSM System. The MP187 is a metal, cylindrical multi-wall transportation cask that contains a dry shielded canister (DSC). The cask is designed for both transportation and storage, and it operates as a transfer cask at the CISF. The MP187 cask is required only for horizontal canister transfer to an HSM and is not used for storage at the CISF. The MP187 has a maximum diameter of 7.6 feet and an overall height of 16.8 feet. Its shielding material is primarily carbon and stainless steel, along with lead and hydrogenous material. Its total weight containing a loaded canister is approximately 177,800 pounds, 109,470 pounds when empty. Cask closure features consist of one bolted lid with two metallic o-ring seals. The cask is lifted and supported during transfer operations using two top and two bottom trunnions. Heat dissipation from the SNF is passive, using an inerted annulus region. The MP187 transportation/storage cask can remove up to approximately 16,300 watts of decay heat if used for storage.

The DPC received inside the MP187 cask is stored inside an HSM for the VECTRA NUHOMS® System. The HSM is a reinforced concrete storage module sized to store either a PWR DPC or a BWR DPC. The HSM, of modular concrete construction, is installed at its designated location in the storage area on the concrete pad provided. The HSM design is for storage only and, unlike the storage casks and TSCs, the HSMs cannot be moved once they are installed. The HSM operation requires an in-place canister transfer from the MP187 transportation/transfer cask in order to place a canister into storage. The storage orientation of the canister inside the HSM is horizontal. The HSM is 19.8 feet long (maximum for BWR canister) by 9.7 feet wide, with an overall height of 15 feet. Its shielding material is primarily reinforced concrete. The HSM's maximum total weight containing a loaded BWR canister is approximately 305,680 pounds, 236,000 pounds when empty. HSM closure features include one welded access door. Heat dissipation from the SNF is passive via air inlet and outlet vents, which can remove up to approximately 24,000 watts of decay heat.

4.2.2.2.3.4 Westinghouse Large/Small MPC System (Ref. 4.2-1 and 4.2-10)

MPCs are shipped to the CISF inside either a large or a small Westinghouse transportation cask from the Westinghouse Large/Small MPC System. The Westinghouse storage cask is a reinforced, cylindrical concrete cask that contains an MPC. The storage cask is designed to store both large and small MPCs, and requires canister transfer from the Westinghouse transportation cask in the transfer facility prior to placement into storage. The cask storage orientation is vertical in the storage area. The large cask design has a maximum diameter of approximately 13.5 feet and an overall height of approximately 20.5 feet to accommodate the large MPC. The small cask design has a maximum diameter of approximately 12 feet and an overall height of approximately 20.5 feet to accommodate the small MPC. Its shielding material is primarily reinforced concrete. Its total weight containing a loaded large MPC is 390,000 pounds, or 306,110 pounds when empty. Its total weight containing a loaded small MPC is 340,000 pounds, or 259,800 pounds when empty. Cask closure features consist of one bolted metal lid on top and one bolted lid on bottom, with no seals. The casks are lifted using 16 top lid inserts and a base notch. Heat dissipation from the SNF is passive, using inlet and outlet air vents. The large Westinghouse cask is designed to remove up to approximately 18,400 watts of decay heat from the large MPC while in storage.

4.2.2.2.3.5 Sierra TranStor™ System (Ref. 4.2-11)

A DPC is shipped to the CISF inside a TranStor™ transportation cask from the Sierra TranStor™ System. The TranStor™ storage cask is a reinforced, cylindrical concrete cask that contains a welded dual-purpose canister. The concrete cask is designed for storage. Prior to its placement into storage, it requires a canister transfer from the TranStor™ transportation cask while inside the transfer facility. The storage cask orientation in the storage area is vertical. The cask has a maximum diameter of approximately 11.3 feet and an overall height of approximately 17.7 feet. Its shielding material is primarily reinforced concrete. Its total weight containing a loaded canister is 290,000 pounds or 213,602 pounds when empty. Cask closure features consist of one bolted metal lid; lid seals are not required. The cask is lifted by using two bottom steel channels, which also serve as its air inlets while in storage. Heat dissipation from the SNF is passive, using inlet and outlet air vents. The TranStor™ storage cask is designed to remove up to 26,000 watts of decay heat while in storage.

4.2.2.2.3.6 Storage Cask Spacing Configuration

The proposed cask spacing for placement of the Holtec HI-STAR, Sierra TranStor™, NAC STC, and Westinghouse Large/Small MPC Systems is 20 feet center-to-center. This spacing was obtained by assessing minimum spacing requirements contained from the vendor SARs.

4.2.2.2.4 Safety Considerations

Safety considerations for each of the vendor cask storage systems are provided in the vendor SARs. (Refer to Table 3.1-1).

4.2.2.3 Cask Transporter Systems

Cask transporters are provided for each vendor cask system to carry casks to their respective storage locations in the storage area.

4.2.2.3.1 Operating Function

Cask transporter systems are designed to transport storage and transportation casks between the transfer facility and the storage area. Some cask transporter systems also provide canister transfer mating capabilities in the storage area. The cask transporters carry individual casks to the storage area and place them in their storage locations in a manner that allows retrieval of each individual cask on a selective basis without disturbing adjacent casks.

4.2.2.3.2 Major Components

Cask transporter equipment is purchased from vendors to interface with the lifting and transport features of their particular transfer and storage designs. The number and designs required will match the SNF throughput requirements and the particular lifting features of each of the vendor cask designs.

4.2.2.3.3 Design Description

Cask transporters are designed with appropriate radiological shielding and systems for measuring direct radiation levels in and around the transporter during operation. This ensures the radiation dose to cask transporter operator is kept ALARA and is properly monitored.

Cask transporter designs are based on commercially available heavy lift and haul transporters. They are equipped for 24-hour all-weather operation. Cask restraint systems are mounted within the transporter frames to secure the lifted casks in position during transport operations. The transporter turning radii are consistent with the space available within the storage area subsystem. The hydraulic systems on each of the cask transporters are self-contained.

4.2.2.3.3.1 Vertical Cask Transporters

Several cask transporter designs are required to interface with the vertical concrete casks and the metal TSCs. These cask systems are handled and transported in the vertical position. The transporters are either of self-propelled (track or wheels) straddle type, or of a type that is towed by a site tractor. The transporters straddle, vertically lift, restrain, transport, and place the casks onto their concrete pad locations in the storage area.

Cask transporters are described for each of the specific vendor cask designs in the following paragraphs.

TSC Transporter - A transporter is available from the vendor for transporting the NAC STC and the HI-STAR 100 casks by engaging the top lifting trunnions of the casks. The transporter is self-propelled, wheel or track type. It is functionally designed to straddle the cask, engage the top trunnions with a lifting boom, hydraulically lift the cask, secure the cask for movement, transport the TSC to the storage area, and position and hydraulically lower the TSC onto the concrete pad for storage.

TranStor™ Concrete Cask Transporter - A transporter is available from the vendor for transporting the TranStor™ concrete cask by engaging lifting beams that have been inserted into the bottom air channels of the concrete cask. This transporter is a self-propelled, wheel or track type transporter. It is functionally designed to straddle the cask, engage the lifting beams with a transporter lifting boom, hydraulically lift the cask from the bottom, secure the cask for movement, transport the cask to the storage area, and position and hydraulically lower the cask onto the pad for storage.

Westinghouse Concrete Cask Transporter - A transporter is available from the vendor for transporting the Westinghouse concrete cask by engaging the bottom of the concrete cask. The transporter is a modified version of the Westinghouse system's upender/downender. It is modified to roll on wheels, and it is adapted to be towed by a site tractor. It is functionally designed to straddle the cask, engage the bottom of the concrete cask, hydraulically lift the cask, secure the cask for movement, transport the cask to the storage area, and position and hydraulically lower the cask onto the pad for storage. The transporter design is based on the current upender/downender design by Westinghouse.

4.2.2.3.3.2 Horizontal Cask Transporters

Horizontal storage modules of the VECTRA NUHOMS® System design are constructed in place in the storage area. The MP187 transportation casks are taken directly to the storage area for canister transfers. Cask handling equipment for this system is unique and includes a transport trailer, which is pulled by a site tractor, and a hydraulic ram system for transferring canisters into the HSMs.

A special transfer trailer is available from the vendor for horizontally transporting the NUHOMS® MP187 transportation cask. This transfer trailer cradles the top and bottom lifting trunnions of the cask, and is designed to be towed by a site tractor. The transfer trailer is also used in the storage area to support canister transfer from an MP187 transportation cask to an HSM. It features a transfer skid, a skid positioner, a hydraulic ram system and hydraulic jacks for stabilization. The system utilizes a self-contained hydraulic ram to hydraulically push the canister out of the MP187 transportation cask and into the HSM. The alignment of the MP187 and the HSM is verified by an alignment system of CISF design.

4.2.2.3.4 Safety Considerations

Cask transporter system equipment is classified as QA 1 because the equipment must be designed to safely lift, support and carry QA 1 casks to the storage area. This equipment is also classified as QA 7 because the site transporters travel in areas that subject operators to radiological exposure.

4.3 POOL AND POOL FACILITY

The design of the CISF does not include a pool or pool facility.

4.4 OTHER OPERATING SYSTEMS

This section describes the equipment and general operations of the following CISF auxiliary systems.

- Heating, ventilation and air conditioning systems
- Electrical power distribution systems
- Compressed air supply systems
- Water supply systems
- Wastewater water systems
- Communication and alarm systems
- Fire protection systems
- Maintenance systems
- Cold chemical systems
- Radiation monitoring systems
- Cask decontamination system
- Transporter wash-down system.

4.4.1 Heating, Ventilation and Air Conditioning (HVAC) Systems

This section describes HVAC systems for the transfer facility, the security complex, site gatehouses, the fire protection pump building and the switchgear building.

4.4.1.1 Transfer Facility HVAC System

The transfer facility HVAC system is designed to provide for personal comfort, personnel safety protection, and equipment functional protection throughout the transfer facility. Air exhausted from the transfer facility is monitored for radiation. High-Efficiency Particulate Air (HEPA) filters are provided for ALARA purposes only. The areas served by the transfer facility HVAC system are the shipping/receiving area, the canister transfer area and the site transporter area. The HVAC system is supplied by the primary power system on site.

4.4.1.1.1 Functional Description

The transfer facility HVAC system is designed such that all effluents are released via a common exhaust, which is monitored for radionuclide release. With respect to radiological considerations, the HVAC system minimizes in-leakage of air in order to minimize exhaust flow rates. To assure air effluent control, a slight negative pressure is maintained in the transfer facility by providing an exhaust air flow rate greater than the supply air flow rate. In this way, all leakage is into the transfer facility building. Exterior roll-up doors are closed whenever possible to prevent bypass flow and release of air to the environment other than through the monitored discharge.

The transfer facility HVAC system is designed for smoke control in the event of a fire. In order to mitigate the spread of particles of combustion, an interlock from the smoke detection system deactivates the supply air fans. The exhaust air fan continues to operate to purge the smoke from the transfer facility.

A separate HVAC system provides environmental and climate control for the transfer facility personnel building to maintain personnel comfort conditions. The maintenance support areas and mechanical equipment rooms are provided with adequate ventilation, cooling, and heating for equipment protection and worker safety. A packaged air conditioning unit, ductwork, dampers, piping, valves and controls are provided to ensure a reliable HVAC source for the transfer facility personnel building. The personnel building will be maintained at a slightly positive pressure with respect to the transfer facility in order to prevent the potential migration of radiological contamination.

4.4.1.1.2 Design Requirements

The HVAC design requirements for the transfer facility are as follows.

- Ambient Conditions
  - Temperature: -40 to 125°F
  - Solar Heat Load: 2949.4 Btu/day-ft^2 on horizontal flat surfaces

    1474.7 Btu/day-ft^2 on curved surfaces
  - Humidity: 100%
- Normal Operating Conditions
  - Summer: 78°F db, 50% RH
  - Winter: 55°F db.

The minimum temperature setpoint of 50°F is maintained for protection of personnel and equipment.

The HVAC supply system filters and conditions outside air prior to entering the transfer facility to minimize dust and control environmental conditions within the facility. Figure 4.4-1 shows the transfer facility HVAC supply system.

The HVAC exhaust system design includes in-line HEPA filters and a damper for bypass operation. The normal operation of the system will be in the bypass mode, bypassing the HEPA filters. Prior to exhaust, the transfer facility vent air effluent is monitored on a continuous basis. If the discharge monitor detects a predetermined level of activity, the system damper will automatically direct the exhaust air through the in-line HEPA filters prior to discharge to the exhaust vent. Manual control of the bypass damper is also provided. In order to minimize the size of the HVAC system, the air flow rates within the transfer facility are maintained as low as possible while providing sufficient air supply to occupants. The supply air and exhaust air flow rates are controlled so that the transfer facility is maintained at a slightly negative pressure with respect to the atmosphere and the personnel building. Figure 4.4-2 shows the transfer facility HVAC exhaust system.

4.4.1.1.3 Major Components

The HVAC supply air system consists of a supply air fan, air handling unit (AHU), hot water system, chilled water system, ductwork, filtration, dampers, registers, valves, controls, and other components necessary to provide a reliable HVAC source and acceptable indoor air quality. The ventilation exhaust system consists of an exhaust fan, ductwork, filtration, dampers, registers, valves, controls, and an exhaust vent to effectively remove noxious odors, hazardous gases, dust, or excessive heat and to provide fresh air to occupants. The transfer facility HVAC equipment is located in the two rooms designated as HVAC area in Figure 4.1-8. These two areas are located between columns 2 and 4.

4.4.1.1.4 Operational Description

The primary functions of the HVAC system are to maintain building pressure and climate conditions based on design setpoints. The transfer facility pressure is controlled by the coordinated operation between the supply air fan and the exhaust air fan. The exhaust air fan and supply air fan are initially started with the corresponding control dampers in the open position. These control dampers modulate on a signal from the static pressure transmitter to maintain the transfer facility at the static pressure setpoint. The ventilation system reacts to changes in the infiltration of air into the transfer facility by adjusting the variable speed drive on the fans and modulating the control dampers in order to maintain the negative pressure setpoint of the transfer facility with respect to atmosphere. A high-velocity air curtain at the roll-up doors will initiate upon opening of the roll-up doors to minimize the entrance of dust and insects and to minimize unfiltered air release from the building to the environment.

The temperature in the transfer facility is controlled by a temperature sensor. When cooling is required, the control unit starts the refrigeration unit to provide refrigerant to the direct expansion coil in the AHU. Heating requirements are provided by a hot water system serving a heating coil located in the AHU.

4.4.1.1.5 HVAC Controls

Fan status indication is provided locally and remotely to permit verification of fan operation. Failure of a running fan is alarmed. Indication of damper positions/alignment is provided remotely. Indication of pressure drop across filters (supply filters and HEPA filters) is provided locally at the filter train. High and low temperature alarms for the transfer facility are provided.

4.4.1.1.6 HVAC Interface with Other Systems

CISF ventilation systems are engineered for smoke control and exhaust capability to mitigate the spread of particles of combustion. The systems have the capability of filtering particulate after suppression of a fire in areas where the potential for the presence of radioactive material exists. Ductwork, accessories, and support systems are designed and tested in accordance with NFPA 101 (Ref. 4.4-1) and NFPA 90A (Ref. 4.4-2), including specification and installation of smoke and fire dampers at wall penetrations and smoke pressurization/containment dampers as required for smoke pressurization/evacuation systems.

The HVAC system also interfaces with the transfer facility radiation monitoring systems, as discussed in Section 4.4.1.1.2.

4.4.1.1.7 Safety Considerations

As necessary, the HVAC system design for the CISF includes automatic fire dampers to impede the spread of fire from one zone to another, includes provisions to automatically protect filters from exposure to fires, and provides the capability to filter building exhausts and remove smoke after suppression of a fire. Fire dampers are not used on exhaust system ducting if it is required to maintain confinement of hazardous airborne particulate during and after a fire event. The transfer facility HVAC system is classified as QA 5 and QA 7.

4.4.1.2 Security Complex HVAC System

The security complex HVAC system provides environmental and climate control for the personnel support areas. This system is classified as conventional quality and is equipped with fans, ductwork dampers, piping, valves, and instrumentation and control. The system is also designed to include automatic fire dampers to impede the spread of fire from one zone to another, provisions to automatically protect filters from exposure to fires, and the capability to filter building exhausts and remove smoke after suppression of a fire.

Upon detection of a fire in areas protected by inert gas systems (i.e., control room), the ventilation flow to those areas is shut down. Ventilation equipment for all other areas continues to operate in the event of a fire.

4.4.1.3 Gatehouse HVAC Systems

For the receiving gatehouse, the inspection gatehouse and the main gatehouse, a self-contained window or rooftop HVAC system provides environmental and climate control for personnel support areas. This system is classified as conventional quality.

4.4.1.4 Fire Protection Pump Building and Switchgear Building HVAC Systems

Heating and ventilation for the fire protection pump building and the switchgear building are provided by electric wall heaters and roof fans, both of which are thermostatically controlled. This system is classified as conventional quality.

4.4.2 Electrical System

The CISF electrical system supplies power to the transfer facility, security complex and other CISF support facilities. The supply and installation of equipment is in accordance with NFPA 70, National Electrical Code (Ref. 4.4-3) and ANSI C2, National Electrical Safety Code (Ref. 4.4-4).

4.4.2.1 Site Electrical Power Distribution System

The site electrical power distribution system consist of all systems, structures and components required to deliver electric power from the point of connection to the electric utility serving the CISF to the service entrance equipment for each of the CISF facilities. Figure 4.4-4 shows a cross-sectional view of the CISF switchyard and site electric power delivery system.

4.4.2.1.1 Major Components and Operating Characteristics

The major components of this system are as follows.

- Transmission line
- Circuit breaker and disconnect switches
- Main transformer
- Power delivery switchgear
- Power distribution components, including cable, cable tray, conduit and duct banks
- Building service transformers
- Site grounding system.

4.4.2.1.1.1 Transmission Line

Power is transmitted to the CISF through a single transmission line from a host utility. This line enters the CISF at a connection point in the CISF switchyard and connects to the CISF main transformer through a power circuit breaker. The transmission line terminates on a structural steel tower in the CISF switchyard.

The switchyard contains both structural steel and concrete. Structural steel is used as the material for the strain structure, disconnect switch mounts, breaker switch mounts, and any other equipment mounts. Spread footings are used to support the strain structure and other equipment.

4.4.2.1.1.2 Circuit Breaker, Disconnect Switches and Bypass Switch

The high voltage switchyard breaker provides electrical protection and isolation for the main transformer. The breaker is rated to provide circuit interruption in case of an electrical fault. The breaker is provided with two disconnect switches, one on either side for providing electrical isolation which allows for replacement or maintenance. A bypass switch around the breaker is provided for use when the breaker is isolated for maintenance. This switch is interlocked with the breaker disconnect switches such that it cannot be closed unless the isolation switches are open.

4.4.2.1.1.3 Main Transformer

The main transformer is rated to provide the load requirements of the entire CISF with a margin for expansion. The transformer has on-load tap changing and is filled with a non-hydrocarbon-based insulating oil.

4.4.2.1.1.4 Power Delivery Switchgear

One 4.16 kV switchgear group is installed inside the switchgear building in the switchyard. It is fed by cable through an incoming main breaker located in the switchgear. The switchgear is sized to serve future loads as described above for the main transformer. The switchgear bus is copper and the breakers are vacuum type. The switchgear building houses the switchgear, the associated equipment, and a local control panel for control of the switchyard breakers and transformer fans. This equipment is designed to be accessible for installation, removal or maintenance. Figure 4.4-3 provides an electrical one-line diagram for the CISF distribution system.

4.4.2.1.1.5 Power Distribution Cable

Power is distributed to secondary substations throughout the CISF by 8 kV cable of appropriate ampacity. This cable is routed in cable trays which are mounted in cable trenches and terminates in secondary substation transformers. The cable penetrates the controlled access area through concrete-encased conduit banks in order to meet applicable security requirements. Conduit banks are also provided under roads and railroad tracks. Power is distributed from the secondary substations to the facility electrical distribution equipment (motor control center, distribution panel, etc.) by cable routed in concrete-encased conduit banks.

4.4.2.1.1.6 Building Service Transformers

The electrical distribution to the various building and outside electrical loads for the CISF is shown in the electrical one line drawing (Figure 4.4-3). The distribution service is 4160 volts and feeds the building service transformers in a loop configuration. In this design an electrical problem with one of the building service transformers or a cable section failure does not disable the rest of the distribution service. As shown in Figure 4.4-3, any cable section or building service transformer can be isolated thereby allowing the rest of the electrical distribution to be in service. Each of the building service transformers are pad mounted dry type. They are compartmental type, self cooled, tamper proof and weatherproof for mounting on a concrete pad. The average temperature rise of the windings is 65°C when the transformer is operated at rated kVA output in a 40°C ambient. These pad-mounted transformer(s) are capable of being operated in a 30°C average, 40°C maximum ambient, at a load as defined in ANSI/IEEE C57.12.00 (Ref. 4.4-5), without loss of service life expectancy. The high voltage and low voltage compartments are located side-by-side-by-side separated by a steel barrier. The medium voltage terminations and equipment are dead front and conform to ANSI C57.12.22 requirements. The terminations and equipment are arranged for loop feed, dead front with drawout-load current limiting fuses and load break oil rotary switching. The low voltage bushings are epoxy and provided with blade-type spade terminals, with NEMA standard hole spacing arranged for vertical take-off. The low voltage side is provided with a secondary main breaker for isolation of electrical power to the building for fire protection purposes. Two, 2 1/2% no load taps are provided above and below nominal.

4.4.2.1.1.7 Grounding and Lightning Protection

A grid is provided under the CISF facility buildings, as appropriate for the site soil resistivity, to meet the grounding requirements of National Fire Protection Association (NFPA) 70 (Ref. 4.4-3), ANSI C2 (Ref. 4.4-4), and IEEE 142, IEEE Recommended Practices for Grounding Industrial and Commercial Power Systems (Ref. 4.4-6). The building ground systems are interconnected to each other, as well as to the switchyard substation ground. All major electrical equipment, including the power panel boards, lighting panel boards, and motors, are connected to the building ground. All building steel is grounded to meet the requirements of the above referenced standards. A separate instrument ground is provided for the control system equipment, which is tied to the building ground mat. To prevent damage resulting from a lightning event, all CISF SSCs will be designed in accordance with NFPA 780, Standard for Lightning Protection Code (Ref. 4.4-7).

4.4.2.1.2 Safety Considerations and Controls

The site electrical power distribution system is classified as conventional quality and does not contain any important to safety electrical loads.

4.4.2.2 Facility Electrical Systems

4.4.2.2.1 Major Components and Operating Characteristics

4.4.2.2.1.1 Backup Power Sources

Backup power is provided for the following systems: (1) communication system, (2) building fire detection system, (3) security monitoring and alarm system, (4) site security lights, (5) fire protection system, and (6) cask monitoring system.

The communication and security systems each have a dedicated UPS system sized for 24 hours service, supplied by the security systems diesel generator on loss of normal power. The security lighting system is backed up by the security diesel generator on loss of normal power.

The building fire detection system has a dedicated UPS sized for 24 hours service. The fire protection system has a diesel-driven backup pump in case normal electrical power is lost.

The storage cask monitoring system located in the transfer facility personnel building is backed up by a UPS upon loss of off-site power to prevent loss of computer data and provide time for an orderly shutdown of the computer monitoring system. Selected light fixtures and exit light fixtures in the CISF facilities are supplied with a battery pack that provides emergency power for 90 minutes upon the loss of off-site power.

Upon loss of off-site power, the local utility will be contacted to determine the expected duration of the lost service. If the expected loss of service exceeds 24 hours, a portable diesel from an off-site contractor will be brought in and connected to the 5 kV electrical switchgear located in the switchgear building.

4.4.2.2.1.2 Lighting

Interior lighting for office areas consists of commercial-type fluorescent luminaries with high power factor, energy efficient ballasts. High intensity discharge (HID) luminaries are used in high bay areas. Selected light fixtures are supplied with a battery pack that provides emergency power for 90 minutes. Exit light fixtures comply with applicable Underwriters' Laboratories (UL) and NFPA requirements. Lighting for individual rooms is controlled by local switches and by automatic switches as part of an energy conservation program. Lighting in larger areas is controlled by circuit breakers in area lighting panel boards.

4.4.2.2.1.3 Motors

The voltage rating of motors is 4160 V, 3 phase for motors rated above 250 hp; 460 V, 3 phase for motors rated ½ hp through 250 hp; and 115 V, 1 phase for those rated ½ hp or less. The motors have a service factor of 1.15 and class F insulation as a minimum. The continuous duty rating is based on an ambient temperature of 40°C. The use of energy-efficient motors is evaluated for all applications. Motor enclosures are open drip-proof or totally enclosed fan-cooled (TEFC), as conditions require. Motor power factor is .85 minimum, which is corrected to .90, using power factor correcting capacitors. This correction takes place at the motor terminals.

4.4.2.2.1.4 480 Volt Load Centers

The 480 V load centers are low-voltage, metal-enclosed switchgear manufactured in accordance with applicable NEMA, ANSI, and UL standards. The voltage rating is 600 V alternating current (AC) nominal. The main bus is copper. Drawout circuit breakers are used.

4.4.2.2.1.5 Motor Control Centers

Motor control centers are rated 600 VAC maximum, 3 phase, and consist of one or more enclosed vertical sections. They meet the latest UL, NEMA and NEC standards. The bus is silver-plated copper. Across-the-line magnetic starters are provided in accordance with NEMA standards.

4.4.2.2.1.6 Lighting Panel Boards

Lighting panel boards are rated at 208/120 VAC or 480/277 VAC, 3 phase. They are designed in accordance with NEMA PB-1, Panel Boards (Ref. 4.4-8), UL 67, Underwriters Laboratory Standard for Safety Panel Boards (Ref. 4.4-9), and other applicable UL standards. Copper bus is used. Wiring gutters are sized in compliance with NEC requirements, and terminals are UL listed. Boxes are code-grade galvanized steel with doors and flush locks. Thermal magnetic, molded-case circuit breakers have ON, OFF and TRIPPED positions.

4.4.2.2.1.7 Dry Type Transformers

Low voltage dry type distribution transformers are used for power distribution inside the facility for lighting and general service requirements. These transformers are 480 V, delta primary windings 208/120 Y dry type. The transformer insulation system conforms to NEMA Standard ST20, Dry-Type Transformers for General Application (Ref. 4.4-10) for a 220°C UL component recognized insulation system.

4.4.2.2.1.8 Conduit and Cable Trays

Conduit is UL-approved rigid steel or 304 stainless steel for most applications. The minimum size used is ¾ in. for power circuits and ½ in. for instrumentation and controls circuits and communication circuits. Flexible steel conduit prevents damage due to vibration. Aluminum conduit is used where steel is unsuitable because of electromagnetic or environmental concerns. Aluminum conduit is not embedded in concrete or buried in the ground.

Cable trays are aluminum or hot-dipped galvanized ladder type. Non-ventilated covers are provided if required for protection.

4.4.2.2.2 Safety Considerations and Controls

The facility electrical system does not contain any important to safety electrical loads, however, requirements for electrical power backup exist for several systems. The systems affected by these requirements are the (1) communication system, (2) building fire detection system, (3) security monitoring and alarm system, (4) site security lights, (5) fire protection system, and (6) cask monitoring system. The electrical backup power sources for these systems are listed in Section 4.4.2.2.1.1.

4.4.2.2.3 Transfer Facility

There are no requirements for QA 1 power requirements in the transfer facility, since no systems are required to have power to perform safety functions. Electrical systems are either not required to operate under QA 1 conditions or accident scenarios, or they are designed to be fail-safe during loss of power. Design of the cask handling overhead bridge cranes is fail-safe. Electrical system SSCs for the transfer facility are classified as QA 5 and 7.

Power is transmitted to the transfer facility from breakers in a loop arrangement from the electric power distribution system switchgear located in the CISF switchgear building (see Figure 4.1-10). The breakers feed a 4160/480 V pad-mounted, dry-type transformer located outside of the transfer facility. The loop-type system is used such that the failure of a breaker or cable feed can be isolated and power can be fed from the other breaker. A separate breaker and cabling from the switchgear provides power for a 4 kV motor control center, which supplies any 4 kV motors.

Power is distributed to loads in the transfer facility through a system of transformers, 480 V low voltage metal enclosed switchgear, motor control centers, and panel boards. Transfer facility distribution equipment is oversized by 25% to permit future additions.

4.4.2.2.4 Security Complex and Gatehouses

Power is distributed to the security complex from the security complex substation transformer to two panelboards in the electrical equipment room inside the security complex. The first of these is designated the Security Complex Panelboard and serves the normal building loads. These loads do not have electrical backup and include building lighting and receptacle loads for the administrative and office areas of the security complex. The second panelboard is designated Security Panelboard A. This panelboard supplies security system loads and has electrical backup. The loads served by this panelboard include security room HVAC and the security system battery charger and UPS system. The security UPS supplies the 120 VAC UPS Power Panelboard C, which supplies the security room lights, the security control system, the communications system and monitoring equipment (Figure 4.4-5).

Electrical backup power is provided to the Security Panelboard A from a 500 kVA diesel generator connected to the Security Panelboard D. The diesel generator will start upon a loss of voltage to Panelboard A and power will automatically transfer when the diesel generator is up to speed and voltage.

The security system lighting is supplied from the security lighting substation transformer. This transformer serves Security Panelboard B which feeds the security system lighting in the storage area and other security lighting at the transfer facility and the receiving gatehouse. This panelboard is also backed up by electrical backup power from the security diesel generator as shown on Figure 4.4-5. The diesel generator will start upon a loss of voltage to Panelboard B and power will automatically transfer when the diesel generator is up to speed and voltage.

Power for the main gatehouse and receiving gatehouse is provided from the Security Complex Panelboard and is distributed by 600 volt cable of appropriate ampacity, direct buried in the ground. Conduit banks are provided under roads and railroad tracks. Power is distributed to the electrical distribution equipment (motor starters, distribution panel, etc.) in the gatehouses by cable routed in concrete-encased conduit banks. Power for the inspection gatehouse is provided from the Security Panelboard A and has electrical backup power.

Degradation of the electrical backup power source or the uninterruptible power source system equipment is annunciated in the security control room. The security system power supply powers all security system equipment in accordance with manufacturer specifications. The largest connected load or motor is energized, assuming that the system is otherwise fully loaded, without causing loss of other security system loads due to voltage dip. The power supply has a minimum capacity of 25% greater than the anticipated operational load. Security complex electrical SSCs are classified as conventional quality.

4.4.2.2.5 Fire Protection Pump Building

Electrical power for the fire protection pump is supplied from the CISF switchgear building. Power is distributed to the fire protection pump house 4160/480 Volt, 300 kVA secondary substation by cable of appropriate ampacity. This cable is routed in cable trays which are mounted in cable trenches. The cable terminates in the secondary substation transformer located outside the fire protection pump house. Conduit banks are provided under roads and railroad tracks. Power is distributed from the secondary substation to the facility electrical distribution equipment (motor starters, distribution panel, etc.) by cable routed in concrete-encased conduit banks. Fire protection pump building electrical SSCs are classified as conventional quality.

4.4.2.2.6 Switchgear Building

The 4.16KV electrical switchgear is located in the switchgear building at the end of the switchyard. Electric power is supplied to this building from the security complex substation transformer.

The switchgear building houses the switchgear, the associated equipment, and a local control panel for control of the switchyard breakers and transformer fans. This equipment is designed to be accessible for installation, removal, or maintenance. Electrical power for the switchgear building is provided from the security facility substation transformer. Power is distributed by 600 volt cable of appropriate ampacity, direct buried in the ground. Conduit banks are provided under roads and railroad tracks. Power is distributed to the electrical distribution equipment (motor starters, distribution panel, etc.) in the gatehouses by cable routed in concrete-encased conduit banks. Switchgear building electrical SSCs are classified as conventional quality.

4.4.2.2.7 Potable Water Wellhouse

Electrical power for the potable water wellhouse is provided from the CISF switchgear building. Power is distributed to potable water wellhouse secondary substations by cable of appropriate ampacity. This cable is routed in cable trays which are mounted in cable trenches. The cable shall terminate in the secondary substation transformer located outside the potable water wellhouse. Conduit banks are provided under roads and railroad tracks. Power is distributed from the secondary substations to the facility electrical distribution equipment (motor starters, distribution panel, etc.) by cable routed in concrete-encased conduit banks. Potable water wellhouse electrical SSCs are classified as conventional quality.

4.4.2.2.8 Temporary Support Facilities

Electrical power for the temporary support facilities is provided from the CISF switchgear building. Power is distributed to the temporary support facilities secondary substations by cable of appropriate ampacity. This cable is routed in cable trays which are mounted in cable trenches. The cable shall terminate in the secondary substation transformer located outside the buildings. Conduit banks are provided under roads and railroad tracks. Power is distributed from the secondary substations to the facility electrical distribution equipment (motor starters, distribution panel, etc.) by cable routed in concrete-encased conduit banks. Temporary support facilities electrical SSCs are classified as conventional quality.

4.4.2.2.9 Transporter Wash-Down Station

Electrical power for the transporter wash-down station is supplied from the CISF switchgear building. Power is distributed to transporter wash-down station 4160/480 volt, 40 kVA secondary substation by cable of appropriate ampacity. This cable is routed in cable trays which are mounted in cable trenches. The cable terminates in the secondary substation transformer located outside the transporter wash-down station. Conduit banks are provided under roads and railroad tracks. Power is distributed from the secondary substation to the facility electrical distribution equipment (motor starters, distribution panel, etc.) by cable routed in concrete-encased conduit banks. Transporter wash-down station electrical SSCs are classified as conventional quality.

4.4.3 Compressed Air Supply Systems

This section describes general operations and equipment provided in the compressed air services systems at the CISF. Compressed air services are required for the transfer facility and the security complex.

4.4.3.1 Transfer Facility Compressed Air Services System

The transfer facility compressed air system consists of all SSCs necessary to provide the transfer facility with a source of compressed air. Compressed air system SSCs are classified as QA 7. This system consists of a compressed air station located inside the mechanical equipment room of the attached personnel area building. Due to the location of the compressed air station, failure of system components will not impact QA 1 components.

The compressed air station provides service air to various pneumatic tools, robotics, and other equipment used for operation and maintenance. The compressed air station provides instrument quality air to air-operated instrumentation, pneumatic valve operators, and HVAC pneumatic dampers.

The air station is comprised of two air compressors, two air receivers, two air dryers, a compressed air piping distribution system and associated valves and pressure control equipment, and instrumentation and controls necessary to deliver compressed air to various air supply points.

Two compressed air receivers are provided at each air compressor to provide air storage for sudden heavy demands of service and instrument air and to act as secondary separators beyond the aftercooler, removing more of the oil and condensate. A refrigerated air dryer and filtration system and a backup are located downstream of the air receivers. Each air dryer is capable of producing dry air from a set dew point range, and removing oil and water aerosols and particulates.

4.4.3.2 Security Complex Compressed Air Services System

The compressed air services required for the security complex are service air and instrument air. Security complex compressed air system SSCs are classified as conventional quality.

This system consists of a compressed air station located inside the mechanical equipment room of the security complex. The air station is comprised of two air compressors, two air receivers, two air dryers, a compressed air piping distribution system and associated valves and pressure control equipment, and instrumentation and controls necessary to deliver compressed air to various air supply points.

4.4.4 Water Supply Systems

The water supply system 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.

These systems are classified as conventional quality and are sized and will be installed in accordance with the National Plumbing Code (Ref. 4.4-11) or equivalent applicable plumbing code of the locality, and good workmanlike practice. Materials for piping and components conform to the minimum requirements of the American Society of Mechanical Engineers/American National Standards Institute (ASME/ANSI) B31.1-1995 Code (Ref. 4.4-12). This code invokes the American Society for Testing and Materials (ASTM) standards, and the American Water Works Association (AWWA). Cathodic protection is provided as necessary. The method of cathodic protection is dependent on the piping materials and the soil characteristics of the site.

The system consists of a yard well house and a piping distribution system, a submersible well pump, water storage tanks, pressure control equipment and I&C as necessary to provide a safe and reliable source water to the CISF. Provisions are made for water treatment and filtration, if required. Figure 4.1-14 shows the configuration of the water supply well house and Figure 4.4-6 shows a process flow diagram for the water supply system.

4.4.5 Wastewater Systems

Chapter 6 describes the general operations and equipment provided in the conventional wastewater and sanitary wastewater systems provided at the CISF.

4.4.6 Communication and Alarm Systems

The communications system consists of all SSCs necessary to provide communications for the CISF. Reliability of message transmission is provided, in part, by the variety of systems available to the staff and by the individual system design.

Communications equipment for the CISF includes a telephone system, with utility telephone cable and microwave capability, a public address handset system, and radio system. Security personnel have control of all communications systems for controlling access to the site areas and in protecting the facilities. These systems are powered from the security complex UPS system.

CISF communications systems provide communications for normal and off-normal conditions. CISF communications systems are compatible with those of federal, state and local law enforcement and emergency response agencies.

All permanently installed communication systems are classified as conventional quality.

4.4.6.1 Telephone System

The telephone system consists of all site switching equipment, lines, extensions, fax machines, and a voice mail and answering system required for the facility to perform its intended functions. Phone lines will be connected to the site from the local telephone utility and will be backed up by a microwave radio system. Telephone handsets will be installed at key locations within the site and at a centrally located switchboard at the security complex. This system functions to provide dial-up point-to-point or private line verbal communications via the main switchboard and interface with the voice paging system. The site telephone system is also connected to the local telephone system for outside communication.

4.4.6.2 Public Address System

The public address handset system consists of handsets, speakers, amplifiers, and associated wiring as necessary for site paging or to alert personnel to off-normal conditions at the CISF. Handsets are installed at fixed locations throughout the site. It functions to provide party-line (two or more persons) and site-wide verbal communications and alarm signaling.

4.4.6.3 Radio System

The radio system provides a dedicated system for providing continuous two-way communication among members of the security force and the central and secondary alarm station. A wide-area-coverage radio system designed to communicate within a larger area around the site for dispatching and control of mobile units is also provided. Access to the public address system will be provided so that personnel in the building can communicate with the rest of the facility. The control console for these radio systems is in the security complex. Also, available for voice communication is the VHF/UHF radio.

4.4.7 Fire Protection

This section describes general operations and equipment provided in the fire protection systems for the CISF. The fire protection systems consist of all SSCs necessary to provide fire detection and suppression, life safety, and fire fighting functions to control and extinguish all potential credible fires.

4.4.7.1 Design Basis

The objectives of the fire protection systems at the CISF are as follows.

- To ensure that no threats to the public health and welfare result from fire
- To ensure that employees are not exposed to undue hazards from fire
- To ensure that vital DOE programs do not suffer unacceptable delays as a result of fire
- To ensure that property damage is held to manageable levels.

To meet these objectives, the fire protection systems provide features and concepts to minimize fire ignition, to promptly detect and extinguish fires, and to mitigate the consequences of fire. Features used include noncombustible materials, fire walls, barriers, and spatial separation to isolate specific hazards.

Fire protection structures, systems, and components are conservatively classified as QA 4 and comply with the design requirements of ANSI/ANS-57.9, Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type) (Ref. 4.4-13) and applicable NFPA codes. Protection of personnel is assured through suitable features provided in accordance with NFPA 101, Life Safety Code (Ref. 4.4-1). Certain fire protection system SSCs are also classified as QA 5 and/or QA 7.

QA 1 structures, systems, and components are designed and located so that safety functions continue to be performed under credible fire and explosion exposure conditions. Explosion and fire detection, alarm, and suppression systems are designed and provided with sufficient capacity and capability to minimize adverse effects of fires and explosions on QA 1 structures, systems, and components. Noncombustible and heat-resistant materials are used wherever practical throughout the CISF, particularly in locations vital to the control of radioactive materials and to the maintenance of safety control functions.

The design of the CISF includes provisions to protect against adverse effects that might result from either the operation or failure of a fire suppression system.

4.4.7.2 System Description

The CISF fire protection systems are comprised of the following major fire protection systems.

- Yard fire protection system
- Building fire protection system
- Transformer fire protection system.

In addition, the following fire protection features can be applicable to more than one of the major systems above.

- Fire detection and alarm systems
- Manual fire fighting equipment
- Life safety features
- Passive fire protection features
- Fire brigades.

4.4.7.2.1 Yard Fire Protection System

The yard fire protection system distributes water to the automatic sprinkler systems and interior standpipe systems for building fire protection and to the fire hydrants that are provided at the site. A dedicated fire water storage and distribution system is used. The yard fire protection system consists of redundant water storage tanks, a pumphouse with redundant fire pumps, underground supply piping and a looped distribution system, and yard hydrants. An unmanned hose house equipped with fire hoses, nozzles, hydrant wrenches, and hardware is provided for every two hydrants. Figures 4.4-7 and 4.4-8 show a process flow diagram of the CISF yard fire protection distribution system.

In accordance with the Fire Hazards Analysis Summary and System Evaluation (Appendix 4A) the site storage area does not require a fire protection loop to suppress or mitigate a fire because the storage area is maintained devoid of any significant quantity of combustibles, lacks ignition sources, and there are no credible accidents in the area that would result in a fire that such a loop would be used to suppress or mitigate. Other than transient combustibles, such as trash, the primary combustibles in the storage area are as follows.

- Hydraulic fluid in the hydraulic ram system used for the NUHOMS® MP187 system
- Fuel in portable electrical generators
- Fuel in the tank of the storage cask transporter
- Hydaulic fluid contained in the hydraulic system of the storage cask transporter.

4.4.7.2.1.1 Fire Protection Water Storage Tanks

The design of the fire protection water storage tanks is sufficient to meet the density, residual pressure, and duration requirements of NFPA 13, Standard for Installation of Sprinkler Systems (Ref. 4.4-14) and is filled from a source capable of replenishing the supply for the fire protection needs of an eight-hour period. Specifically, two steel, cylindrical, ground-level water storage tanks, one located on either side of the pump building, provides a suction supply for the fire protection pumps. For redundancy, each tank is sized for the maximum anticipated water supply needed to control and extinguish a design basis fire anywhere in the CISF. Each of the storage tanks have a minimum capacity based on system requirements. System requirements are based on the final design of all water-based fire suppression systems that will use these tanks as their primary source. At least one tank is available for use at all times and shall be design earthquake qualified, and through valve alignment, either tank can supply either pump. The potable water well pump is used to fill and provide makeup water to the storage tanks. In the event the tank is emptied, off-site sources are utilized to supplement the potable water well pump in restoring capacity to the tanks. Once a site has been selected and environmental conditions assessed, the tanks will be heated as necessary in accordance with one of the heating methods described in NFPA 22, Standard for Water Tanks for Private Fire Protection (Ref. 4.4-15).

The Fire Protection Water Storage Tank design parameters are presented in table 4.4-1.

Table 4.4-1. Fire water storage tank design parameters

Quantity	2
Type	Vertical, cylindrical
Material	Steel
Design Capacity	150,000 gal
Diameter	30 ft
Height (approximate)	30 ft
Normal Operating Pressure	Atmospheric
Normal Temperature	76°F
Design Temperature (max./min.)	125°F / -40°F

4.4.7.2.1.2 Fire Protection Pumps

The fire protection pump building houses the equipment that supplies the site with water for extinguishing fires. Figure 4.1-15 provides a plan view of the fire protection building. The system provides two horizontal, split-case, centrifugal fire pumps, each sized to provide 100% of the maximum anticipated water demand needed to control and extinguish a potential credible fire. Either pump can discharge through either leg of a distribution grid. One pump is electric motor-driven and the other is diesel-engine driven.

The Fire Protection Distribution Pump design parameters are presented in Table 4.4-2.

Table 4.4-2. Fire Protection Distribution Pump Design Parameters

Quantity	2
Type	Horizontal, split-case centrifugal
Design Capacity	960 gpm
TDH @ Design Capacity	338 ft, 147 psi
Minimum NPSH	25.8 ft
Design Temperature	60°F
Brake Horsepower	126.2 hp
Voltage (electric motor-driven pump)	480 VAC

Each pump is arranged to start automatically upon sensing a decrease in system water pressure. The electric motor-driven pump will have priority over the diesel-engine driven pump. In addition, remote, manual start switches located in a constantly attended location in the security complex are provided. Two sets of starting batteries are provided for the diesel engine. A small dedicated diesel fuel oil tank, located in the fire protection pump building, provides an eight-hour fuel supply as a minimum.

A single, electric motor-driven jockey pump, also located in the fire protection pump building, is provided to maintain normal system pressure.

The Fire Protection Jockey Pump design parameters are presented in Table 4.4-3.

Table 4.4-3. Yard Fire Protection Jockey Pump Design Parameters

Quantity	1
Type	Horizontal, Centrifugal
Design Capacity	20 gpm
TDH @ Design Capacity	Later

4.4.7.2.1.3 Yard Distribution System

The entire water distribution system, including the piping network associated with the fire pumps, is arranged such that a single pipe break or valve failure does not totally impair the performance of the system. Figures 4.4-7 and 4.4-8 show a process flow diagram of the CISF yard fire protection distribution system.

To achieve this protection, the yard main piping is arranged in a looped-type configuration. If a pipe break or valve failure occurs, the area is isolated by sectional valving so that all other locations can be supplied by one of the ends of the distribution loop. Individual feed mains connect the water distribution system to the sprinkler and/or standpipe fire protection systems inside the transfer facility, personnel building, security facilities, fire protection pump building, and the switchgear building. Necessary piping, valves, flow and pressure control equipment, and instrumentation and controls are provided to ensure a reliable source of fire protection water for fighting postulated on-site fires.

Yard distribution piping terminates at the first shut-off valve inside the facility being supplied with fire protection water. Building fire protection piping systems begin at this point.

4.4.7.2.2 Building Fire Protection System

The building fire protection system includes automatic sprinkler systems and standpipe systems, as well as indication systems for the sprinklers, fire detection and alarm systems, and smoke control. The yard fire protection distribution system supplies water to the building fire protection systems.

4.4.7.2.2.1 Automatic Sprinkler Systems

Wet pipe sprinkler systems are provided throughout each building unless precluded by other considerations such as freezing conditions. Automatic sprinkler systems are designed and installed to comply with NFPA 13, Standard for Installation of Sprinkler Systems (Ref. 4.4-14). Selection of a specific sprinkler system type is determined by the nature of the fire hazard, ambient temperature, drainage, and optimum use of water.

Sprinkler systems are engineered as necessary to protect against specific hazards in accordance with parameters established by the Fire Hazards Analysis Summary and System Evaluation (App. 4A). Water flow switches are provided to alarm and annunciate sprinkler system activation. Sprinkler system control valves are locked open to ensure that systems remain operable.

4.4.7.2.2.2 Smoke Control

Based upon the fire hazards identified in the Fire Hazards Analysis Summary and System Evaluation, ventilation systems inside buildings will be engineered as necessary for smoke control and exhaust capability to mitigate the spread of particles of combustion. Ductwork, accessories and support systems will be designed and tested in accordance with NFPA 90A (Ref. 4.4-2) and NFPA 101 (Ref. 4.4-1).

4.4.7.2.2.3 Fire Detection and Alarm Systems

A facility-wide fire alarm system, which includes a microprocessor-based, intelligent, central alarm system console, is located in the security complex. Individual local alarm panels are located in various buildings where fire detection is required. The secondary alarm monitoring station will be located at the closest fire department, response agency or local law enforcement agency.

The type of detector(s) and extent of coverage for each building will be determined, in part, by the fire hazards identified in the Fire Hazards Analysis Summary and System Evaluation. The coverage for all designated fire detection devices will comply with NFPA 72, National Fire Alarm Code (Ref. 4.4-16). A mixture of detector types may be appropriate. Spacing will be based on threshold fire size, fire growth rate and ceiling height, as described in this standard.

Flow alarms are provided wherever a sprinkler system is installed and will comply with the requirements of NFPA 72.

4.4.7.2.2.4 Manual Fire Fighting Equipment

Portable fire extinguishers are located inside all buildings and throughout the site. All fire extinguishers comply with NFPA 10, Standard for Portable Fire Extinguishers (Ref. 4.4-17).

Standpipe systems are supplied from the yard fire protection water distribution system. Fire hose stations are located and positioned so that any interior location of a building can be reached by at least one hose stream. Installation of standpipe and hose systems will comply with NFPA 14, Standard for Installation of Standpipe and Hose Systems (Ref. 4.4-18) for Class II service.

4.4.7.2.2.5 Life Safety Features

Stairs, doors, vertical and horizontal exits, aisles, travel distances, exit capacity, exit signs and emergency lighting all comply with NFPA 101 (Ref. 4.4-1). Occupant notification also complies with NFPA 101.

4.4.7.2.2.6 Passive Fire Protection Features

In order to prevent or mitigate the effect of any fires at the CISF, noncombustible and heat-resistant materials are used whenever practical, particularly in locations vital to the control of radioactive materials and to the maintenance of safety control functions. All wire, cable and wiring devices comply with the applicable NEC and IEEE codes and/or standards.

Fire barriers have a minimum fire resistance rating in accordance with parameters established by the Fire Hazards Analysis Summary and System Evaluation and appropriate NFPA codes. A lightning protection system is provided for the CISF in accordance with NFPA 780, Lightning Protection Code (Ref. 4.4-7).

4.4.7.2.2.7 Fire Brigades

The existence and scope of an on-site fire brigade is based on the requirements identified in the Fire Hazards Analysis Summary and System Evaluation, and the response times of an off-site fire brigade. Once a site has been identified for the CISF, the response times of an off-site fire brigade can be determined and evaluated in light of the hazards that exist at the CISF.

4.4.7.2.3 Transfer Facility Fire Protection System

This section describes general operations and equipment provided in the fire protection system for the transfer facility. The fire protection system provides fire detection and suppression capabilities for all areas of the transfer facility, including receiving areas, SNF cask and canister handling areas, control areas, personnel areas and equipment areas. All fire suppression systems provided are hydraulically designed according to NFPA standards.

A detailed Fire Hazards Analysis has been conducted for the CISF, to evaluate the effects of potential fire and to establish the required features for fire protection systems. An automatic sprinkler system is not needed in the transfer facility because of the lack of any significant quantity of permanently installed combustibles. In lieu of such a system and in light of the potential fires, suitable fire extinguishers are located throughout the transfer facility in accordance with NFPA 10, Standard for Portable Fire Extinguishers (Ref. 4.4-17). Standpipe and hose systems are also provided for the transfer facility in accordance with NFPA 14, Standard for Installation of Standpipe and Hose Systems (Ref. 4.4-18). Fire hose stations are located and positioned so that any interior location of the building can be reached by at least one hose stream. The yard fire protection distribution system supplies water to the standpipe system.

Ventilation systems in the transfer facility are designed for smoke control and exhaust capability in order to mitigate the spread of particles of combustion.

As part of the fire alarm and detection system, typical modular multi-zone fire alarm control panels are provided. Each panel has a dual power supply consisting of normal building power and battery backup power capable of maintaining the system for a minimum of 24 hours. Hose system water flow detectors are connected to the panel on separate zones. Automatic smoke detectors wired to the fire alarm control panels are used in the transfer facility. Smoke or heat detectors are used as necessary. Manual fire alarm pull stations are connected to separate fire alarm system zone modules. Activation of a detector, manual pull station, or flow detector results in audible and visual signals at the control panel and audible and visual signals inside the building.

Necessary piping, valves, pressure and flow control equipment, and local instrumentation and controls provide fire suppression and detection functions for each system provided.

The personnel building at the transfer facility is provided with an automatic, water-based sprinkler system. Additionally, since this area will have a high level of occupancy in comparison with other areas of the CISF, an automatic fire detection system in the form of smoke detectors is provided.

4.4.7.2.4 Security Complex Fire Protection System

The yard fire protection distribution system supplies water to the security complex fire suppression system. All fire suppression systems are hydraulically designed according to NFPA standards. Water flow detectors, which are connected to the local and central fire alarm systems, detect activation.

The administration areas within the security complex are provided with an automatic water-based sprinkler system. The central security computer areas are provided with an inert dry-gas system (Halon gas substitute). The areas containing mechanical and electrical equipment are provided with an automatic water-based sprinkler system. Additionally, the administration areas within the security complex and areas containing mechanical and electrical equipment are provided with a fire detection system.

As part of the fire alarm and detection system, typical modular multi-zone fire alarm control panels are provided. Each panel has a dual power supply consisting of normal building power and battery backup power capable of maintaining the system for a minimum of 24 hours. Automatic smoke detectors wired to the fire alarm control panels are used in the security complex. Smoke or heat detectors are used as necessary. Manual fire alarm pull stations are connected to separate fire alarm system zone modules. Activation of a detector, manual pull station, or flow detector results in audible and visual signals at the control panel and audible and visual signals inside the building.

Necessary piping, valves, pressure and flow control equipment, and local instrumentation and controls provide fire suppression and detection functions for each system provided. The ventilation system in the security complex is designed for smoke control and exhaust capability in order to mitigate the spread of particles of combustion.

4.4.7.2.5 Fire Protection Pump Building Fire Protection System

The fire protection pump building poses a fire hazard due to the diesel fuel tank and diesel-operated fire pump housed inside; therefore, the building is provided with an automatic wet pipe sprinkler system. Based on the current design of the CISF, the fire severity of this fire area, according to the Fire Hazards Analysis Summary and System Evaluation, is "moderate." Due to the nature of these fire hazards, the ignition of either could result in an intense fire whose duration would depend upon the quantity of diesel fuel involved. If sufficient fuel is involved, the entire building could be destroyed. However, the automatic suppression system to be installed in the building ensures that such a fire would be promptly mitigated.

The fire protection pump building is a single-story, slab-on-grade structure. The exterior walls are load-bearing 12-inch concrete block with a textured finish. The roof structure consists of two-inch lightweight concrete topping on metal decking over steel beams. Access to the building is through a metal roll-up door and a personnel door. A three-hour fire barrier is provided to separate the diesel-driven pump and fuel tank from the electric motor-driven pump and the jockey pump.

4.4.7.2.6 Switchgear Building Fire Protection System

A detailed Fire Hazards Analysis has been conducted for the CISF to evaluate the effects of potential fire and to establish the features required for fire protection systems. The yard fire protection distribution system supplies water to the switchgear building fire suppression system. All fire suppression systems are hydraulically designed according to NFPA standards. Water flow detectors, which are connected to the local and central fire alarm systems, detect activation. Necessary piping, valves, pressure and flow control equipment, and local instrumentation and controls provide fire suppression and detection functions for each system provided.

The switchgear building poses a fire hazard due to the electrical equipment housed inside; therefore, the building is provided with an automatic wet pipe sprinkler system. A fire detection system is also provided. Based on the current CISF design, the fire severity of this fire area, according to the Fire Hazards Analysis Summary and System Evaluation, is "moderate" due to the combustibles (in the form of electrical SSCs) in the fire area. This equipment, in most likely fire scenarios, would either (1) produce a smoldering fire that could be detected by the fire detection system or (2) catastrophically fail and result in a large fire. The provision of an automatic wet pipe sprinkler system in this building and its prompt response during a fire ensures an unmitigated fire in the building due to the latter scenario will not occur.

4.4.7.2.7 Gatehouse Fire Protection Systems

The gatehouses at the CISF site are provided with portable fire extinguishers, and do not have an automatic fire suppression system.

4.4.7.2.8 Transformer Fire Protection System

The main transformer does not require a fire suppression system because it is filled with a non-hydrocarbon based insulating oil, it is adequately separated from adjacent electrical equipment, and the transformer can be promptly replaced in the event of a catastrophic fire causing substantial damage to the transformer. A spare transformer is maintained nearby to achieve an acceptable downtime. The transformer is mounted on a concrete pad with a retaining dike sized to hold the oil inside the transformer in case of a leak.

Based on the current CISF design, the fire severity of this fire area, according to the Fire Hazards Analysis Summary and System Evaluation, is "moderate" due to the combustibles (in the form of electrical SSCs) in the fire area.

4.4.7.3 System Evaluation

Fire protection systems have been evaluated and the results recorded in a Fire Hazards Analysis performed for the various CISF fire areas. The primary fire hazards evaluated were those of sufficient quantity that a fire involving these hazards could indirectly or directly affect QA 1 SSCs. Nine fire areas were identified for evaluation. The evaluation criteria, area descriptions, analysis, and conclusions for each are summarized in the Fire Hazards Analysis Summary And System Evaluation presented in Appendix 4A.

The fire area evaluation criteria include code requirements, fire severity, fire barriers, life safety and other necessary design assumptions. A description of these items is also presented in Appendix 4A.

In summary, the following conclusion has been reached regarding the fire protection systems evaluation. The fire protection systems are adequate in their ability to mitigate the credible potential fires presented by the identified fire hazards at the CISF. Additionally, the CISF QA 1 SSCs will not be adversely impacted by the credible potential fires. Overall, the CISF is well designed from a fire protection and life safety point of view. However, once a final site is selected for the CISF and the fire protection systems are designed, this analysis will have to be reviewed to ensure conformity with the final site-specific criteria, system designs, and the adequacy of the design with respect to the fire hazards present.

4.4.7.4 Inspection and Test Requirements

During construction of the CISF, the installation, testing, and inspection of fire protection systems shall be in accordance with applicable NFPA codes and manufacturers' requirements to ensure the integrity of the installed systems. Additionally, the design and installation of the fire protection system pumps, valves, sprinkler heads and other components shall provide adequate accessibility for inspection, testing and maintenance functions.

4.4.7.5 Personnel Qualification and Training

The organizational structure for CISF operation is described in Section 13.1. The Industrial Safety Coordinator is responsible for the implementation of CISF industrial safety programs and procedures. This shall include programs and procedures for training individuals in safety, and maintaining the performance of the facility fire protection systems. The qualifications, training and experience of the CISF operating contractor staff occupying key positions are described in Section 13.1. Files and records will be maintained to demonstrate compliance with the minimum requirements set forth in Section 13.2.

The facility training program is described in Section 13.3. Additional information on fire brigade training is contained in Section 13.5.

4.4.8 Maintenance Systems

CISF systems and operations are designed to keep operating areas free of loose surface contamination, resulting in a radiologically clean facility. Dedicated maintenance periods are scheduled during which all significant sources of direct radiation, such as transportation and storage systems containing SNF, are removed from operating areas. This provides unrestricted access to all areas of the transfer facility for routine scheduled maintenance of lifting equipment and remote operating devices in accordance with conventional maintenance practices.

4.4.9 Cold Chemical Systems

There are no cold chemical systems associated with SNF handling at the CISF. As described in Section 4.4.4, neither are there chemical systems currently planned for treatment of water supplies for support activities. If site-specific measures are required for the water supply systems at the CISF site that is finally selected, applicable chemical systems for that site will be described in the license application.

4.4.10 Radiation Monitoring Systems

CISF radiation monitoring system features are provided to ensure that radiation exposures to workers and the public meet NRC regulatory criteria, and are maintained ALARA. These features are listed below and covered in more detail in Chapter 9. CISF radiation monitoring systems are classified as QA 5 and QA 7.

Radiation monitoring equipment:

- Area Radiation Monitor System - This system is used to monitor the transfer facility, the cask wash-down area and the cask transporter for direct gamma and neutron dose rates. Within these facilities, monitors are located in occupied areas where radiation fields may change significantly. The remote readout and alarm panel is located in the personnel building adjacent to the transfer facility. Detailed information regarding the instruments is provided in Section 9.3.5.1.

- Radioactive Airborne Effluent Monitoring System - The transfer facility HVAC system exhaust is constantly monitored by an airborne effluent monitoring system. The equipment is located in the transfer facility HVAC room adjacent to the exhaust duct. The system output is monitored both locally, at the equipment, and remotely, in the cask monitor room of the personnel building. Each channel of the monitor has an adjustable alarm setting for aligning the exhaust air flow through the HEPA filters. Detailed information regarding this system is provided in Section 9.3.5.2.

- Portable Continuous Air Monitors (CAM) System - These monitors, located throughout the transfer facility, monitor the atmosphere during tasks that could generate airborne activity. The CAMS are equipped with local audible alarms to warn of high airborne radioactivity concentrations.

- Radiation Protection Counting Laboratory System - The counting laboratory is located in the personnel building and consists of the equipment required for processing contamination smears, gas sampling and liquid sampling. The following equipment is located in the counting laboratory room.

  - A gamma multi-channel analyzer for liquid or gas samples
  - A proportional counter to identify alpha and beta activity in contamination smears
  - A beta scintillation counter to identify beta activity in smears and liquid samples
  - Computer hardware/software to record and analyze radiological monitoring/sampling and personnel exposure data
  - Portable alpha, beta, gamma and neutron monitoring instruments.

- Other radiation monitoring equipment includes:

  - Whole body contamination monitor located in the contamination control area between the personnel building and the transfer facility
  - Personnel dosimeters: thermoluminescent dosimeters (TLDs) for cumulative personnel exposure recording and self-reading dosimeters (SRD) for instantaneous dose rate and short-term cumulative exposure monitoring
  - Portal radiation monitor (walk-through type) at the badge issue station for personnel exiting the site
  - Personnel friskers at locations of access to the transfer facility, and at other site locations where personnel contamination is a possibility
  - Whole body counter to detect personnel internal radioactive contamination.

4.4.11 Cask Decontamination System

Decontamination of incoming transportation casks and TSCs is primarily the result of surface contamination on transportation casks which have been submerged in utility fuel pools. The need for decontamination activities at the CISF is expected to be minimal. Under ordinary operating conditions, decontamination of incoming transportation casks is not needed; only a small percentage may be contaminated to a degree that requires cleaning. It is conservatively assumed that a maximum of one in 10 transportation casks received at the CISF will require some type of decontamination.

The cask decontamination system of the transfer facility is classified as conventional quality. Located in the shipping/receiving area of the transfer facility, it consists of an enclosed cask decontamination booth (cask decon booth) equipped with robotics and a decon solution pressure spray system, including spray wands. Decontamination solution supply to the booth is provided by a decontamination solution tank, part of the decon solution pressure spray system. The cask decon booth robotics perform RP surveys of all the transportation casks and TSCs received at the CISF. The robotics also perform both local and wash-down decontamination activities.

4.4.11.1 Major Components and Operating Systems

The cask decon booth performs the following major decontamination functions.

- Removes small quantities of radioactive contamination from transportation casks
- Contains decontamination solution during decontamination activities

During normal operations, the transportation casks or TSCs are upended, lifted from their transportation carriers and placed vertically on the floor just outside the cask decon booth. With the crane remaining engaged, RP surveys are performed on the entire cask (including the bottom). The robotic arms take contamination swipes of the cask's outside surfaces.

If the casks are contaminated, they are lifted and placed inside the cask decon booth, the overhead crane is disengaged, and the cask is prepared for cask decon activities. A set of robotic arms inside the booth can spray and swipe the cask surface for local decon activities, or can grip a set of pressure spray wands for decon solution wash-down activities.

Once decon activities are complete and the cask is allowed to dry, the overhead bridge crane is engaged and the casks are removed and prepared for the next operational step. The robotic arms then collect and dispose of all solid radwaste within the booth after the cask is removed.

4.4.11.2 Safety Considerations and Controls

The cask decon booth is situated over a basin designed to collect the waste decontamination solution and route it to the transfer facility radioactive waste tank, located below grade just outside the facility. Some liquid radioactive wastes may be created from cask wash-down water collected in the decontamination booth. Waste water collected in the basin is routed to a dedicated radioactive waste tank. Sampling and disposition of waste water is discussed in Chapter 6.

4.4.12 Transporter Wash-Down System

The transporter wash-down station is located between the inspection gatehouse and the transportation cask queuing areas just inside the controlled access area fence. The function of the transporter wash-down station is to remove road dirt from the incoming transporter, to aid in maintaining transfer facility cleanliness and to facilitate security inspections.

The transporter wash-down station is a conventional quality prefabricated metal building built on a reinforced concrete slab, as shown in Figure 4.1-16. It is approximately 79 feet long by 40 feet wide by 24 feet high; with four 16-foot wide, by 20 foot-high roll-up doors. It features a bay for wash-down of rail deliveries, and a second bay for heavy haul truck deliveries. The rail bed and road paving system are sloped to central collection floor drains. Inside the building is a series of washing stations. The wash-down station utilizes a water reclamation system, which reclaims water at its system design flow rate. The water make-up is from the potable water system.

The system is initially filled with potable water. A sump pump system supplies wash water from a subgrade storage tank. Water is pumped through a centrifugal separator and a basket filter to an above-ground wash water storage tank. The water is then pumped to the wash system, where it is used and then drained back into the subgrade storage tank for reuse.

The collection, filtering and disposal of the wash water is described in Chapter 6.

4.5 OPERATION SUPPORT SYSTEMS

This section describes the instrumentation and controls (I&C) features of the CISF that are associated with operations.

The sections below describe surveillance and monitoring system requirements for the various vendor technologies. The surveillance and monitoring systems are provided as part of the storage area SSCs and are QA 7.

For remote control, surveillance and/or monitoring systems in the transfer facility, refer to Section 4.6. For communication control console and surveillance and/or monitoring systems for site security, refer to Section 4.9.

4.5.1 Storage Module Thermal and Pressure Monitoring System

The storage area modular concrete pads are electrically wired during construction for installation of thermal and pressure monitoring instrumentation for the storage casks as required. Air outlet temperature monitoring for the concrete casks and HSMs measures the components' thermal performance, and requires surveillance of the monitor signal on a routine basis. Thermal monitoring also helps to detect a possible hazard event, such as blocking of an air inlet of a storage cask by debris due to natural events that, if not mitigated, may produce excessive cask temperatures. Continuous inner-lid pressure monitoring of the NAC STC system is required for detection of leakage past the inner seals. The alarm board is monitored on a daily basis and is tested annually to ensure proper functioning.

To facilitate monitoring activities, an electrical terminal box, located between every two vertical cask storage pad locations, collects single-pair instrumentation transmission cables from 16 casks (two instruments per cask - 32 cables), and a box between every two HSM modular storage pad locations collects single-pair instrumentation transmission cables from 40 modules (two instruments per HSM - 80 cables). Each electric terminal box location has connecting multi-pair transmission cable that runs through buried conduit in the storage area. All single and multi-pair cables are shielded and rated at 300 volts.

All transmission cable runs to the cask monitor room of the personnel building, (part of the transfer facility) where it connects to a cask instrumentation monitoring terminal cabinet containing the alarm board for the NAC STC casks. The cask instrumentation monitoring terminal and alarm board is monitored on a daily basis and tested annually to ensure proper functioning. Power is supplied to the terminal boxes from an uninterruptible power supply (UPS) system located in the cask monitor room. This will ensure that thermal and pressure monitoring is uninterrupted upon loss of off-site power.

4.5.2 Hydraulic Ram Pressure Monitoring Systems

Hydraulic ram systems are used during canister transfer operations while employing the Westinghouse Large/Small MPC and the VECTRA NUHOMS® cask systems. The Westinghouse MPC hydraulic ram system is stationary and is used during canister transfer operations in the transfer facility. The VECTRA NUHOMS® hydraulic ram system is mobile and is used during canister transfers in the storage area.

Both hydraulic ram systems are an integral part of the vendors' cask system designs. During canister transfer operations, the hydraulic ram system pressure is monitored continuously. The maximum ram push/pull forces are limited automatically by the systems' design features. These monitoring systems prevent damage to the canisters or storage modules due to possible canister misalignment accidents. Refer to the technical specifications presented in Chapter 14 and for operating conditions, controls, and limits.

4.6 CONTROL ROOM AND CONTROL AREA

Several remote control and/or monitoring areas are provided in the transfer facility for ALARA purposes. No SSCs or activities in these areas are important to radiological safety. These shielded areas are provided solely for the purpose of allowing operators to control, observe and/or monitor transfer facility operations or storage cask performance parameters from locations at sufficient distances from radiation sources to maintain ALARA worker dose. Dose analyses have determined that remote operations are necessary at the CISF because of the large number of casks handled and tasks performed. These remote areas provided for specific control and/or monitoring tasks are associated with specific transfer facility or storage area components; the CISF does not have a distributed control system.

4.6.1 Crane Operating Room

A crane operating room is provided along one wall of the transfer facility, approximately 27 feet above the operating floor. A viewing window is provided in the transfer facility wall. The room is constructed of reinforced concrete to ensure that tornado-generated missiles do not penetrate the room and enter the transfer facility through the viewing window. The location of the operating room allows operators to view the shipping/receiving area and the canister transfer room. The two overhead bridge cranes and the gantry-mounted robot are operated from this room via remote control consoles. Cameras are provided on the cranes, on the gantry-mounted robot and throughout the transfer facility to aid operators in observing crane and robot activities via closed-circuit television (CCTV) monitors in the operating room. The distance of the room from radiation sources in the transfer facility maintains ALARA operator radiation dose. The crane operating room is shown in Figure 4.1-5.

4.6.2 Remote Operating Room

The automated bolt/stud tensioners in the shipping/receiving area are operated remotely from a room below the crane operating room. Operators use cameras to observe tasks performed by the automated equipment, and the room contains automated equipment remote control consoles and CCTV monitors. The location of this remote control and monitoring room is convenient to the shipping/receiving area, so that workers can perform hands-on tasks in the work area, if necessary, and return to the room in order to maintain their ALARA radiation dose while still observing area activities. This remote operating room is shown in Figure 4.1-4.

4.6.3 Remote Control Consoles

Remote console rooms are located at one end of the canister transfer room, along the elevated walkways at the sides of the room. These rooms are constructed of reinforced concrete to provide shielding from radiation sources. Remote control consoles and CCTV monitors allow workers to operate canister transfer robotic equipment, automated components and canister transfer alignment devices from low radiation dose areas. The locations of the remote console rooms provide convenient access to the canister transfer work areas when hands-on tasks are required. These remote console rooms are shown in Figure 4.1-4.

4.6.4 Cask Monitoring Room

A cask monitoring room is provided in the personnel building, located outside of the main transfer facility building. This room houses computers and instrumentation for monitoring parameters of storage casks in the storage area. Storage cask parameters, such as temperature and pressure, are periodically monitored in this room via a system of computer data monitors that are hard-wired to the storage casks. The remote location of the cask monitoring room with respect to the storage area is necessary to keep worker dose ALARA, because of the radiation field created by the large number of casks in the storage area. The cask monitoring room is shown in Figure 4.1-4 in the personnel building.

4.7 ANALYTICAL SAMPLING

The CISF handles only canistered SNF. Liquid, solid and gaseous radioactive wastes result only from occasional wash-down, cleaning and venting of transportation casks, and radiation surveys of casks and cask handling components. These minimal liquid and solid radioactive wastes created at the CISF are collected on-site and removed from the facility by contracted vendors. No major radioactive waste processing facilities are required for the CISF.

4.7.1 Liquid Radioactive Waste Sampling

Liquid waste may be contaminated as a result of cask and canister decontamination operations. The extent of contamination should be small compared to radiological release limits. Liquid wastes are collected in storage tanks and regularly sampled for contamination. Samples are counted using analytical equipment to determine radionuclide composition as described in Chapter 9.

4.7.2 Solid Radwaste Sampling

Low volumes of solid radioactive wastes are anticipated. Solid radioactive wastes resulting from cask contamination surveillance and decontamination activities are disposed of in solid waste containers located and temporarily stored in the transfer facility. These solid radwastes generally consist of paper or cloth swipes, paper towels and rubber gloves. Solid radioactive wastes produced in decontamination operations are surveyed for measurable activity prior to dispensation. Solid radioactive waste is treated as low-level radioactive waste. Disposal is provided by vendors contracted to periodically collect the waste containers and take them off site for processing.

4.7.3 Gaseous Radioactive Waste Sampling

Air samples of the annular space between the transportation cask and the SNF canister are taken prior to opening the transportation cask, to ensure confinement and to protect personnel. The air sample is drawn from the cask through a sample filter paper to collect entrained particulates. The sample filter is analyzed for radionuclide content using analytical equipment described in Chapter 9. Sample exhaust is directed to the transfer facility HVAC exhaust system.

4.8 TRANSPORTATION CASK REPAIR AND MAINTENANCE

Major repair, maintenance, reconfiguration and annual certification of transportation casks are not performed at the CISF. These activities are performed by vendors at off-site locations. Vendor system SARs address transportation cask repair and maintenance.

Transportation cask repair is performed in the transfer facility as necessary to unload casks or to accomplish cask closure on empty casks for dispatch from the CISF. Such repair includes replacement of lid seals, repair or replacement of bolts/studs, and installation of threaded bolt/stud inserts for lids, trunnions, sample ports, impact limiters or personnel barriers. When major repairs or maintenance are required, incidental repairs are performed only to the degree necessary to safely transport the casks to an off-site repair facility.

4.9 PHYSICAL PROTECTION

This Section of the TSAR describes the CISF Physical Protection Plan components as outlined in NUREG-1497 (Ref. 4.9-1). The level of detail provided does not require a separate safeguard submittal. A detailed site-specific Security Plan will be developed for the CISF following site designation and be available for NRC review at least 90 days prior to receiving SNF on site.

The purpose of this non-site-specific Security Plan is to provide a description of the material to be contained in the Security Plan. This summary description, along with DOE's certification in the license application that the CISF will be provided such safeguards as it requires at comparable DOE facilities, is expected to satisfy the NRC's regulatory requirements relating to physical protection.

4.9.1 Introduction

The security system provides the basic capabilities needed for physical protection of the CISF and SNF. SSCs included in the security system are described at a sufficient level to provide a general overview of the physical protection system.

4.9.2 QA Classifications

Specific SSCs within the CISF security system have been conservatively classified as QA 6 - Important to Physical Protection of Facilities and Materials, and QA 7 - Important to Occupational Radiological Exposure. Therefore, the overall security system classification will be QA 6 and QA 7.

Security SSCs which have been classified as QA 6 include the following.

- Security complex
- Inspection gatehouse
- Security vehicles
- Controlled access area physical barriers
- Surveillance and monitoring
- Security lighting
- Communications
- Power supply.

Two security SSCs have been classified as QA 7. They are surveillance and monitoring, and security lighting.

4.9.3 Security System Functions

CISF functions are allocated to the security system and to the individual SSCs within the security system in order to ensure the design performs as intended. The main function of the security system is to provide protective services, which include material control and accountability (MC&A), physical security, emergency preparedness/response and emergency medical treatment.

4.9.4 Physical Protection Plan Components

4.9.4.1 Introduction and Schedule for Implementation

The security complex is located at the perimeter of the controlled access area. The supporting facilities are located in the controlled area of the facility. (See Figure 4.9-1.)

The security system's main support service function is to provide physical protection and access controls. The security system will also provide safeguards as required to promote the common defense and security in compliance with 10 CFR 72.24(o) and 10 CFR 72.40(a)(8).

Security design products are presented for the following SSCs.

- Security complex
- Receiving gatehouse
- Inspection gatehouse
- Main gatehouse
- Security vehicles
- Controlled access area physical barriers
- Surveillance and monitoring
- Security lighting
- Communications
- Power supply.

The physical layout of the security facilities includes all areas within the controlled area.

The CISF security facility is comprised of the SSCs identified above. Figure 4.9-1 shows the CISF site layout. The controlled access area contains the transfer facility, security complex, transporter wash-down station and cask staging area, and SNF storage area. The controlled area is the land within the site boundary.

4.9.4.1.1 Schedule

A security plan implementation schedule is not applicable to a non-site-specific TSAR.

4.9.4.2 General Performance Objectives

The security facilities' equipment and procedures provide physical protection of the CISF. The system is designed to protect the facility from radiological sabotage. Specific functions of the security facilities are as follows.

- Establish controlled access areas where special nuclear materials (SNM) are stored or used.

- Monitor, with intrusion alarms or other devices or procedures, the controlled access area to detect unauthorized penetrations or activities.

- Ensure that an on-site CISF facility guard or off-site response force will respond to all unauthorized penetrations or activities.

- Establish design basis threat, including necessary communication and surveillance equipment, that allows adequate response to security events.

- Establish facility stations to allow adequate implementation of the security plan (e.g., personnel access portals, vehicle access portals, and central alarm and monitoring stations).

- Ensure adequate aids to perform additional functions if security members will be providing other facility functions (such as fire brigade members or first aid responders).

- Provide a minimum of 0.2 foot candles (fc) of lighting for the controlled access area fence, isolation zones (interior and exterior), and inside the controlled access area.

- Conduct periodic security patrols to detect evidence of tampering with the physical protection system (e.g., barriers, locks, and intrusion detection equipment) and to detect any unauthorized activity.

- Conduct searches to prevent the introduction of explosives or other unauthorized materials and equipment. Electronic searches (e.g., metal detectors and explosive detectors) are required. Conduct pat-down searches on unbadged or suspect personnel.

The security facility provides physical protection and access controls capable of SNF protection under design-basis threats, as determined by 10 CFR 73. Guidance is provided for response to the sabotage of the facility or SNF.

10 CFR 72 contains the licensing requirements for SNF storage in a monitored retrievable storage (MRS) or interim storage facility. Subpart H, Physical Security, delineates the security requirements and references the applicable portions of 10 CFR 73.

To prevent sabotage of a facility, access must be denied to certain equipment that, if compromised or destroyed, can lead to a release of radioactive material or substantial reduction of program productivity.

In most cases, physical protection systems for theft and sabotage are similar, so design of the CISF physical protection system will be adequate whether the concern is SNM theft or sabotage. All proposed SNM protection systems and equipment are reviewed by safety and health personnel to ensure that CISF personnel are adequately protected and that systems do not present an undue risk.

The following specific hostile actions involving SNM and vital equipment will be avoided.

- Diversion of SNM (e.g. unauthorized placement of SNM within a material access area, or protected area)
- Sabotage of an SNM facility or vital equipment, including nuclear facilities or shipments that would result in an unacceptable impact to national security or public health and safety
- An unacceptable impact to public health and safety based on radiological exposure.

Security areas are established to protect SNM and personnel as follows.

- Controlled access area controls quantities of SNM and provides protection for personnel.
- Material access areas control access to areas containing quantities of SNM.
- Central alarm station access control areas protect alarm monitoring and communication capabilities.

4.9.4.3 Security Organization

4.9.4.3.1 Establishment of Security Organization

The establishment of a security organization provides for the monitoring of detection and assessment SSCs, for performing access control functions and for communication with a local law enforcement agency in the event of detection of unauthorized personnel or activity.

The security organization includes the Security Manager, Security Shift Supervisors, and a number of security personnel. The security organization is shown in Figure 13.1-4 (page 3 of 3). The Security Manager directs the Security Shift Supervisors and is responsible for day-to-day security activities. Security Shift Supervisors oversee the activities of shift security personnel, report events to local law enforcement (when required), and log security guard activities. The Security Guards report any disturbances or any breach of security occurring in the controlled and controlled access areas to the Security Shift Supervisor, who then takes appropriate action.

The security organization chain of command flows from the Security Manger to the Security Shift Supervisor to assigned security personnel. At least one Security Shift Supervisor is on site at all times. Security shifts overlap to ensure the transfer of instructions and information from one shift to another.

Security conflicts with personnel are reported to the Security Manager's office located in the security complex building. Security Guards are continuously stationed in the badging area located in the security complex which provides entrance to the controlled access area. At least two Security Guards are present in the badging area at all times, with one guard behind the counter. Security Guards are responsible for securing personnel and vehicle access gates, and for monitoring the facility through site cameras. The security complex guards are in constant contact with other site guards, and know their approximate locations at all times. Security personnel are present on the site at all times and in sufficient number to assess any unauthorized penetration and to perform other emergency response functions as described in Section 13.5.

Security Guards are responsible for patrolling the controlled area of the facility. Their activities are automatically logged as patrol tour stations are activated. Patrol tour monitoring devices are located in the controlled area that require periodic physical inspection.

Security Guards are required to periodically patrol the controlled areas of the facility to detect any unauthorized entry or security breach. All locked doors are randomly checked at least once every four hours. If a security event occurs, the guard promptly notifies the security complex central alarm station via telephone or two-way radio so that the local law enforcement agency can be contacted if necessary. The Security Manager or Security Shift Supervisor, as appropriate, coordinates facility security activities.

Documentation of all routine security tours and inspections and of all tests, inspections, and maintenance of physical barriers, intrusion alarms, communication equipment, and other security-related equipment is recorded and filed. The documentation for these events is retained for three years from the date of documentation.

All security personnel wear uniforms clearly distinguishable from local law enforcement and other on-site personnel. Security Guards will be equipped in accordance with Appendix B of 10 CFR 73. The security complex building contains all surveillance and communication equipment necessary for monitoring facility areas. Each Security Guard on duty is capable of maintaining constant communication with the badging area, with the security complex building and with other guards via two-way radio. Personnel in the badging area can call for assistance from local law enforcement authorities. Communication is provided by two-way radio or by conventional telephone service. Both radio base stations and telephone service have power sources that provide an independent source of electrical back-up power in the event of loss of normal power. In areas where the use of portable radios would interfere with plant monitoring equipment, telephones are provided. Two-way radios used by security are maintained in operable condition. Hand-held two-way radios are tested once at the beginning of each security personnel work shift, and the radio base station is tested daily. The security organization monitors detection and assessment subsystems, performs access control functions, and communicates with a designated response force or local law enforcement agency in the event of detection of unauthorized penetration or activities.

4.9.4.3.2 Security Audits

Security audits will be performed at least every 24 months. Each audit will include an evaluation of the effectiveness of the physical protection system and an audit of commitments established with local law enforcement agencies. Audits will be conducted by individuals independent of security management and personnel having direct responsibility for security program implementation. The reports will be maintained in an auditable form, available for inspection, for a period of three years.

4.9.4.3.3 Qualifications for Employment in Security

Individuals will not be permitted to act as guards, armed response persons or other members of the security organization unless they have been trained, equipped and qualified to perform each assigned job duty in accordance with 10 CFR 73 Appendix B. All security personnel granted unescorted access to the controlled access area where spent fuel is stored will undergo screening prior to being granted such access. This screening will include a Federal Bureau of Investigation criminal history check, a previous employment check and two reference checks.

4.9.4.3.4 Security Force Training

A guard force training and qualification plan will be established and included as an appendix to the physical protection plan when the license application is submitted. The plan will document that the applicable criteria of 10 CFR 73 Appendix B will be met. These criteria include: educational development (possession of a high school diploma or equivalent), no felony convictions involving the use of a weapon or reflecting on the individual's reliability, and physical qualifications indicating no physical weakness or abnormalities that would adversely affect the performance of assigned job duties.

4.9.4.3.5 Records

The following records will be established, maintained and retained: screening records until the affected individual terminates employment, and training and qualification records for a period of three years after the record is made.

4.9.4.4 Physical Barrier System

Physical barriers are described in this section and cover issues described in NUREG-1497 (Ref. 4.9-1) to the level of detail necessary for the CISF TSAR. Physical barriers will be discussed to a greater detail in the license application when a CISF site is specified.

4.9.4.4.1 General Layout

The CISF site layout (Figure 4.9-1) shows that SNF will be stored only within the controlled access area double fence.

4.9.4.4.2 Physical Barriers

The physical barriers for the CISF controlled access area consist of two eight-foot fences with an isolation zone between them. The fences are constructed of No. 11 American wire gage or heavier wire fabric, topped with three strands or more of barbed wire or a similar material on brackets angled outward between 30° and 45° from vertical, with an overall height of not less than eight feet, including the barbed wire topping. Posts, bracing and other structural members are located inside the secured perimeters. Once in place, all fence hardware is peened or spot welded to prevent easy removal. A 35-foot wide alarm zone and an intrusion alarm sensor system is provided between the fences. An isolation zone is established around buildings or facilities within the controlled access area and adjacent to the controlled access area fences. Except for security-related facilities, buildings are located a minimum of 30 feet inside the fence. Lighting is provided to allow 24-hour surveillance of the barriers. A patrol road within the perimeter of the controlled access area facilitates routine surveillance and alarm response. Other roads are provided for transport vehicles, delivery vehicles and other authorized vehicles. All private vehicles are parked outside of the controlled access area. A single fence separates the receiving and handling area from the SNF storage area limiting access to authorized personnel and vehicles.

Detection devices consist of video cameras, card readers and balanced magnetic door contacts. Other security measures, such as security guard patrol, personnel and vehicle motorized gates, door locks and electronic door strikes also aid in preventing unauthorized intrusion.

4.9.4.4.3 Security Posts

Security personnel will be stationed at several security posts at the CISF facility. These posts include the following locations.

4.9.4.4.4 Security Complex

The security complex is a rectangular, single-story structure located at the end of the main personnel and vehicular entrance through the controlled access area fence (see Figure 4.9-1). General arrangements for the controlled access badging area are provided in Section 4.1. Monitoring of assessment systems will be done by security personnel stationed in the continuously manned central alarm station located within the security complex. A secondary alarm station with the same monitoring capability as the central alarm station will be located at the local law enforcement agency.

The security complex is the main operation center for site security personnel and controls the site emergency vehicles. The building consists of one floor with approximately 12,000 square feet of floor area.

The security complex provides a secured, controlled entry for personnel, visitors and vehicles into the controlled access area. The building houses security personnel and contains the necessary equipment to search and badge personnel and to inspect vehicles. The complex also contains the necessary support functions for personnel. To efficiently utilize security personnel, a cargo access portal (CAP) is included.

The security complex is not directly involved in the CISF's principal processing functions. Activities at the controlled access badging area of the security complex include the following.

- Control and check employees, visitors and vehicles entering and exiting through the controlled access area fence.
- Search personnel.
- Issue and collect badges.
- Inspect vehicles (site maintenance, site emergency, site personnel, and off-site service) entering and leaving the controlled access area.
- Provide visual and electronic surveillance of the controlled access area.
- Provide control and administration of the cargo access portal.

4.9.4.4.5 Receiving Gatehouse

Access for radioactive shipments to the CISF is provided by two gatehouses, the receiving gatehouse and the inspection gatehouse. The receiving gatehouse, the first of the two encountered, is located at the CISF control boundary and is staffed only when deliveries are expected (Figure 4.9-1). SNF shipments enter through this gatehouse to obtain access to the controlled access area. Rail shipments (non-SNF) enter through this gatehouse to obtain access to the controlled area. The receiving gatehouse is not directly involved in the CISF's principal processing functions. The function of the receiving gatehouse is to control access to the controlled area for radioactive and non-radioactive shipments.

4.9.4.4.6 Inspection Gatehouse

The inspection gatehouse is located outside of the controlled access area and is enclosed by an extension of the fence surrounding the controlled access area (Figure 4.9-1). At the inspection gatehouse, SNF shipments are received and security inspections of heavy haul and rail transporters are performed. The inspection gatehouse also provides final clearance for shipments to be dispatched offsite. Access to the CISF site is controlled by motorized rolling gates at roadway and railway penetrations. The first set of gates allows off-site vehicles into the inspection gatehouse enclosure. The second and third sets of gates close off the controlled access area during inspection. An interlock capability prevents all gates from being opened simultaneously. Microwave detection and video camera coverage are provided as required.

After release of the off-site vehicle, the first gate is closed. When all inspections are completed, the second and third gates are opened to give an on-site transfer vehicle access to the transportation cask transporter for transport to the transfer facility receiving bays.

The inspection gatehouse is not directly involved in the CISF's principal processing functions.

Activities at the inspection gatehouse include the following.

- Receive SNF assembly shipments from off site.
- Complete initial paperwork and documentation verification.
- Perform detailed security inspection.
- De-couple off-site vehicles (trucks or locomotives).
- Connect on-site vehicles to transportation trailers or rail cars.

4.9.4.4.7 Main Gatehouse

Personnel and vehicular access to the CISF is provided by the main gatehouse located at the site boundary of the CISF (Figure 4.9-1). This gatehouse controls the access of personnel and vehicles to the CISF.

4.9.4.4.8 Illumination

The isolation zones and clear areas between barriers shall be provided with illumination sufficient for the monitoring required by 10 CFR 73, but not less than 0.2 foot candles (fc). Security lighting will be provided with high intensity discharge (HID) lighting fixtures. The security lighting will be powered from the local utility and backed up by the security diesel generator.

The controlled access area fence, the exterior isolation zone and the area within the controlled access area are illuminated to a minimum of 0.2fc. However, general lighting levels in excess of this minimum are necessary for adequate visual surveillance. Certain limited areas (e.g., beneath overhangs) may only be 0.2fc. Lighting units high in red content of the light spectrum (e.g., high pressure sodium vapor) are used for optimum video camera performance. Generally, the light levels exceed 2.5fc in video-monitored areas. Light fixture locations correspond to video camera positions so that light poles do not obstruct video camera view. Lighting units are located above the video camera height and viewing area to avoid glare and blooming. Receptacles at the base of each light pole connect temporary lighting if needed.

The light source selected for the security lighting system has the minimum practical re-strike time. The security lighting system provides sufficient light to perform its functions within two minutes of power restoration following an interruption. This light level is maintained at the end of the maintenance cycle, through the life of the light source and independent of any natural or other artificial light sources. All security lighting, both permanent and temporary, are of the same type of light source so as not to adversely affect current and future camera coverage areas.

The security lighting system turns on and off automatically. A manual override permits an operator to turn the lights on if the automatic system fails. The entire lighting system cannot be switched off from any single location beyond the security lighting distribution panel.

The personnel and vehicle access portal to the controlled access area requires light for personnel viewing and identification, as well as for vehicle searches. Lighting is selected to permit accurate color distinction and to provide a minimum illumination level of 2.5fc measured horizontally at ground level. Security information signs at vehicle and personnel entrances are illuminated to ensure visibility.

4.9.4.5 Access Control Subsystems and Procedures

4.9.4.5.1 Identification System

Each employee at the facility wears a badge with the employee's picture and a number. The number assigned to each person enables retrieval and filing. Badges must be displayed upon entry to the facility and while in the controlled area. Personnel recognition of co-workers, escort of visitors and other access controls provide adequate measures of protection against the presence of unauthorized persons within the area, and prevent the unauthorized disclosure of classified information.

4.9.4.5.2 Access to Controlled Access Areas

Access to the controlled access area is limited to individuals who are authorized for unescorted access to SNF and vital equipment, or authorized escorted individuals who require such access to perform job duties. Authorized unescorted employees have separate access authorization levels for the controlled access area which are magnetically encoded on their badges. Letters on the badge indicate the areas for which the person is cleared. Unescorted access to the controlled access area may be authorized for an individual not employed by the licensee, but who requires frequent and extended access to the area. Upon entrance into the controlled access area, the individual receives a numbered picture badge indicating non-employee unescorted status, the areas to which unescorted access is authorized, and the period for which such access is authorized. Emergency response vehicles and personnel requiring access to the controlled access area drive to the vehicle access gate at the security complex, where the driver and any passengers exit the vehicle and enter the security complex badging area. Visitors are cleared, signed in and given visitors' badges. Security personnel visually search the vehicle before entry into the controlled access area. If the vehicle is acceptable, the gate opens and the vehicle enters the site. Vehicles leaving the controlled access area are also searched.

4.9.4.5.3 Access Controls at the Controlled Access Area

Access control for personnel and packages delivered to the controlled access area is controlled from the security complex. A CISF employee requiring access to the controlled access area wears a picture badge. After entering the badging area in the security complex, the employee gives his or her badge number to security personnel, who retrieve the badge from the badge rack. Security personnel conduct a quick picture identification and then insert the badge into a card reader to record that the badge has been released. The employee takes the badge, walks through a metal detector and bomb sniffer, and inserts the badge into a card reader at the turnstile, which disengages the lock and allows the person to enter the controlled access area. During periods of heavy personnel traffic (e.g., at shift changes), security personnel may be posted at the gate entrance and turnstile to expedite personnel flow into the controlled access area.

Vehicles requiring access to the controlled access area will drive up to the vehicle access gate, where the driver and any passengers will exit the vehicle and enter the security complex badging area. The visitors are cleared, signed in and given visitors' badges. Security personnel visually search the vehicle cab, engine compartment, undercarriage and cargo area before entry into the controlled access area. If the vehicle is acceptable, the gate opens and the vehicle enters the site. Vehicles leaving the controlled access area are also searched.

SNF shipments enter the site through the receiving gatehouse and the inspection gatehouse.

4.9.4.5.4 Escorts and Escorted Individuals

Individuals not employed by the facility will be escorted by a member of the security organization or another individual designated by facility management while in the controlled access area. All individuals with authorized escorted CISF access wear badges designating them as visitors. Visitor escorts are documented at the controlled access area badge house. Visitor access and egress is recorded on a CISF log which lists name, employment affiliation, citizenship and badge number of the escort, and the name of the individual visited. These records will be retained for three years after the visitor's last entry. The maximum visitor-to-escort ratio is 10 to one. Visitors walk through the bomb sniffer and metal detector, and may undergo random searches by security personnel.

4.9.4.5.5 Key and Lock Control

All security keys, locks, combinations and related equipment used to control access to various areas will be controlled by security to reduce the probability of compromise. The distribution of combinations, access cards and keys for locks or padlocks used to secure gates or doors within the controlled access area will be given only to those individuals with authorized access to those areas.

Combination, keys and locks used in the controlled access area are changed whenever an individual's access authorization is revoked due to his or her lack of trustworthiness or reliability, inadequate work performance, or evidence or suspicion that the combination or key and lock may have been compromised. Keys and locks to which an employee has access will be changed within five days, card readers will be updated within 24 hours and the person's badge will be revoked after an employee is terminated. All locks, keys and combinations used in the controlled access area will be rotated or changed at least once every 12 months. A record of the combination of locks is stored in a locked drawer in the security complex. Keys or access cards shall not leave the controlled access area, and will be accounted for at the end of each workday. Security will keep a key to every door in the facility in a locked box located at the security complex. Security will also have keycards, which can access every door having a card reader.

Security will maintain a listing of keys and access cards, users, in and out time, and other pertinent information. A record of all locks, codes, keys and cards which might be used to compromise the integrity of the security system is stored in a location secured by a combination lock. A physical inventory of locks, codes, keys, cards and related equipment will be stored in a location secured by a combination lock. The security shift supervisor will be in charge of all locks, keys and cards.

4.9.4.5.6 Records

Records will be established, maintained and retained for current written procedures that permit access control personnel to identify authorized versus unauthorized entry of the controlled access area, the record of escorted individuals for a period of three years from the date of record, and a written procedure of key lock control for the period SNF is stored.

4.9.4.6 Detection, Surveillance and Alarms Subsystems

4.9.4.6.1 Isolation Zone Penetration

The intervening space between the two fences of the controlled access area will be monitored or periodically checked to detect the presence of personnel or vehicles and to allow the security organization to respond to suspicious activity or to breaching of the physical barriers. Monitoring of the controlled access area shall be performed by random patrol by the security force and through the use of a closed circuit television (CCTV) system.

The isolation zone around the physical barrier at the perimeter of the controlled access area will be monitored to detect the presence of individuals in the zone, to allow immediate response of the armed members of the security organization at the time of penetration of the controlled access area. Monitoring of the isolation zone shall be performed by random patrol by the security force and through the use of a CCTV. CCTV monitoring will be at the central alarm station located in the security complex. The cameras will be mounted around the storage area so that an unobstructed view can be obtained by remote operation with tilt, zoom and infrared capabilities. The isolation zone will also be protected by a volumetric intrusion detection system. Security vehicles are provided to support plant-related security functions. Each security vehicle is equipped with a siren, a two-way radio, and a spotlight.

4.9.4.6.2 Alarm Annunciation at Security Post

All alarms will annunciate in the central alarm station located in the security complex, as well as at a secondary alarm station located at the headquarters of the local law enforcement agency.

4.9.4.6.3 Power Sources

Electrical power for the security facilities is provided from the CISF switchgear building. Power is distributed to the security complex substation transformer and the security lighting substation transformer by cable of appropriate ampacity (Figure 4.9-2). This cable is routed in cable trays which are mounted in cable trenches. Cable penetrates the controlled access area through conduit banks in order to meet applicable security requirements. Conduit banks are provided under roads and railroad tracks.

Power is distributed from the security complex substation transformer to two panelboards. The first of these is designated as the security complex panelboard and serves the normal building loads. These loads do not have electrical backups and include building lighting and receptacle loads for the administrative and office areas of the security complex. The second panelboard is designated as Security Panelboard A. This panelboard supplies security system loads and has electrical backup. The loads served by this panelboard include security room HVAC, the security system battery charger and the UPS system. The security UPS system supplies the 120 VAC UPS Power Panelboard C, which in turn supplies the security room lights, the security control system, the communications system and monitoring. Electrical backup is provided to Security Panelboard A from a 500 kVa diesel generator connected to Security Panelboard D. The diesel generator will start upon a loss of voltage to Panelboard A and power will automatically transfer when the diesel generator is up to speed and voltage. The security diesel generator fuel tank is sized for 24-hour operation at full load.

The security system lighting is supplied from the security lighting substation transformer. This transformer serves the Security Panelboard B, which feeds the security system lighting in the storage area and other security lighting at the transfer facility and the receiving gatehouse. This panelboard is also backed up by electrical power from the security diesel generator, as shown in Figure 4.9-2. The diesel generator will start upon a loss of voltage to Panelboard B, and power will automatically transfer when the diesel generator is up to speed and voltage.

Power for the main gatehouse and receiving gatehouse is provided from the security complex panelboard and is distributed by cable of appropriate ampacity, buried directly in the ground. Conduit banks are provided under roads and railroad tracks. Power is distributed to the electrical distribution equipment (motor starters, distribution panel, etc.) in the gatehouses by cable routed in concrete-encased conduit banks. Power for the inspection gatehouse is provided from Security Panelboard A and has electrical backup.

The security system power supply powers all security system equipment in accordance with manufacturer specifications. The largest connected load or motor can be energized, assuming that the system is otherwise fully loaded, without causing loss of other security system loads due to voltage dip. The power supply has a minimum capacity of 25% greater than the anticipated operational load.

For more detail on power sources and electrical power delivery, see Section 4.4.2.

4.9.4.6.4 Component Supervision

All intrusion detection systems are tamper-indicating and self-check, meaning an automatic indication is provided when failure of an alarm system or a component occurs. Degradation of the electrical backup power source or the uninterruptible power system equipment is annunciated in the security control room.

4.9.4.6.5 Controlled Access Area Monitoring and Assessment

The isolation zone around the physical barrier at the perimeter of the controlled access area will be monitored to detect the presence of individuals in the zone. This will allow immediate response of the armed members of the security organization at the time of penetration of the controlled access area. Monitoring of the isolation zone shall be performed by random patrol at least every eight hours by the security force, and through the use of a CCTV system. CCTV monitoring will take place at the central alarm station located in the security complex. The cameras will be mounted around the storage area so that an unobstructed view can be obtained by remote operation with tilt, zoom and infrared capabilities. The area will also be protected by a volumetric intrusion detection system.

4.9.4.7 Communications Subsystems

4.9.4.7.1 Security Force Communications

Each guard on duty shall have the capability of maintaining continuous communication with the central alarm station within the controlled access area. Each guard shall also have the capability of calling for assistance from other guards or local law enforcement authorities, and shall be equipped with two-way radio communications equipment.

For more detail on the communications system, see Section 4.4.6.

4.9.4.7.2 Alarm Station Communications

The central alarm station in the security complex, which is in the controlled access area, will have conventional telephone service for communication with law enforcement authorities. Two-way radio voice communications will be established between local law enforcement authorities and the facility, and shall terminate at the facility in the central alarm station.

The security complex communication system consists of telephones, a public address system and a radio system. The radio system provides a dedicated system for continuous two-way communication among members of the security force and between guards and the central alarm station. It also provides communication capabilities between the central alarm station and the secondary alarm station, and between the alarm stations and local law enforcement agencies. A wide-area-coverage radio system, designed to communicate within a larger area around the site for dispatching and control of mobile units, will also be provided. Access to the public address system will be provided so that personnel in the building can communicate with the rest of the facility. The control console for all of these radio systems will be located in the central alarm station.

For more detail on the communications system, see Section 4.4.6.

4.9.4.7.3 Power Sources

The security UPS supplies the 120 VAC UPS Power Panelboard C, which supplies the security room lights, the security control system, the communications system and monitoring equipment (Figure 4.9-2). Electrical backup power is provided to Security Panelboard A from a 500 kVa diesel generator connected to Security Panelboard D. The diesel generator will start upon a loss of voltage to Panelboard A and power will automatically transfer when the diesel generator is up to speed and voltage.

For more detail on power sources and electrical power delivery, see Section 4.4.2.

4.9.4.8 Test and Maintenance Program

4.9.4.8.1 Specification Tests

All equipment will be tested to manufacturers' specifications at initial installation.

4.9.4.8.2 Operational Tests

Intrusion alarms, emergency alarms, communication equipment, physical barriers and other security-related devices or equipment will be tested and maintained per 10 CFR 73.50(f)(2). All alarms will be functionally tested for operability and required performance at the beginning and end of each interval during which they are used for security, but not less frequently than once every 7 days. Per 10 CFR 73.50(f)(3), communication equipment is tested for operability and performance at least once at the beginning of each security personnel work shift. Initial qualification tests for security equipment are maintained for the life of the equipment, and records of security equipment maintenance are maintained for a period of one year. A system for recording each alarm, false alarm, alarm check and tamper indication is established and maintained, identifying the date and time of alarm annunciation, type of alarm, location of alarm detector, alarm circuit, and alarm and incident findings as determined by the responding security organization members. These records are retained for three years.

4.9.4.8.3 Repairs and Maintenance

All alarms, communications equipment, physical barriers, and other security-related devices or equipment are maintained in operable and effective condition as required by 10 CFR 73.50(f)(1). At least once every four hours, a security guard random patrol will verify the integrity and operability of the security fence, locks and lighting to detect any unauthorized activities. Perimeter intrusion detection systems, communications equipment, lighting and video cameras are tested to ensure operability in accordance with existing testing procedures. Security record retention periods will be specified by maintenance, training, personnel screening, audit reports, patrols, inspections, key issuance log, authorized vehicles, compensatory measures, and abnormal or unusual events.

4.9.4.9 Contingency Response Plans and Procedures

4.9.4.9.1 Contingency Plan Documentation

A safeguards contingency plan will be established for dealing with threats related to the SNM at the CISF. This plan will conform to the criteria in 10 CFR 73 Appendix C.

The safeguards contingency plan and event matrix will provide guidance for security and designated management in order to accomplish specific, defined objectives in the event of threats to the CISF. Incidents addressed in the contingency plan will include the following.

- Attempted and actual intrusions
- Civil disturbances
- Communications failure
- Intrusion detection system failure
- Lighting failure
- Physical barrier degradation
- Discovery of unauthorized personnel and vehicles
- Unavailability of the security force.

These plans will be developed and available to the NRC staff at least 90 days prior to the receipt of SNF on site.

4.9.4.9.2 Response Force Liaison

In accordance with 10 CFR 73.50(g)(2), an agreement with the local law enforcement agency will be established and documented. Copies of the agreement with the local law enforcement agency will be retained until the NRC terminates each license for which the liaison was developed. If any portion of the liaison documentation is superseded, the superseded material is retained for three years after each change.

The Security Shift Supervisor (or designee) will direct and escort the local law enforcement agency members, who will meet the Security Shift Supervisor at the main gate to be directed to the location of the incident. Only cleared personnel will be allowed to enter controlled access areas; all others must remain outside. During entry to the site, only law enforcement personnel will be admitted.

The local law enforcement agency will attend continual refresher training classes on such topics as facility and site tours, the facility security organization, facility responsibilities during an incident, response procedures, and special constraints imposed on security in protecting the facility.

4.9.4.9.3 Response Procedures

Upon detection of an abnormal presence or activity of persons or vehicles within the controlled access area, material access area or isolation zone, the security force will determine whether a threat exists, assess the extent of the threat, and take measures to neutralize the threat. These measures will require every guard to prevent or impede attempted acts of radiological sabotage by using force sufficient to counter the force directed at the guard. This includes deadly force when the guard has a reasonable belief that it is necessary in self-defense or in the defense of others, as required by 10 CFR 73.50(g)(4). The local law enforcement agencies will also be informed of the threat, and assistance will be requested.

If the physical barrier of the controlled access area has a reduction in effectiveness, a guard with communications capability will be posted at the affected area to provide surveillance. The barrier will be replaced with a spare barrier section stored on site, or video camera surveillance with a dedicated monitor and observer will be used. These activities will be implemented within 30 minutes after detection. Security investigates any penetration or attempted penetration of the controlled access area.

4.9.4.9.4 Records

A copy of the safeguards contingency plan and each change to the plan is retained as a record at the CISF and with the local law enforcement agency until the NRC terminates each license for which the plan was developed. Superseded materials are retained for three years after each change.

4.10 REFERENCES

Section 4.2

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4.2-2 NUREG-0612. *Control of Heavy Loads at Nuclear Plants.* 1980.

4.2-3 NUREG-0554. *Single-Failure-Proof Cranes for Nuclear Power Plants.* 1979.

4.2-4 ASME NOG-1. *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge. Multiple Girder).* 1989.

4.2-5 ANSI-N14.6. *Radioactive Materials - Special Lifting Devices for Shipping Containers Weighing 10,000 lbs (4500 kg) or More.* 1986.

4.2-6 Holtec Report HI-941184. Docket No. 72-1008. *Topical Safety Analysis Report for Packaging for the Holtec International Storage. Transport and Repository Cask System (HI-STAR 100 Cask System).* Rev. 3. Holtec International. August 1995.

4.2-7 NAC-T-90002. Docket No. M-55. *Topical Safety Analysis Report for the NAC Storable Transport Cask for Use at an Independent Spent Fuel Storage Installation.* Rev. 3. NAC Services Inc. July 1994.

4.2-8 NUH-003. Docket No. 72-1004. *Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel.* Rev. 3A. VECTRA Technologies Inc. June 1995.

4.2-9 Docket No. 72-0011. *Safety Analysis Report for Rancho Seco Independent Spent Fuel Storage Installation.* Rev. 1. Sacramento Municipal Utility District. October 1993.

4.2-10 MPC-CD-02-017. *Safety Analysis Report for the Small On-Site Transfer and On-Site Storage Segment.* Rev. 0. Westinghouse Government and Environmental Services Co. May 1996.

4.2-11 Docket No. 72-0017. *Trojan Independent Spent Fuel Storage Installation Safety Analysis Report.* Portland General Electric Co. March 1996.

Section 4.4

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4.4-2 NFPA 90A. *Standard for Installation of Air Conditioning and Ventilating Systems*. 1993 edition.

4.4-3 NFPA 70. *National Electrical Code*. 1996 edition.

4.4-4 ANSI C2. *National Electrical Safety Code*. 1997 edition.

4.4-5 ANSI/IEEE C57.12.00. *Standard General Requirements for Liquid-immersed Distribution, Power, and Regulating Transformers.*

4.4-6 IEEE 142. *IEEE Recommended Practices for Grounding Industrial and Commercial Power Systems*.

4.4-7 NFPA 780. *Standard for Lightning Protection Code*. 1992 edition.

4.4-8 NEMA PB-1. *Panel Boards.*

4.4-9 UL 67. *Underwriters Laboratory Standard for Safety Panel Boards.*

4.4-10 NEMA Standard ST20. *Dry-type Transformers for General Application*.

4.4-11 *National Plumbing Code*. 1990 edition.

4.4-12 ASME/ANSI B.31.1-1995. American Society of Mechanical Engineers/American National Standards Institute. *Power Piping*. 1995.

4.4-13 ANSI/ANS-57.9-1992. *Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)*. 1992.

4.4-14 NFPA 13. *Standard for Installation of Sprinkler Systems*. 1994 edition.

4.4-15 NFPA 22. *Standard for Water Tanks for Private Fire Protection*. 1996 edition.

4.4-16 NFPA 72. *National Fire Alarm Code*. 1993 edition.

4.4-17 NFPA 10. *Standard for Portable Fire Extinguishers*. 1994 edition.

4.4-18 NFPA 14. *Standard for Installation of Standpipe and Hose Systems*. 1996 edition.

5. OPERATING PROCEDURES

This Chapter provides a description of the CISF operations. Detailed procedures will be developed as described in Chapter 13 which will ensure that routine operations are conducted in a safe manner. The operating procedures will integrate appropriate information from the technical specifications presented in Chapter 14 and from the vendor SARs.

Section 5.1 describes the major operating steps for handling the cask/canister and transportable storage cask (TSC) systems. Section 5.2 presents the hazard identification and evaluation process used to ensure that all design-basis events (DBEs) are identified and considered as an integral part of CISF design.

This TSAR seeks NRC concurrence that:

- The proposed operating descriptions of the principal operating functions expected to occur are acceptable and adequate.

- The proposed operating descriptions conform with the Technical Specifications.

- The proposed operating descriptions incorporate ALARA principles, provide effective measures to preclude potential unplanned and uncontrolled releases of radioactive materials, and ensure off-site dose rates will be maintained within regulatory limits.

- The TSAR presents a systematic approach to the identification of off-normal and accident events that is comprehensive and provides reasonable assurance that all DBEs are identified and appropriately considered as an integral part of CISF design.

5.1 DESCRIPTION OF OPERATIONS

This section describes the normal handling of vendor cask systems at the CISF as follows.

- Holtec HI-STAR 100 System
- Nuclear Assurance Corporation (NAC) STC System
- VECTRA NUHOMS®-MP187/HSM System
- Westinghouse Large/Small Multi-Purpose Canister (MPC) System
- Sierra TranStor™ System.

Detailed operational flowsheets for these systems are presented in Figures 5.1-1 through 5.1-32. The flowsheets include all CISF cask-handling activities, from receipt of the transportation casks and TSCs at the gate, to placement of the TSCs and storage casks in the storage area, and dispatch of the empty transportation casks. All vendor-specific equipment needed for accomplishing these tasks is identified. The flowsheets are indexed in Table5.1-1.

The flowsheets identify the operational steps to be performed for receipt, handling, transfer and storage of commercial SNF using various vendor technologies, and the personnel responsible for performing them. Personnel responsible for CISF receiving, dispatch, canister transfer, storage, retrieval and recovery operations include:

- Transfer Facility Crane Operator (TFCO)
- Transfer Facility Operator (TFO)
- Transfer Facility Remote Operator (TFRO)
- Radiological Protection (RP) personnel
- Site Operator
- Storage Operator.

Table 5.1-1. Operational Flowsheet Index

Systems	Operational Step Descriptions	Figure No.
Transportation Cask Receipt (All Vendors)	Receipt at Site	5.1-1 & 5.1-2
	Receipt at Shipping/Receiving Area	5.1-3 through 5.1-5
	Shipping/Receiving Area to Dispatch	5.1-6
	Dispatch Off site	5.1-7
Holtec HI-STAR 100 System	TSC Preparation	5.1-8
	TSC to Storage	5.1-9
NAC STC System	TSC Preparation	5.1-10
	TSC to Storage	5.1-11
VECTRA NUHOMS® System	MP187 Preparation	5.1-12 & 5.1-13
	HSM Preparation	5.1-14
	Transfer to Storage	5.1-15 & 5.1-16
Westinghouse Large/Small MPC System	Storage Cask from Staging Area	5.1-17
	Storage Cask Preparation	5.1-18
	Transfer Preparation	5.1-19
	Canister Transfer	5.1-20 through 5.1-22
	Storage Cask Closure	5.1-23
	Storage Cask to Storage	5.1-24
Sierra TranStor™ System	Storage Cask from Staging Area	5.1-25
	Storage Cask Preparation	5.1-26
	Transfer Preparation	5.1-27
	Canister Transfer	5.1-28 through 5.1-30
	Storage Cask Closure	5.1-31
	Storage Cask to Storage	5.1-32

The CISF design also accommodates SNF retrieval. Operational steps for retrieving SNF for shipment are generally performed in the opposite order from those described in this section; accordingly, operational flowsheets for retrieval operations are not presented.

5.1.1 Receiving and Dispatch Operations for All Cask/Canister Systems

Figures 5.1-1 through 5.1-7 identify the operating steps for receipt and dispatch of all transportation cask system designs. Receipt operations involve site receipt systems, and the transfer facility cask off-loading and loading system.

"Receipt at Site" (Figures 5.1-1 and 5.1-2) indicates the operational steps that take place on the CISF site. Loaded transportation casks and TSCs are received at the CISF, bills of lading and other shipping papers are inspected, the site prime mover is hitched, and a security inspection and RP radiation survey of the casks are performed. The casks are moved to the transporter wash-down station where road grime is removed, as necessary, and they are then taken to the transfer facility for transfer and storage preparation.

"Receipt at Shipping/Receiving Area and Shipping/Receiving Area to Dispatch" (Figures 5.1-3 through 5.1-6) indicate operational steps within the CISF transfer facility.

"Dispatch Off site" (Figure 5.1-7) operational steps also take place on the CISF site. Dispatch of empty transportation casks occurs shortly after SNF canisters are received, transferred and placed into storage, or when SNF canisters are retrieved from storage and placed in the transportation casks for shipment off site. After the empty or loaded transportation casks are moved from the transfer facility to the inspection gatehouse, shipping paperwork is prepared and the casks are dispatched off site.

For the Holtec HI-STAR 100 and the NAC STC systems, canister transfer operations are not necessary for retrieval. Dispatch of the TSCs occurs only when retrieval operations are necessary.

5.1.2 Holtec HI-STAR 100 System

The HI-STAR 100 is a metal, cylindrical multi-wall transportation cask that contains a canister. Designed for both transportation and storage, the cask functions as a TSC. At the transfer facility, the HI-STAR 100 is received as a transportation cask. It is then vertically transported to the storage area and vertically positioned for interim storage. There are no canister transfer operations involved in placing the HI-STAR 100 into storage.

For storage operations, the HI-STAR 100 is received at the site, taken to the transfer facility, upended to a vertical position and removed from the transporter by the overhead bridge crane. The cask is radiologically surveyed and decontaminated (if required). A gas sample is taken from the cask's annular region and tested. Containment leak checks are performed on closures and penetrations prior to storage. The thermal performance of the cask is tested and verified. Each cask's identity and condition are verified. The site transporter then engages, secures, lifts and moves the cask from the transfer facility to the storage area for direct placement into storage. Figures 5.1-8 and 5.1-9 identify the operating steps for placing the HI-STAR 100 into storage.

For retrieval operations, the site transporter engages, secures, lifts and moves the HI-STAR 100 from the storage area to the transfer facility. The casks are radiologically surveyed and decontaminated (if required). Gas samples are taken from the cask's annular region and tested. Containment leak checks are performed on closures and penetrations prior to dispatch. The thermal performance of the cask is tested and verified. Each cask's identity and condition are verified. The casks are then lifted and positioned over their transporters in the transfer facility shipping/receiving area by the overhead bridge cranes, lowered, secured and prepared for dispatch.

5.1.3 NAC STC System

The NAC STC is a metal, cylindrical multi-wall transportation cask that contains bare SNF assemblies. Designed for both transportation and storage, the cask functions as a TSC. It contains bare SNF assemblies inside an integral basket; no removable welded steel canister is provided. At the transfer facility, the NAC STC is received as a transportation cask. It is then vertically transported to the storage area and positioned vertically for interim storage of the SNF. No canister transfer operations are involved in placing the NAC STC into storage.

For storage operations, the NAC STC is received at the site, taken to the transfer facility, upended to a vertical position and removed from the transporter by the overhead bridge crane. The NAC STC is radiologically surveyed and decontaminated (if required). The NAC STC interlid region is pressure-tested prior to storage. Each cask's identity and condition are verified. The site transporter then engages, secures, lifts and moves the NAC STC from the transfer facility to the storage area for placement. Once the NAC STC is in place on the storage pad, pressure monitoring systems are installed to provide continuous monitoring of the interlid region of the cask. Figures 5.1-10 and 5.1-11 identify the operating steps for placing the NAC STC into storage.

For retrieval operations, the pressure monitoring systems are disconnected from the NAC STC. The site transporter engages, secures, lifts and moves the NAC STC from the storage area to the transfer facility. The NAC STC is radiologically surveyed and decontaminated (if required). The NAC STC interlid region is pressure-tested prior to dispatch. Each cask's identity and condition are verified. The NAC STC is then lifted and positioned over the transporter by the overhead bridge crane, lowered, secured and prepared for dispatch.

5.1.4 VECTRA NUHOMS®-MP187/HSM System

The NUHOMS® system includes the MP187 transportation cask and the Horizontal Storage Module (HSM). The MP187 cask is a metal, cylindrical multi-wall transportation cask that contains a welded canister. The cask is designed for both transportation and storage. The MP187 cask is received as a transportation cask and horizontally transported from the transfer facility by a special transfer trailer to the storage area. Canister transfer is performed in the storage area by horizontally positioning, aligning and mating the MP187 to an HSM, and then pushing the canister out of the cask into the HSM. A thermal monitoring system is installed on the HSM air outlets.

For storage operations, the MP187 cask (containing welded canisters) is received at the site, taken to the transfer facility, upended to a vertical position and removed from the transporter by the overhead bridge crane. The cask is radiologically surveyed, the cash cavity is vented and tested, and the cask is decontaminated (if required). Each cask's identity and condition are verified. The cask is then placed horizontally on a site transfer trailer by the overhead bridge crane.

The site transfer trailer transports the cask to the storage area, where operators prepare for field transfer of the canister into an HSM. The MP187 cask is moved to within a few feet of the HSM. The MP187 cask is positioned and approximately aligned, and the top cover plate is removed. The transfer trailer is backed to the HSM door and docked. The MP187 cask is aligned with the HSM, and a hydraulic ram system is installed and engaged to push the canister from inside the MP187 cask into the HSM.

The hydraulic ram system is disengaged and removed, and the empty MP187 cask is retracted and moved clear. The HSM door is installed using a portable yard crane. The top cover plate of the empty MP187 cask is reinstalled. The empty MP187 cask is towed to the transfer facility shipping/receiving area and prepared for dispatch and reuse. Figures 5.1-12 through 5.1-16 identify the operating steps for canister transfer operations for the NUHOMS®-MP187 System.

For retrieval operations, the MP187 cask is received at the site, taken to the transfer facility, upended to a vertical position, removed from the transporter by the overhead bridge crane and placed horizontally on the transfer trailer. The transfer trailer transports the MP187 cask to the storage area, where operators prepare for field transfer of the canister from the HSM to the MP187 cask. The cask is moved to within a few feet of the HSM and approximately aligned, and the top cover plate is removed. The transfer trailer is backed to the HSM door and the MP187 cask is docked. The canister is aligned with the MP187 cask. The hydraulic ram system is installed and engaged to pull the canister from inside the HSM into the cask.

The hydraulic ram system is then disengaged and moved. The cask is retracted and moved clear, the cask's top cover plate is reinstalled, and the cask is towed to the receiving area of the transfer facility to be prepared for dispatch. The cask is upended and lifted from the transfer trailer by an overhead bridge crane and placed vertically on the floor of the shipping/receiving area. The MP187 cask is inverted, radiologically surveyed and decontaminated (if required). The cask is then lifted and positioned over the transporter in the transfer facility shipping/receiving area by the overhead bridge crane, lowered, secured and prepared for dispatch.

5.1.5 Westinghouse Large/Small MPC System

The Westinghouse Large/Small MPC System includes transportation casks, which are designed for transportation only, and concrete storage casks. Large or small MPCs are horizontally transferred from a Westinghouse Large/Small MPC System transportation cask to a large or small concrete storage cask in the transfer facility. The transportation casks serve as the transfer casks in both the large and small Westinghouse designs. Concrete storage casks, containing the canisters, are vertically transported to the storage area and vertically positioned for storage. A thermal monitoring system is installed on the air outlets.

The Westinghouse Large/Small MPC System transportation cask is upended and removed from the transporter in the transfer facility shipping/receiving area by overhead bridge crane. The cask is then placed vertically on the floor near the cask decontamination booth in the shipping/receiving area. The transportation cask is radiologically surveyed and decontaminated (if required).

Once the Westinghouse Large/Small MPC System transportation cask is in the canister transfer area, it is placed horizontally into a transfer cradle by the overhead bridge crane in order to prepare for horizontal transfer of the canister to the storage cask. The transfer cradle is used to support, position and mate the large or small Westinghouse transportation casks to the large or small storage cask for horizontal canister transfer.

An upender/downender device is also provided to support and rotate the large and small Westinghouse concrete storage casks from a vertical position to a horizontal position for horizontal canister transfer. The upender/downender device is mounted on rails, and self-contained drive motors position it for mating the storage cask to the transportation cask. The overhead bridge crane is used to place storage casks into and take them out of the upender/downender devices using the concrete cask intermediate lifting device.

The canister transfer components include a ram device for pulling canisters horizontally from transportation casks into storage casks. The ram pushes canisters from storage casks into transportation casks during retrieval operations. The ram is attached to a pintle on the top of the canister, which pulls the canister into the storage cask. Once the canister is inside, the storage cask is closed with a bottom lid and a top lid and prepared for storage.

The concrete storage cask is engaged, secured, lifted and moved by the site transporter to the storage area and placed into storage. A thermal monitoring system is installed on the cask air outlets. Figures 5.1-17 through 5.1-24 identify the operating steps for canister transfer operations for the Westinghouse Large/Small MPC System designs.

In general, retrieval operations are the reverse of the operations for placing the casks into storage as described above. For retrieval of both the large and the small Westinghouse MPC designs, an empty transportation cask is received at the site, taken to the transfer facility, upended and removed from the transporter by the overhead bridge crane. The transportation cask is then moved into the canister transfer area and placed horizontally onto a vendor-supplied transfer cradle, in order to prepare for horizontal transfer of the canister from the concrete storage cask. The concrete storage cask is engaged, secured, lifted and moved from the storage area to the transfer facility by the site transporter, moved to the transfer area by the overhead crane, and prepared for canister transfer to the transportation cask. The overhead bridge crane is used to place the concrete storage cask in a permanently mounted upender/downender device. The upender/downender device lifts the concrete storage cask and rotates it from a vertical to a horizontal position in preparation for canister transfer.

After the canister is pushed inside the transportation cask by the hydraulic ram, the empty concrete storage cask is upended, contamination surveys are performed at the top of the empty concrete storage cask, and the lid is reinstalled. The identity and condition is verified for each transportation cask. The transportation cask is then closed and inerted, radiologically surveyed and decontaminated (if required). It is then lifted and positioned over the transporter by the overhead bridge crane, lowered, secured and prepared for dispatch. The empty concrete storage cask is moved to the storage area by the site transporter for reuse.

5.1.6 Sierra TranStor™ Cask/Canister System

The TranStor™ system includes transportation casks, which are designed for transportation only, and concrete storage casks. Canisters are vertically transferred from the transportation casks to the concrete storage casks in the transfer facility. A separate, shielded metal transfer cask is provided to accomplish the vertical transfer operations. The concrete storage casks, containing the canisters, are vertically transported to the storage area and vertically positioned for storage. A thermal monitoring system is installed on the concrete cask air outlets.

The TranStor™ system transportation cask is upended and removed from the transporter in the transfer facility shipping/receiving area by the overhead bridge crane. The cask is then placed vertically on the floor near the decontamination booth in the shipping/receiving area, where it is radiologically surveyed and decontaminated (if required).

The TranStor™ cask is then placed on the floor of the canister transfer area by the overhead bridge crane and supported in preparation for vertical canister transfer. An empty TranStor™ concrete storage cask is brought into the transfer facility site transporter area, placed in a vertical position by the site transporter, and picked up by overhead bridge cranes using the concrete cask intermediate lifting device. The overhead bridge crane carries the empty concrete storage casks into the canister transfer area, and then back out into the site transporter area after it is loaded.

The TranStor™ system uses a separate transfer cask to transfer SNF canisters from transportation casks to concrete storage casks. One of the transfer facility overhead bridge cranes lifts the transfer cask and sets it on top of a loaded transportation cask that has been prepared for canister transfer. After properly supporting and mating the transfer cask to the transportation cask, a shield door is opened in the bottom of the transfer cask and the SNF canister is lifted up into the transfer cask with a lifting sling. The shield door in the bottom of the transfer cask is closed and the transfer cask is moved to, mated with and supported on the storage cask. The doors in the bottom of the transfer cask are opened and the canister is lowered into the storage cask. After removing the lifting slings and support devices, the transfer cask is moved away from the storage cask. The top of the canister provides shielding so that the lids of the storage and transportation casks need not be in place in order to shield personnel performing the transfer operation.

Prior to canister transfer, a concrete storage cask is prepared for transfer operations. After canister transfer is completed, the storage cask is closed with a lid and prepared for storage. The concrete cask is then engaged, secured, lifted and moved by the transporter and placed in storage. A thermal monitoring system is installed on the cask air outlets. Figures 5.1-25 through 5.1-32 identify the operating steps for canister transfer operations for the TranStor™ system.

In general, retrieval operations are the reverse of the operations for placing the casks into storage as described in detail above. For retrieval operations, a transportation cask (receiving casks) for the TranStor™ system is received at the site, taken to the transfer facility, upended, and removed from the transporter by an overhead bridge crane. The receiving cask is then lifted and moved into the canister transfer area, and prepared for vertical canister transfer from the concrete storage cask (source cask). The source cask is engaged, secured, lifted and moved from the storage area to the transfer facility by the transporter.

The source cask is then moved to the canister transfer area by the overhead crane and prepared for canister transfer to the receiving cask. The canister is vertically transferred from the source cask to the receiving cask by a shielded TranStor™ transfer cask. Each receiving cask's identity and condition is verified, the cask is closed and inerted, and contamination surveys are performed at the top of the cask. The empty source cask is decontaminated (if required) and the lids are reinstalled. The receiving casks are radiologically surveyed and decontaminated (if required), lifted and positioned over the transporter by the overhead bridge crane, lowered, secured and prepared for dispatch. The empty source cask is then moved to the storage area by the site transporter and prepared for reuse.

Figure 5.1-1 Transportation Cask Receipt (All Vendors) - Receipt at Site

Figure 5.1-2 Transportation Cask Receipt (All Vendors) - Receipt at Site (cont'd.)

Figure 5.1-3 Transportation Cask Receipt (All Vendors) - Receipt at Shipping/Receiving Area

Figure 5.1-4 Transportation Cask Receipt (All Vendors) - Receipt at Shipping/Receiving Area (cont'd.)

Figure 5.1-5 Transportation Cask Receipt (All Vendors) - Receipt at Shipping/Receiving Area (cont'd.)

Figure 5.1-6 Transportation Cask Receipt (All Vendors) - Shipping/Receiving Area to Dispatch

Figure 5.1-7 Transportation Cask Receipt (All Vendors) - Dispatch to Off site

Figure 5.1-8 Holtec HI-STAR 100 System - TSC Preparation

Figure 5.1-9 Holtec HI-STAR 100 System - TSC to Storage

Figure 5.1-10 NAC STC System - TSC Preparation

Figure 5.1-11 NAC STC System - TSC to Storage

Figure 5.1-12 VECTRA NUHOMS® sYSTEM - MP187 Preparation

Figure 5.1-13 VECTRA NUHOMS® - MP187 Preparation (cont'd.)

Figure 5.1-14 VECTRA NUHOMS® System - HSM Preparation

Figure 5.1-15 VECTRA NUHOMS® System - Transfer to Storage

Figure 5.1-16 VECTRA NUHOMS® System - Transfer to Storage (cont'd.)

Figure 5.1-17 Westinghouse MPC System - Storage Cask From Staging Area

Figure 5.1-18 Westinghouse MPC System - Storage Cask Preparation

Figure 5.1-19 Westinghouse MPC System - Transfer Preparation

Figure 5.1-20 Westinghouse MPC System - Canister Transfer

Figure 5.1-21 Westinghouse MPC System - Canister Transfer (cont'd.)

Figure 5.1-22 Westinghouse MPC System - Canister Transfer (cont'd.)

Figure 5.1-23 Westinghouse MPC System - Storage Cask Closure

Figure 5.1-24 Westinghouse MPC System - Storage Cask to Storage

Figure 5.1-25 Sierra TranStor™ System - Storage Cask from Staging Area

Figure 5.1-26 Sierra TranStor™ System - Storage Cask Preparation

Figure 5.1-27 Sierra TranStor™ System - Transfer Preparation

Figure 5.1-28 Sierra TranStor^{TM} System - Canister Transfer

Figure 5.1-29 Sierra TranStor™ System - Canister Transfer (cont'd.)

Figure 5.1-30 Sierra TranStor^{TM} System - Cansiter Transfer (cont'd.)

Figure 5.1-31 Sierra TranStor™ System - Storage Cask Closure

Figure 5.1-32 Sierra TranStor™ System - Storage Cask to Storage

5.2 IDENTIFICATION OF SUBJECTS FOR SAFETY ANALYSIS

This section presents the hazard identification process used to ensure that all design-basis events (DBEs) are identified and considered as an integral part of CISF design. In addition to reviewing DBEs evaluated by the cask vendors a Preliminary Hazards Assessment (PHA) was performed to support CISF design and licensing activities. The PHA identifies potential radiological hazards to facility workers, the public and the environment, ranging from normal operation events through design-basis accidents. In conjunction with the reference dry storage system review process, the PHA ensures that all DBEs considered in the facility design or analyzed for potential important-to-safety consequences are identified. Although the primary goal of hazard assessment is to comprehensively review the impact of identified events on nuclear safety, potential non-nuclear industrial consequences are also identified as part of the hazard evaluation process. The reference dry storage system DBE review and PHA processes are also useful in identifying potential important-to-safety and defense-in-depth facility design and administrative control features. Identified DBEs are evaluated further in separate design analyses for important-to-safety consequences; these evaluations are described in Chapter 12.

5.2.1 Reference Dry Storage System Design Events

Events considered for further analysis include DBEs associated with light water reactor (LWR) SNF dry storage facilities previously identified in industry and regulatory documents, as well as commercial storage system SARs. Sources of information used to identify this group are listed in Table 5.2-1.

Table 5.2-1. References Used for Determining DBEs

Source of Information	**Reference**
Title 10, Part 72 of the Code of Federal Regulations	5.2-1
NRC Regulatory Guide 3.48	5.2-2
American National Standards Institute (ANSI)/American Nuclear Society (ANS) standard 57.9-1992	5.2-3
NRC Probabilistic Risk Assessment (PRA) Procedures Guide	5.2-4
NRC Draft Standard Review Plan for Spent Nuclear Fuel (SNF) Dry Cask Storage Systems	5.2-5
NRC Draft Standard Review Plan for SNF Dry Storage Facilities	5.2-6
Draft Topical Safety Analysis Report (TSAR) for Dry Transfer System	5.2-7
Safety Analysis Reports (SARs) for reference storage systems and selected site specific Independent Spent Fuel Storage Installation applications	5.2-8 through 5.2-17

Based on a review of the reports and references identified above, a comprehensive list of events potentially applicable to the CISF was developed. This list included 62 potential events. Types of events included are natural phenomena, industrial accidents, fires and cask system related.

The Probabilistic Risk Assessments Guide, NUREG/CR-2300, provides guidance in the screening of events. Based on this guidance, a set of screening criteria was produced which included generic site design criteria presented in Chapters 2 and 3. The screening criteria were applied to all identified events in order to select the significant events for further detailed analysis and for use as CISF design input. Events eliminated from further evaluation are listed in Table 5.2-2. Events identified for further evaluation are listed in Table 5.2-3 and are included in the accident analysis. See Chapter 12 for analysis summary and results.

Table 5.2-2. Events Eliminated from Consideration for the CISF

Event	Remarks
Aircraft Impact	Site-specific event addressed in Section 2.2 of the site-specific SAR; for CISF, site considered to be at low risk from aircraft impact.
Avalanche	Site-specific event addressed in Section 2.6.5 of the site-specific SAR; for CISF, site is considered to be flat.
Cask Burial Under Debris	Effects are bounded by the blockage of air inlet/outlet and off-normal ambient temperature events and the snow and ice load criteria provided in Section 3.3.1.6.
Cooling Tower Collapse	Site-specific event to be covered in Section 2.2 of the site-specific SAR.
Drought	Not applicable to CISF; facilities do not require a water supply for a heat sink and ground subsidence is covered by the foundation design criteria described in Section 2.6.4.
Failure of Fuel/Canister Grapple	No fuel handling or manipulation will take place. Canister Grapple design and associated DBEs are evaluated as part of reference storage system design evaluations.
Failure of Single Active Component	Included under the failure of instrumentation and loss-of-power event DBEs.
Fog	Included under the accident analyses of aircraft impacts and vehicular impact DBEs.
Forest Fire	Included under the fire DBE.
Frost	Considered within ambient temperature criteria provided in Section 3.3.2.1.
Hail	Effects are considered within the blockage of air inlet/outlet and the tornado missiles events and the ambient temperature and snow and ice load criteria provided in Section 3.3.
Heavy Snow Storm	Effects are considered within the blockage of air inlet/outlet event and are covered by the snow and ice loading criteria provided in Section 3.3.1.6.
High Heat Load/ Temperature	Effects are considered within the thermal criteria presented in Section 3.3.2.

Figure 5.2-2. Events Eliminated from Consideration for the CISF (cont'd.)

Event	Remarks
Hurricane	Effects are considered within the extreme/tornado wind and tornado missile events and are covered by structural criteria presented in Section 3.3.1.
Ice Cover	Effects are considered within the blockage of air inlet/outlet event and are covered by the snow and ice loading criteria provided in Section 3.3.1.6.
Inadvertent Loading of Newly Discharged Fuel Assembly	No fuel loading or manipulation will take place at the CISF.
Industrial or Military Facility Accident	Effects are included under and bounded by the explosion, fire, and loss of power gas events. The frequency of occurrence and magnitude of these events will be covered in Section 2.2 of the site-specific SAR.
Intense Precipitation	Effects are bounded by the blockage of air inlet/outlet events and the precipitation and snow and ice load presented in Section 3.3.
Landslide	Site-specific event addressed in Section 2.6.5 of the site-specific SAR; for CISF design purposes, site is considered to be flat.
Low Lake Level or Low River Stage	Not applicable to CISF since its important to safety SSCs do not require a water supply.
Low Temperature	Effects are covered by the ambient temperature criteria presented in Section 3.3.2.1.
Meteorite	Extremely low probability (negligible contribution to risk) and all sites have approximately the same frequency of occurrence.
Natural Gas Power Plant Event, Pipeline Accident	Section 2.2 of site-specific SAR will discuss proximity of industrial facilities, including pipelines, and provide a site-specific explosion and fire evaluation, as necessary.
Release of Chemicals in On-site Storage	There are no permanent chemical storage tanks located at the CISF as described in Chapter 4.

Figure 5.2-2. Events Eliminated from Consideration for the CISF (cont'd.)

Event	Remarks
Low Lake Level or Low River Stage	Not applicable to CISF since its important to safety SSCs do not require a water supply.
Sandstorm	Effects are bounded by the blockage of air inlet/outlet and the snow and ice load criteria presented in Section 3.3.1.6.
Snow and Ice Load	Defined by snow and ice load criteria presented in Section 3.3.1.6.
Soil Shrink-Swell Consolidation	Site-specific event addressed in Section 2.4 of the site-specific SAR; for CISF design purposes, all SSCs important to safety are designed assuming soil characteristics presented in Section 2.6.4.
Structure Collapse	Event is covered under the earthquake, extreme/tornado wind, vehicular impact, and tornado missile events and is designed against by structural design criteria provided in Section 3.3.1.
Stuck Fuel Assembly	No fuel handling or manipulation will take place at the CISF.
Toxic Gas	Site-specific event addressed in Section 2.2 of the site-specific SAR. There are no permanent chemical storage tanks located on-site at the CISF as described in Chapter 4.
Transportation Accidents	Site-specific event with effects bounded by explosion, fire and vehicular impact events. This is anticipated to be a low frequency event, covered in Section 2.2 of the site-specific SAR.
Turbine Generated Missiles	Effects are likely to be covered by the tornado missile event. CISF equipment does not include high speed rotating equipment capable of generating a missile. The proximity of off site turbine missile sources and the frequency of an accident involving them will be covered in Section 2.2 of the site-specific SAR.
Volcanic Activity	Effects are likely to be bounded by the blockage of air inlet/outlet event and the snow and ice load criteria presented in Section 3.3.1.6.
Coastal Erosion, High Tide, High Lake Level, or High River Stage, River Diversion, Seiche, Storm Surge, Tsunami, Waves	Site-specific events addressed in Section 2.4 of the site-specific SAR; for CISF design purposes, all SSCs important to safety are assumed to be located above the probable maximum flood level as described in Section 2.4.2.

Table 5.2-3. Off-Normal and Accident Events Applicable to the CISF

Accident Events	Off-Normal Events
Blockage of Air Inlets/Outlets	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	

5.2.2 Preliminary Hazards Assessment

In conjunction with the reference dry storage system DBE review, a PHA is performed to ensure that all credible accidents, accident-level conditions and off-normal conditions applicable to the CISF have been identified or bounded, and that all of the potential consequences with safety implications have been acceptably considered. The PHA comprehensively identifies potential facility events, their initiators and the dominant scenarios; estimates their frequencies and consequences; and presents the results in a risk matrix. Systematic hazard analysis techniques are employed to provide reasonable assurance that all possible off-normal and accident-level events and conditions have been identified and appropriately evaluated as part of the facility design process. The PHA is performed in a two-step process of hazard identification and hazard evaluation.

Hazard identification is the process of highlighting material, system, process and facility characteristics having the potential for initiating accidents with undesirable consequences. The hazard identification process requires a thorough understanding of facility design features, design criteria and operational process flow. Two approaches were utilized in identification of CISF potential hazards as described below.

The first approach for hazard identification involves examining each step of every operation to evaluate the impact of static performance of structures, systems and components (SSCs) on safety. Information needed to identify hazards specific to proposed facility operations is obtained from the following sources.

- Descriptions of facility operational steps
- Design drawings
- Descriptions of facility SSCs
- Design criteria
- Applicable SARs
- Consultations with facility designers, safety analysts and experienced operations personnel.

The hazard identification process systematically develops a complete list of areas, processes and operational subsystems associated with the CISF. Initiating events are then identified for the development of specific event scenarios through the following process.

- Review of each functional operation
- Presumption of single independent performance failures of any SSCs or performance of any operation with potential safety consequences, and projection of secondary failures and resulting consequences
- Close examination of reliance on human infallibility in performance or restraint.

The second approach for hazard identification can be used to evaluate SSCs when detailed process flow descriptions are not available (i.e., support SSCs). This review process involves an examination of support subsystems or areas in order to identify potential hazards in the form of energy sources, which could directly or indirectly initiate off-normal or accident-level events with nuclear safety implications. Energy sources are identified within each subsystem for review as potential event initiators. Natural phenomena events which may affect the operability of the subsystems themselves, or which may initiate events involving interaction with important-to-safety SSCs, are also evaluated. Energy sources identified include:

- Natural phenomena: seismic, wind, wind-driven missiles, wind-driven drift temperature changes, precipitation, flooding, erosion, ground water change, lateral earth pressure
- Wildlife: nest building, organic debris

- Potential energy: drops, collapses, falls, tipovers, spring energy, compressed gas, fluid head, embanked earth

- Kinetic energy: crane movement, vehicular movement, robot movement, rotating equipment, equipment assembly

- Chemical energy: corrosion, galvanic action, explosions, fire potential, toxicity

- Electrical energy: potentials, shorting, open circuits, equipment control, electrocution

- Nuclear energy: radiation, embrittlement, criticality, radio hydrolysis

- Human activity: errors, negligence.

Similar to the process flow hazard identification method previously described for process related SSCs, hazards associated with each support SSC are listed on the hazard evaluation risk matrix. Hazard event scenarios are then developed, and a hazard evaluation is performed.

The purpose of the hazard evaluation is to identify significant events that require further evaluation for determination of risk acceptance, and to help identify facility design features or operational administrative controls which can significantly enhance facility safety. Hazard evaluation constitutes the primary focal point of the PHA. It provides the detailed information that allows the full development of specific events and scenarios (i.e., initiation, detection and consequences) associated with a system or operation.

Hazard evaluation is performed in accordance with the methodology and assumptions presented above. The identified events were analyzed as part of a systematic process to evaluate all events associated with each CISF subsystem. In accordance with the methodology previously presented, event scenarios were developed by identifying causes and consequences for each hazard event. Events are identified for further evaluation if the following important-to-safety design functions are potentially affected.

- Criticality control
- SNF confinement
- Radiation protection
- SNF retrievability
- Thermal.

Although the primary goal of hazard evaluation is to comprehensively review identified events for impact on facility safety, potential non-nuclear industrial hazard and facility production consequences are also identified as part of the hazard evaluation process. Hazard evaluation measures overall safety significance based on a combined qualitative measure of event frequency and consequence. This quantitative measure is used to screen events for further evaluation. Hazard evaluation is performed without taking credit for CISF design features or administrative controls prior to the screening process. However, potential facility features are identified in the PHA hazard evaluation for subsequent consideration in the design process and safety analysis of DBEs. Safety significant hazards identified by the PHA for further consideration are presented in Table 5.2-4.

5.2.3 Design Features and Administrative Controls

The reference dry storage system DBE review and PHA processes are also useful in identifying potential important-to-safety and defense-in-depth facility design and administrative control features with nuclear safety relevance, as identified and described in Table 5.2-4. Additional information regarding facility design and administrative control features is provided in Chapters 3 and 14, respectively.

5.2.4 Event Classification and Analysis

Events requiring safety analysis are identified through a comprehensive review and hazard assessment process. Identified DBEs are categorized as off-normal or accident events based on the guidance provided by NRC Regulatory Guide 3.48 and American National Standards Institute/American Nuclear Society (ANSI/ANS) Standard 57.9-1992. This categorization analysis ensures safe operations commensurate with the SSCs important to safety, based on overall risk which is a function of the probability or frequency of occurrence. The accident analysis section of Regulatory Guide 3.48, Chapter 8 recommends applying four levels of design events defined in ANSI/ANS Standard 57.9-1984 (an earlier version of ANSI/ANS 57.9-1992) to categorize off-normal operations and accidents. These criteria are based on the frequency of occurrence and are applied to the events remaining from the screening process to establish off-normal and accident events.

The safety-significant events determined to be applicable to the CISF are classified in accordance with ANSI/ANS 57.9-1992. Safety analyses are performed for all applicable DBEs and the results of this classification process are presented in Chapter 12.

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Runaway site tractor, site locomotive or rail car	Vehicular Impact	Radiological Confinement Criticality Retrievability	Transfer facility bypass rail line and switch and/or retractable impact limiting barriers in place outside of shipping/receiving bay doors Speed limited design characteristics (or features) for site tractors and locomotives Vertical cask spacing established to reduce potential interactions Robust transportation and storage systems	Site vehicle speed limits established by administrative procedures Site and storage operator on-site vehicle navigation training Transfer facility operating procedures to assure SNF packages removed from rail lines prior to commencement of receipt operations Rail line switch aligned to bypass and/or barriers active at the top of the queuing lines during transfer operations in the transfer facility Apply rail cars brakes while queued Program level receipt/dispatch

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Drop of transportation cask caused by gantry running into the transfer facility crane in the shipping/receiving area	Drop Event	Radiological Confinement Criticality Retrievability	Robust transfer facility crane and rigging designed in accordance with NUREG-0612 to be singular failure proof and tolerant of incidental interactions of handled loads with other structures, systems, or components under rated conditions Visual and/or video monitoring capability of shipping/receiving area during crane operations Transportation systems required to withstand drop from maximum handling height	Operating procedures to coordinate the movements of the transfer facility equipment to prevent interactions and to monitor and control lift height restrictions Transfer facility crane operator training Component lift height restrictions

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Drop of transportable storage cask (TSC) by transfer facility	Drop Event	Radiological Confinement Criticality Retrievability	Transfer facility structure designed to support transfer facility cranes while both are lifting rated loads under generic site design-basis seismic conditions Transfer facility crane and rigging designed in accordance with NUREG-0612 Transfer facility crane designed to handle rated loads under generic site design-basis seismic conditions Transfer facility crane protected from tornado missiles Transfer facility crane incorporates fail-safe braking feature to prevent load drop following loss of power Transfer facility crane incorporates redundant lift travel stops features Visual and/or video monitoring capability of shipping/receiving area during crane operations TSC required to withstand drop from maximum handling height	Crane operator training and procedures will prevent cask interactions during lifting operations and will ensure component lift heights are monitored and controlled Component lift height restrictions

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Gantry, gantry mounted robotics, or transportation facility robotics impact on cask system	Handling Event	Radiological	Visual and/or video monitoring capability of shipping/receiving area during crane operations Gantry and robotics are lightweight relatie to casks Gantry and robotics speed of motion limited to acceptable levels to preclude damage to important-to-safety cask design features	Crand and robot operator training and procedures will prevent cask interactions Operating procedures coordinate transfer facility equipment movements Maintenance program for gantry and robotics will minimize potential for equipment failure
TSC, VECTRA MP187, Westinghouse MPC Storage cask (WSC) or transportation cask (WTC), and Sierra Nuclear TranStor™ storage cask (SNSC) or transportation cask (SNTC) interaction with other SSCs	Handling Event	Radiological	Transfer facility design minimizes the amount of cask swinging which occurs during load movements or during seismic events Transfer facility design to withstand generic site design-basis seismic event Visual and/or video monitoring capability of shipping/receiving area during crane operations Robust transportation and storage systems Low-speed feature of transfer facility crane to facilitate engaging casks	Crane operator training and procedures prevent cask interactions during lifting operations Clearly marked cask travel paths Administrative procedures which maintain the cask travel paths clear of equipment or obstructions Administrative procedures requiring loads to be handled at acceptable heights

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Tipover of the NAC STC, MP187, SNTC or WTC during transfer facility operations	Tipover	Radiological Confinement Criticality Retrievability	Transfer facility crane (when attached) Transportation and storage system designs required to preclude tipover under design-basis seismic event	Procedures to assure casks attached to seismically qualified equipment (transfer facility crane, site transporter, etc.) when not restrained by vendor provided equipment
Tipover of a TSC and site transporter	Tipover	Radiological Confinement Criticality Retrievability	Speed limited low center-of-gravity design characteristics (or features) for site transporter Robust TSC systems	Site vehicle speed limits established by administrative procedures Storage operator on-site vehicle navigation training

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Drop of WTC by transfer facility crane	Drop Event	Radiological Confinement Criticality Retrievability	Transfer facility structure designed to support transfer facility cranes while both are lifting rated loads under generic site design-basis seismic conditions Transfer facility crane and rigging designed in accordance with NUREG-0612 Transfer facility crane designed to handle rated loads under generic site design-basis seismic conditions Transfer facility crane protected from tornado missiles Transfer facility crane incorporates fail-safe braking feature to prevent load drop following loss of power Transfer facility crane incorporates redundant lift travel stops features Visual and/or video monitoring capability of shipping/receiving area during crane operations Robust WTC design required to withstand drop from maximum handling height	Crane operator training and procedures will prevent cask interactions during lifting operations and ensure component lift heights are monitored and controlled Maintenance program for transfer facility crane and rigging will minimize potential for equipment failure Component lift height restrictions

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Overturning of WTC and transfer cradle	**Tipover**	**Radiological Confinement Criticality Retrievability**	**Transportation and storage system designs required to preclude tipover under design-basis seismic event**	Operator training and procedures assure proper transfer cradle operations Maintenance program for WTC transfer cradle will minimize potential for equipment failure
Release of airborne radioactive material from MP187, WTC or SNTC by opening cask lid	**Loss of Confinement**	**Radiological Confinement**	Vent/test rig piped directly to HVAC exhaust provided to confirm acceptable internal contamination levels and/or leak-tightness of canisters contained in transportation casks prior to lid removal HVAC system designed to control airborne emissions so that all effluents are released via a common plant vent, which is monitored for radionuclide releases Canister based transportation and storage systems required to assure canister confinement integrity during normal transportation and handling events Canister based transportation and storage system features maintain cask/canister annulus free of contamination during loading in at-reactor fuel pools	**Operational procedures should minimize the potential release of radioactivity by requiring sampling prior to opening of cask lid** **Regularly scheduled maintenance of the vent/test rig will minimize the potential results of this event** **At-reactor loading procedures and operator training assure closure integrity and minimize potential for cask/canister contamination**

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Drop of Westinghouse MPC	Drop Event	Radiological Confinement Criticality Retrievability	Bolted bottom lid of WSC Robotic bolt tightening features Visual and/or video monitoring capability of Westinghouse MPC transfer area during transfer operations	Remote operator procedures will require verification of presence of bolts and compliance with tightness criteria Regularly scheduled maintenance and testing of the transfer area robotic torque wrench attachments to minimize potential for undertightened bolts
Tipover of WSC or SNSC and site transporter	Tipover	Radiological Confinement Criticality Retrievability	Speed limited low center-of-gravity design characteristics (or features) for site transporter Robust WSC and SNSC systems	Site vehicle speed limits established by administrative procedures Storage operator on-site vehicle navigation training

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Drop of Sierra Nuclear transfer cask (SNXC) by transfer facility crane	Drop Event	Radiological Confinement Criticality Retrievability	Transfer facility structure designed to support transfer facility cranes while both are lifting rated loads under generic site design-basis seismic conditions Transfer facility crane and rigging designed in accordance with NUREG-0612 Transfer facility crane designed to handle rated loads under generic site design-basis seismic conditions Transfer facility crane protected from tornado missiles Transfer facility crane incorporates fail-safe braking feature to prevent load drop following loss of power Transfer facility crane incorporates redundant lift travel stop features Visual and/or video monitoring capability of shipping/receiving area during crane operations Robust SNXC design required to withstand drop from maximum handling height	Crane operator training and procedures will prevent cask interactions during lifting operations and will ensure component lift heights are monitored and controlled Maintenance program for transfer facility crane and rigging will minimize potential for equipment failure Component lift height restrictions

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Drop of SNSC/SNTC lid over cask containing canister of SNF	Drop Event	Radiological Confinement	Transfer facility structure designed to support transfer facility cranes while both are lifting rated loads under generic site design-basis seismic conditions Transfer facility crane and rigging designed in accordance with NUREG-0612 Transfer facility crane designed to handle rated loads under generic site design-basis seismic conditions Transfer facility crane protected from tornado missiles Transfer facility crane incorporates fail-safe braking feature to prevent load drop following loss of power Transfer facility crane incorporates redundant lift travel stop features Visual and/or video monitoring capability of shipping/receiving area during crane operations Robust Sierra Nuclear canister design required to withstand lid drop from maximum handling height	Crane operator training and procedures will prevent cask interactions during lifting operations and will ensure component lift heights are monitored and controlled Maintenance program for transfer facility crane and rigging will minimize potential for equipment failure Component lift height restrictions

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Impact of a SNXC into SNSC or SNTC	Handling Event	Radiological	Transfer facility crane design minimizes the amount of cask swinging which occurs during load movements or during seismic events Transfer facility design to withstand generic site design-basis seismic event Visual and/or video monitoring capability of shipping/receiving area during crane operations Visual and/or video monitoring capability of cask-to-cask lift clearances prior to lateral crane motions Robust transportation, transfer and storage system overpack designs Low speed feature of transfer facility crane to facilitate engaging casks	Crane operator training and procedures will prevent cask interactions during transfer operations Administrative procedures require confirmation of proper cask-to-cask clearances and obstruction-free cask travel paths prior to lateral crane motions Administrative procedures dictate that casks moved by the transfer facility crane not be moved quickly, thereby minimizing the potential kinetic energy involved in interactions

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Drop of a Sierra Nuclear canister/SNXC due to canister raised too high in SNSC	Drop Event	Radiological Confinement Criticality Retrievability	Capability provided for operator to monitor crane load sensor and vertical displacement during lift operations Crane capable of lifting total weight of Sierra Nuclear canister transfer system Visual and/or video monitoring capability of Sierra Nuclear canister/SNXC during transfer operations Sierra Nuclear canister lifting sling capable of lifting total weight of Sierra Nuclear canister transfer system Sierra Nuclear canister required to withstand drop from maximum handling height position within SNXC	Operator training and procedures to monitor lifting loads and vertical displacement to prevent canisters from being raised too high in SNXC Pre-operational load testing of crane, rigging and slings Maintenance program for transfer facility crane, rigging and slings

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Sierra Nuclear canister not shielded by SNTC/SNSC/ SNXC	Loss of Shielding	Radiological	Capability provided for operator to monitor crane load sensor and vertical displacement during lift operations Crane and rigging capable of lifting total weight of Sierra Nuclear canister transfer system Sierra Nuclear canister lifting sling capable of lifting total weight of Sierra Nuclear canister transfer system Visual and/or video monitoring capability of Sierra Nuclear canister/SNXC during transfer operations TranStor™ system design required to preclude tipover or separation of SNXC from transportation or storage packages under design-basis seismic event	Operator training and procedures to monitor lifting loads and vertical displacement to prevent canisters from being raised too high in SNXC Operator training and procedures to monitor operations to ensure slings disconnected following canister transfer to SNSC Pre-operational load testing of crane, rigging and slings Maintenance program for transfer facility crane, rigging and slings

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Collapse of transfer facility	Earthquake, Explosion, Tornado Missile, Tornado Winds	Radiological Confinement Criticality Retrievability Thermal	Transfer facility overhead roll-up doors designed to blow out due to tornado or explosion induced differential pressure Transfer facility exterior walls designed to prevent penetration and significant damage by tornado missiles Transfer facility superstructure designed to withstand seismic event Single-ply membrane roof for heavy snow/ice loads on the roof Robust transportation, transfer and storage system overpack designs	Operator training and procedures to monitor local meteorological conditions and secure facility as deemed prudent Maintenance program requiring repair, inspections and/or testing, as appropriate, following severe manmade or natural phenomena events

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Fire involving slightly contaminated solid waste	Fire	Radiological	Facility fire protection system Facility and cask system design features ensure levels of contamination on solid waste collected at facility remain very low (e.g., canister-based transportation and storage systems required to assure canister confinement integrity during normal transportation and handling events, internal annulus contamination prevention features employed during loading, vent/test rig piped directly to HVAC exhaust to confirm acceptable internal contamination levels and/or leak-tightness of canisters contained in transportation casks prior to lid removal) HVAC system is designed to control airborne emissions so that all effluents are released via a common plant vent, monitored for radionuclide releases and capable of being filtered	Facility receives only canisterized SNF Assumed implementation of cask system loading procedures at shipping facilities where packages loaded Facility administrative procedures requiring cask/canister annulus sampling prior to lid removal, alerts personnel to conditions potentially requiring additional confinement considerations Facility administrative procedures to reduce volumes of non-contaminated combustible materials collected with or stored near contaminated waste (e.g., sorting of waste as generated) Facility administrative procedures to control storage conditions and minimize volumes of contaminated waste collected on-site by arranging for frequent disposition off site

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Transfer facility crane or crane rail beams collapse	Earthquake, Tornado Missile	Radiological Confinement Criticality Retrievability	Crane designed to withstand generic site design-basis seismic event while loaded with the heaviest cask Crane and crane rail beams protected from tornado missiles by transfer facility Robust transportation, transfer and storage system overpack designs	Operator training and procedures to monitor local meteorological conditions and secure facility as deemed prudent Maintenance program requiring repair, inspections and/or testing, as appropriate, following sever man-made or natural phenomena events
Transfer facility penetrated by tornado missile	Tornado Missile	Radiological Confinement Criticality Retrievability	Transfer facility exterior walls designed to prevent penetration and significant damage by tornado missiles Internal labyrinth of walls protects transfer area from tornado missiles Robust transportation, transfer and storage system overpack designs	Operator training and procedures to monitor local meteorological conditions and secure facility as deemed prudent Maintenance program requiring repair, inspections and/or testing, as appropriate, following severe man-made or natural phenomena events

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Blockage of cask air vents due to wind-blown debris, snow or ice, insect nest building, or flooding	Blockage of Air Vents	Thermal	Perimeter fence Temperature monitoring instrumentation Storage system vent designs	Routine surveillance monitoring of the cask inlet and outlet vents will be required Temperature measurement of the air outlet temperatures will be performed on a daily basis to ensure heat removal features are functioning properly
Storage cask drop during transfer to storage due to crane/rigging/ trunnion failure or crane operator error	Drop Event	Radiological Confinement Criticality Retrievability	Site transporters required to support storage units while lifting rated loads under generic site design-basis seismic conditions Transporter required to limit lift height to analyzed condition Robust storage system designs required to withstand drops from maximum lift height	(1) Transporter operator training and procedures will assure proper loading/rigging and prevent cask interactions during transfer operations and will ensure component lift heights are monitored and controlled Maintenance program for transporter and rigging will minimize potential for equipment failure Component lift height restrictions

Table 5.2-4. Facility Design and Administrative Features for Event Prevention or Mitigation (cont'd.)

Specific Hazard	Design Event	Potential Impact	Engineered Feature	Administrative Control
Cask (MP187) rolls off of transfer trailer and impacts concrete pad due to equipment failure or personnel error	Drop Event	Radiological Confinement Criticality Retrievability	Transfer trailers and skids designed with a low center of gravity and a restraining mechanism to ensure cask remains attached to the trailer or skid under generic site design-basis seismic conditions Transporter required to limit lift height to analyzed condition Robust storage system designs required to withstand drops from maximum lift height Transfer trailer designed for tornado missile impact	Transporter operator training and procedures assure proper loading/rigging and prevent cask interactions during transfer operations Maintenance program for transporter and rigging minimizes potential for equipment failure
Single mechanical closure seal failure on NAC STC results in loss of itnerlid region gas pressure	Failure of One Confinement Boundary	Confinement	Interlid volume pressure for bolted storage systems containing bare fuel (NAC STC) monitored and alarmed remotely Double lid arrangement provides redundant protection against radiological release Highly reliable metal o-ring seal design	Leak rate testing performed on seals at reactor site prior to cask shipment to CISF Regular surveillance of confinement monitoring system (pressure transducer calibration) to detect seal leakage
Canister damaged by tornado missile during transfer in storage yard	Tornado Missile	Radiological Confinement Criticality Retrievability	NUHOMS® design required to address potential for canister damage from design basis tornado missile events	Operator training and procedures to monitor local meteorological conditions and secure facility as deemed prudent

5.3 REFERENCES

Section 5.2

5.2-1 10 CFR Part 72. *Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste.*

5.2-2 Regulatory Guide 3.48. *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage).* Rev. 1. U.S. NRC. August 1989.

5.2-3 ANSI/ANS 57.9-1992. *Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type).* American National Standards Institute and American Nuclear Society. May 1992.

5.2-4 NUREG/CR-2300. *PRA Procedures Guide: A Guide to the Performance of Probabilistic Risk Assessments for Nuclear Power Plants.* U.S. NRC. January 1983.

5.2-5 NUREG-1536. *Draft Standard Review Plan for Dry Cask Storage System.* U.S. NRC. February 1996.

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5.2-7 *Dry Transfer System for Spent Fuel Topical Safety Analysis Report (Draft).* Transnuclear Inc. March 1996.

5.2-8 NRC Docket No 72-1008, Holtec Report Number HI-941184. *10 CFR Part 72 Topical Safety Analysis Report for the Holtec International Storage, Transport and Repository Cask System (HI-STAR 100 Cask System).* Rev. 2. June 1995.

5.2-9 NAC-T-90002. *Topical Safety Analysis Report for the NAC Storable Transport Cask for Use at an Independent Spent-Fuel Storage Installation.* Rev. 3. NAC Services Inc. July 1994.

5.2-10 MPC-CD-02-016. *Safety Analysis Report for the Large On-Site Transfer and On-Site Storage Segment.* Rev. 1. Westinghouse Electric Corp. June 1996.

5.2-11 MPC-CD-02-017. *Safety Analysis Report for the Small On-Site Transfer and On-Site Storage Segment.* Rev 1. Westinghouse Electric Corp. June 1996.

5.2-12 NRC Docket No 72-002. *Surry Power Station Dry Cask Independent Spent Fuel Storage Installation Safety Analysis Report.* Virginia Electric & Power Co. December 1994.

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5.2-14 *Independent Spent Fuel Storage Installation Safety Analysis Report*. Oconee Nuclear Station. Duke Power Co. October 1989.

5.2-15 *Prairie Island Independent Spent Fuel Storage Installation Safety Analysis Report*. Rev. 3. Northern States Power Co. April 1994.

5.2-16 DAGM NUC 93-135. NRC Docket No. 72.11. *The Rancho Seco Independent Spent Fuel Storage Installation License Application and Safety Analysis Report*. Rev. 1. October 1993.

5.2-17 NRC Docket No. 72-0017. *Trojan Independent Spent Fuel Storage Installation Safety Analysis Report*. Portland General Electric Co. March 1996.

6. WASTE CONFINEMENT AND MANAGEMENT

This chapter describes the waste management systems of the CISF and demonstrates that waste materials generated as a result of CISF operation are safely contained and disposed. The CISF handles only canistered spent nuclear fuel; therefore, the only radioactive wastes generated are the result of residual quantities of radioactive contamination on SNF casks and canisters. Liquid wastes not satisfying CISF discharge limits are treated on-site by contracted vendors and released to a permitted National Pollutant Discharge Elimination System (NPDES) outfall. No major radioactive waste processing facilities are provided by the CISF design.

The CISF does not have a spent fuel pool or any associated wastes generated as a result of pool operations or maintenance.

This TSAR seeks NRC concurrence that:

- The design and proposed operation of the CISF provide for the safe confinement and management of any radioactive waste generated by the facility.

- The generation of radioactive waste volumes and the release of radioactive materials in effluents to the environment are within regulatory limits and ALARA.

6.1 ON-SITE WASTE SOURCES

This section describes and characterizes the potential gaseous, liquid and solid wastes generated as a result of CISF operations. Radioactive isotopes anticipated in facility waste consist of mixed fission products and activation products associated with light water reactor operation. The term "waste" as used in this chapter refers to those wastes generated during CISF operation, and does not include spent nuclear fuel or other high-level wastes stored or otherwise handled at the CISF.

6.1.1 Gaseous Wastes

Discrete or containerized gaseous wastes are not generated at the CISF; however, airborne radioactive contamination can be generated in the transfer facility. The potential sources include:

- Aerosals of surface contamination from the exterior of the transport cask or from the exterior of the internal canister

- Cask leakage as a result of a failed seal.

Airborne radioactive contamination levels in the transfer facility exhaust are expected to be less than the limits listed in Table 2 of 10 CFR 20 Appendix B. Continuous High-Efficiency Particulate Air (HEPA) filtration of facility exhaust is not required, however, HEPA filters are provided for ALARA considerations as described in Section 6.2.

6.1.2 Liquid Wastes

6.1.2.1 Low-Level Liquid Radioactive Waste Water

Potentially radioactive liquid waste is generated at the transfer facility decontamination booth, which is used to remove small amounts of radioactive contamination from SNF transportation and storage casks. Radioactive concentrations in the resultant decontamination solution are expected to be very low. However, concentrations may exceed 10 CFR 20 Appendix B limits for unrestricted concentrations, requiring radioactive waste processing.

The transporter wash-down station is used to clean road grime off of transport trailers and railroad cars prior to entering the transfer facility. Radiological contamination of transporter waste water is not expected to occur.

6.1.2.2 Non-Radioactive Waste Water

Non-radioactive or conventional waste water, potentially contaminated with small quantities of hazardous material, is generated in the CISF transfer facility, transporter wash-down station, fire pump building and security complex. The waste water is 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 water may contain some or all of the following constituents.

- Suspended solids
- Dissolved solids
- Nutrients
- Acids and alkalis
- Heavy metals
- Fuel, oil, and grease.

Only very low levels of the above constituents are expected in CISF conventional waste water.

6.1.2.3 Sanitary Wastes

Sanitary wastes generated at the CISF transfer facility and security complex include the effluents from facility drinking water fountains, water closets, lavatories, mop sinks and other similar fixtures.

6.1.3 Solid Wastes

Solid radioactive wastes are generated at the CISF as a result of cask contamination surveillance and decontamination activities. These wastes generally consist of paper or cloth swipes, paper towels, protective clothing, and other job control wastes contaminated with low levels of radioactivity. These wastes are disposed of in solid waste containers and temporarily stored in the transfer facility. Low volumes of solid radioactive wastes are anticipated. Disposal of these wastes is provided by vendors contracted to periodically collect the waste containers and take them off-site for processing and disposal.

Expended HEPA filters from the transfer facility ventilation system along with job control waste associated with filter changeout, also may contribute to the generation of solid radioactive waste. Job control waste generated during filter changeout is collected and monitored along with other low-level wastes for off-site processing.

6.2 OFF-GAS TREATMENT AND VENTILATION

The off-gas treatment and ventilation systems at the CISF consist of conventional HVAC in the transfer facility and a cask sampling system. These systems are described in Chapter 4. Figure 4.4-2 shows a diagram of the transfer facility HVAC exhaust system.

6.2.1 Design Objectives

The transfer facility HVAC system is designed to discharge facility exhaust to a common plant vent which is monitored for radioactive contamination. HVAC exhaust and supply flows are adjusted to maintain the facility at a negative pressure with respect to the outside atmosphere, ensuring all air leakage will be into the transfer facility structure. The system provides normally off-line HEPA filters that may be placed in service for ALARA purposes. An air activity monitoring system is provided to monitor vent releases.

The cask sampling system is provided for sampling the cask annular space during cask sampling and purging operations. Exhaust from the cask sample/purge system is discharged to the facility HVAC system and released through the monitored vent.

6.2.2 System and Equipment Description

The transfer facility HVAC exhaust provides in-line HEPA filters for the removal of radioactive particulates from the facility effluent. Prefilters are installed to prevent dust loading of the HEPA filters, and test ports are provided upstream and downstream of the HEPA filter bank to allow dioctyl phthalate (DOP) testing. The HEPA filters are protected from smoke, ash and firewater generated in the event of facility fire.

Air operated dampers located at the HEPA inlet and outlet, and in the HEPA bypass line, control effluent flow through the HEPA filters. An associated control system is provided to automatically or manually place the HEPA filters in service if required.

The effluent radiation monitor samples and monitors facility air effluent. The monitor is capable of detecting fission product particulates/gases and activation products as required to determine facility radioactive releases to the environment.

6.2.3 System Operations

During normal operations the transfer facility HVAC system is in service, with both supply and discharge fans maintaining a negative pressure differential in the transfer facility. The HEPA filters are in bypass mode with facility air effluent sampling to monitor facility releases to the environment. If the effluent radiation monitor detects a level of activity exceeding specified limits, the system bypass damper will automatically direct building exhaust air through the in-line HEPA filters prior to discharge to the exhaust vent. The HVAC HEPA filters are periodically tested to determine filter system efficiency.

During SNF canister transfers, sampling and purging of the annular space between the transportation cask and the SNF canister are performed prior to opening the cask. Following analysis, the annulus is vented to the facility HVAC system through a flexible duct. For a description of the cask annulus gas sampling process, see Chapter 4.

6.3 LIQUID WASTE TREATMENT AND RETENTION

Potentially radioactive and non-radioactive or conventional waste liquid is generated at the CISF. Facilities for liquid waste treatment and retention are described in the following sections.

6.3.1 Transfer Facility Radioactive Waste Collection Tank

6.3.1.1 Design Objectives

The transfer facility radioactive waste collection tank is designed to collect and retain waste decontamination solution generated during cask wash-down activities. The collection tank is conservatively designated as QA 3 and QA 7.

6.3.1.2 System and Equipment Description

The radioactive waste collection tank consists of a stainless steel tank situated in a containment vault outside the transfer facility. These structures are designed to withstand the design earthquake. The design provides associated drain/transfer piping and tank level instrumentation. Provisions are made for obtaining samples of tank contents. Figure 6.3-1 shows a flow diagram of the transfer facility radioactive waste collection tank.

6.3.1.3 System Operations

The need for decontamination activities is expected to be minimal, resulting in only a small volume of potentially radioactive liquid. It is conservatively assumed that a maximum of 10% of the transportation casks received at the CISF will require decontamination.

Waste decontamination solution is directed to the radioactive waste collection tank by the decontamination booth basin and drain piping. Waste decontamination solution is collected in batches and sampled for radiological contamination. If radioactive concentrations exceed the limits of 10 CFR 20 Appendix B, the tank contents are transferred to an on-site, vendor-supplied processing unit for treatment. The liquid is treated to meet discharge limits and released to the CISF outfall. Otherwise, the tank contents are transferred to the transfer facility conventional waste collection tank, as discussed in Section 6.3.2.1.

6.3.2 Conventional Waste Water Systems

Separate waste water collection systems are provided at the CISF to collect all non-radioactive or conventional waste water generated by the CISF transfer facility, transporter wash-down station, fire pump building and security complex operations. The systems utilize underground waste water tanks designed to contain and store conventional waste water. All tanks are sized to meet conventional waste water system requirements and are installed during initial construction of the CISF. The conventional waste water systems are designed to minimize the generation of hazardous and mixed wastes.

All design considerations for materials for conventional waste water drainage piping systems and components conform to the minimum requirements of the American Society of Mechanical Engineers/American National Standards Institute (ASME/ANSI) B31.1-1995 Code (Ref. 6.3-1). This code invokes the American Society for Testing and Materials (ASTM) and American Water Works Association (AWWA) standards. All underground waste water and sewer pressure and drainage piping subject to freezing and damage will be buried below the local area frost line, maintaining proper ditch conditions, proper backfill, trench compaction, and protection from above-ground structures and traffic loads. Drain piping is designed to minimize the number of traps, loops and flanges that may accumulate foreign material. Cathodic protection is provided as necessary.

6.3.2.1 Transfer Facility Conventional Waste Water System

6.3.2.1.1 Design Objectives

The transfer facility conventional waste water system is designed to collect process waste water generated in the transfer facility, and to retain waste water in order to permit required sampling prior to release or transfer. The system is designated as conventional quality.

6.3.2.1.2 System and Equipment Description

The transfer facility conventional waste water system consists of a conventional waste water collection tank, waste water drain/transfer piping and valves, and required tank level instrumentation. The conventional waste water collection tank is an underground tank constructed of high-density polyethylene (HDPE). Figure 6.3-1 shows a flow diagram of the transfer facility conventional waste water system.

6.3.2.1.3 System Operation

Transfer facility process waste water is directed to the collection tank by transfer facility collection points and drain piping. Waste water may also be transferred to the tank from the transfer facility radioactive waste tank. The contents of the transfer facility conventional waste water tank are sampled and analyzed prior to release to ensure compliance with the CISF water discharge permit. Waste water in compliance with discharge limits is released to a NPDES outfall. Waste water not meeting discharge permit limits is transferred to an off-site vendor for treatment and disposal.

6.3.2.2 Transporter Wash-down Conventional Waste Water System

6.3.2.2.1 Design Objectives

The transporter wash-down waste water system performs the following functions.

- Collects washwater generated from transporter wash-down
- Retains washwater to permit required sampling prior to release or transfer
- Treats washwater to allow reuse.

Transporter wash-down supports security inspections and limits the amount of foreign material introduced to the transfer facility. This system is conservatively designed as QA 3 and QA 7.

6.3.2.2.2 System and Equipment Description

The transporter wash-down conventional waste water system consists of a holdup tank, a water reclamation system, waste water drain/transfer piping and valves, and required tank level instrumentation. Collection points and drain piping direct waste water from the transporter wash-down station to the holdup tank. The water reclamation system removes suspended and dissolved solids from the contents of the holdup tank to allow reuse of the washwater. Transfer piping provides the capability to transfer the holdup tank contents either to a process sewer and outfall or to a vendor-supplied treatment unit. The holdup tank is situated in an underground containment vault.

The water reclamation system consists of a centrifugal separator and a 50-micron filter for the removal of suspended solids, a carbon adsorber bed for the removal of dissolved solids (i.e., detergent) and a system pump. The adsorber is provided with an automatic backwash capable of rejuvenating the carbon filter media on a periodic basis.

Figure 6.3-2 shows a flow diagram of the transporter wash-down conventional waste water system.

6.3.2.2.3 System Operations

Transporter wash-down drains and piping route washwater to the holdup tank. The washwater is collected and pumped to the water reclamation system centrifugal separator, where approximately 95% of the suspended solids are removed. The washwater is then further cleaned by a 50-micron basket strainer. From the filter, water is directed to the carbon bed adsorber for the removal of dissolved solids. Finally, the reclaimed washwater is transferred to a washwater storage tank for reuse by the transporter wash-down system. Makeup water is provided by the CISF potable water system.

Although radiological contamination of the transporter wash-down station is not expected to occur, the contents of the holdup tank are periodically sampled and analyzed. If the contents exceed established limits for radioactive content, the waste water is held and transferred to an approved vendor for treatment and disposal. If the holdup tank requires emptying, the contents are sampled and analyzed to ensure compliance with the CISF NPDES permit. Waste water in compliance with discharge limits is released to a NPDES outfall. Waste water not meeting discharge permit limits is transferred to an off-site vendor for treatment and disposal.

Solids collected by the centrifugal separator, expended filters and adsorber backwash liquid are held and sampled for radioactive contamination. In the unlikely event that these materials are contaminated, they are packaged and temporarily stored with other low-level radioactive solid wastes.

6.3.2.3 Other Conventional Waste Water Collection Systems

Conventional waste water collection systems are also provided for the fire pump building and the security complex. These systems are similar in design and operation to the transfer facility conventional waste water system. The procedure for sample, analysis and release of conventional waste water collected in the fire protection pump building and the security complex is identical to that discussed in Section 6.3.2.1.3.

6.3.3 Sanitary Waste Systems

Sanitary wastes are generated in the transfer facility and the security complex. Septic tank and leach field systems are provided for each facility's sanitary wastes. The CISF does not have raw sewage treatment capability. Administrative controls prevent the disposal of radioactive material in the sanitary waste system.

6.4 SOLID WASTES

Solid low-level radioactive wastes are generated at the CISF as a result of contamination surveillance and decontamination activities. These wastes are collected, packaged and temporarily stored at the CISF as described below. The program for the collection, handling and disposal of low-level radioactive wastes is designed to minimize both the spread of radioactive contamination and the quantity of radioactive waste generated.

6.4.1 Collection and Packaging

Solid low-level radioactive waste is collected in containers lined with polyvinyl chloride (PVC) bags. These containers are located in areas where waste is expected to be generated. When the containers are full, the PVC bags and containers are sealed and surveyed for external radiation levels and transferrable contamination. The sealed containers are then placed in metallic containers and temporarily stored for off-site shipment. Contaminated HEPA filters are double-bagged and sealed in metallic containers. All low-level radioactive waste containers are labeled in accordance with 10 CFR 20.1904 requirements.

6.4.2 Storage Facilities

Low-level metallic containers and HEPA containers are temporarily stored in an area specifically designated for that purpose. The temporary storage area is roped off or otherwise barricaded and clearly identified. Periodically, the low-level waste containers are shipped off-site to a facility licensed to handle and dispose of low level radioactive waste. Transfers are made in accordance with 10 CFR 20.2006 requirements.

6.5 RADIOLOGICAL IMPACT OF NORMAL OPERATIONS - SUMMARY

Because the CISF handles only canistered spent nuclear fuel, surface contamination of SNF canisters and casks is the only likely source of radioactive material. Subsequent quantities of this radioactive material released in facility effluents is expected to be very small. Consequently, the radioactive material released in CISF effluents is expected to result in an annual dose beyond the controlled area well below the limits of 10 CFR 72.104.

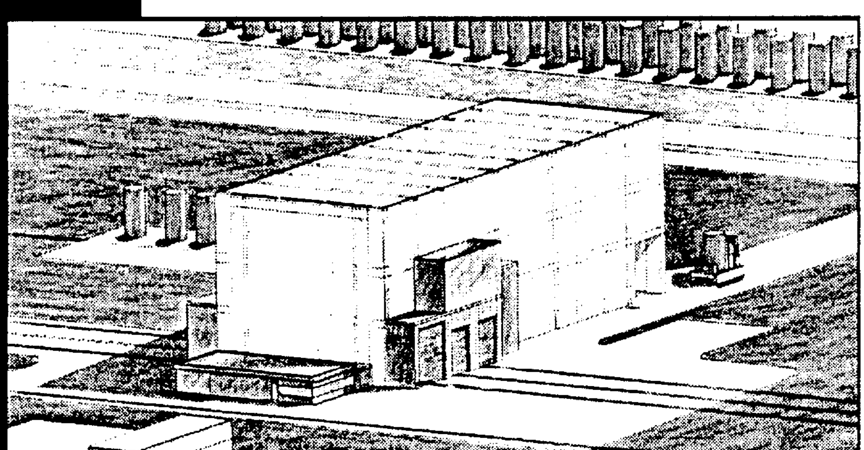
6.6 REFERENCES

Section 6.3

6.3-1. ASME/ANSI B.31.1-1995. *Power Piping.* American Society of Mechanical Engineers and American National Standards Institute. 1995.

Centralized Interim Storage Facility

Topical Safety Analysis Report



Volume II

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7. INSTALLATION DESIGN AND STRUCTURAL EVALUATION

This chapter presents the structural description, design, design criteria and design analysis for major CISF structures. Structures described in Chapter 7 include the confinement structures, systems and components (SSCs), transfer facility, storage pads and structures classified as QA 3, QA 4, QA 5, QA 6 and QA 7.

This TSAR seeks NRC concurrence that:

- The design, design bases, and layout of the CISF and the relation to the generic site characteristics are adequately described, defined, and are acceptable.
- The design of the CISF structures complies with the applicable general design criteria of 10 CFR 72, Subpart F.
- The load definitions and load combinations used for the design of the CISF structures are appropriate based upon their importance to safety.
- The transfer facility and cask storage pads have been designed to withstand the normal operating conditions, accident conditions, and natural phenomena events as described in the TSAR.

7.1 DESCRIPTIONS OF SYSTEMS, STRUCTURES AND COMPONENTS

Major CISF SSCs are described in sufficient detail to evaluate their structural stability and functional suitability, and to provide an adequate basis for CISF TSAR approval. Details of systems provided by vendors are included by reference.

Table 7.1-1 lists CISF structures and their QA classifications. The locations of these structures are shown in Figure 4.1-1.

Table 7.1-1. CISF Structures and QA Classification

Structure and Figure 4.1-1 Location	QA Classification
Storage casks, No. 2 and No. 3	QA 1, QA 3, QA 4, QA 5, QA 6, QA 7
Transfer facility, No. 1, concrete and structural steel	QA 1, QA 3, QA 4, QA 5, QA 6, QA 7
Storage pads, No. 2 and No. 3	QA 5
Fire protection pump building, No. 10	QA 4, QA 7
Security complex, No. 7	QA 6
Inspection gatehouse, No. 8	QA 6

The switchgear building, main gatehouse, potable water well house, transporter wash-down station and receiving gatehouse are of conventional quality, are designed to industrial standards, and are not discussed in this chapter.

7.2 CONFINEMENT SSCs

The CISF confinement structures, systems and components (SSCs) are the storage cask and canister systems. The storage cask systems evaluated for use at the CISF are described in Chapter 4.

Only NRC-approved cask systems will be used at the CISF. These approved cask systems will be referenced in the license application for the CISF. Cask systems used at the CISF shall be evaluated against site parameters and shown to bound site parameters. If actual site parameters exceed the bounds of those assumed in the vendor SARs or the cask certificates of compliance, the license application for the CISF will fully address those areas affected by the variations.

For purposes of the generic CISF design, the vendor cask systems have been evaluated against the CISF design criteria detailed in Chapter 3. The results of this evaluation are presented in Section 3.4.

7.3 POOL AND POOL CONFINEMENT FACILITIES

There are no pool or pool confinement facilities at the CISF.

7.4 REINFORCED CONCRETE STRUCTURES - IMPORTANT TO RADIOLOGICAL SAFETY, QA 1

The transfer facility main structural system and vendor-specific concrete storage casks comprise the only CISF reinforced concrete structures that are important to radiological safety. Section 7.4.1 describes transfer facility reinforced concrete structures that are QA 1 - Important to Radiological Safety. Section 7.4.2 addresses vendor-specific concrete storage casks.

7.4.1 Transfer Facility

The transfer facility is a cast-in-place, fully enclosed reinforced concrete building with a slab-on-grade floor. It provides weather protection, protection against natural phenomena, and support for cask handling and canister transfer equipment. The building is approximately 250 feet long by 88 feet wide by 75 feet high. The concrete superstructure of the transfer facility is designed for a full spectrum of normal operating and environmental loadings, including seismic and tornado loadings.

The transfer facility houses three operational areas for handling SNF casks and canisters: the shipping/receiving area, the canister transfer area, and the site transporter area. The transfer facility shipping/receiving area is used to receive and prepare for shipment all SNF transportation casks arriving at or departing from the CISF. The canister transfer area is used to prepare casks for unloading and loading operations, and to transfer SNF canisters from transportation casks to storage casks. The site transporter area is used to stage concrete storage casks for transfer operations. 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 travel the length of the building to handle SNF transportation, transfer and storage casks. Located near the reinforced concrete transfer facility is a conventional quality personnel building which 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 following sections describe the design of QA 1 transfer facility concrete structures. Criteria and analyses applicable to their design are also presented.

7.4.1.1 Design

Cast-in-place reinforced concrete frames form the columns and roof beams of the transfer facility superstructure. A series of reinforced concrete beams are used to tie the frames together and provide additional support for the roof and walls. Reinforced concrete wall and roof panels fill in 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 with the concrete slab-on-grade basemat, which helps the building resist seismic loadings.

Caissons or rock anchors support the grade beams to resist uplift forces due to seismic and wind loadings. Figures 7.4-1 through 7.4-4 show primary structural members of the transfer facility.

The transfer facility superstructure is designed to withstand the effects of the 0.75g generic site earthquake, and remain functional following the earthquake. Other CISF structures are located at sufficient distances from the concrete transfer facility to have no interaction effects with the QA 1 building during seismic events. The transfer facility structure is designed to accommodate seismic loadings while the cranes are fully loaded with the heaviest casks in the design basis. The transfer facility building is designed to accommodate both cranes, fully loaded, at any location along their rails during a seismic event.

An analysis of the range of probability of a tornado-generated missile strike on SNF canister transfer equipment during transfer operations indicates that the transfer facility should be designed to shield the equipment from missile impact. This analysis investigated the probability of tornado missiles strikes during canister transfer operations for a spectrum of tornado missiles representative of a typical nuclear facility. This was necessary since a specific site has not yet been designated for the CISF. Because of the large number of cask/canisters handled at the CISF, the probability of tornado missile impact on a cask during transfer operations is in the range of 1.91×10^{-6} annually. Using the guidance of RG 1.117, tornado missile protection is provided for the transfer facility.

The canister transfer area and the overhead bridge cranes in the transfer facility are protected from tornado missile strikes. This is accomplished by providing reinforced concrete walls and roof that encompass the entire transfer facility. Protection of these areas/equipment prevents a missile from striking a cask during canister transfer, and prevents damage to a crane that could result in the crane falling on a cask. Tornado missile protection is not required for casks in the shipping/receiving or site transporter areas of the transfer facility, since casks in these areas are always closed and have been designed to withstand a tornado missile strike.

Tornado-generated missiles that could enter the exterior doors of the transfer facility are prevented from entering the canister transfer area by the geometry of the walls and openings. No missile resistant doors are needed. Labyrinths at some doors and at the entrances to the canister transfer area would prevent a tornado-generated missile from directly entering the canister transfer area. Interior missile walls extend to a height that precludes a missile from entering a door and proceeding into the canister transfer area. The interior walls terminate at a height that allows the overhead bridge crane to travel the entire length of the transfer facility uninterrupted. Openings in the roof and walls for items such as fans, ducts, cable chases, etc., 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.

In addition to accommodating tornado-generated missile impact loads, the transfer facility is designed for tornado-induced wind loads and differential pressure loads. Tornado differential pressure forces exerted outward on the interior surfaces of the transfer facility structure are limited by designing at least one of the large overhead doors to blow out at a low differential pressure, thereby reducing the pressure drop across the building's structural components.

Structural concrete used in construction of QA 1 transfer facility structures has a minimum compressive strength of 5,000 psi. All reinforcing steel used in QA 1 structures has a minimum yield strength of 60,000 psi. 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.

Reinforcing bars are lap spliced for bar sizes up to and including No. 11 bars. Mechanical cadweld splices are used for No. 18 reinforcing bars. All reinforcing bar development lengths and lap splice lengths are specified in accordance with the top bar requirements of ACI 349 (Ref. 7.4-1). Applicable ductility and confinement requirements specified by ACI 349 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.

The main transfer facility building columns are reinforced concrete-tied columns, four feet wide by eight feet deep. Figure 7.4-5 shows typical reinforcing layout in the columns. Two rows of No. 18 reinforcing bars are provided in each face of the column around the major axis, and one row of No. 11 bars is provided in each face around the minor axis. Column ties are No. 5 reinforcing bars at a maximum vertical spacing of 22 inches. This spacing is reduced as required for resisting shear and torsion forces in the columns. Closed ties are provided around the column vertical bars so that any given vertical reinforcing bar is no farther than six inches from the corner of a tie.

The capacity of each four by eight-foot column is shown in the column interaction curve provided in Figure 7.4-6. The solid line represents the allowable values of moment and axial load on each of the columns, with no consideration of slenderness effects. The dashed line represents the maximum allowable values of moment and axial load considering slenderness effects, which govern the overall capacity of the columns.

Results from the analysis described in Section 7.4.1.3.3 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.

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. 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.

The main building roof beams that frame into the columns are four feet wide by five feet deep in the interior of each span. Figure 7.4-7 shows the typical reinforcing layout in the four-foot wide by five-foot deep section of the roof beams. In order to accommodate increased end moments due to seismic sideways loadings, the ends of the roof beams taper from five feet deep at eight feet out from the interior face of each column, to a depth of nine feet at the column faces. Two rows of No. 11 reinforcing bars are provided in both the top and bottom faces of each beam, and one row of No. 11 bars is provided in each side face. The reinforcing bars in the bottom of the beams bend downward and follow the taper at the ends of the beams. Closed No. 5 ties are provided in the beams at a maximum horizontal spacing of 22 inches, so that any horizontal reinforcing bar in the beams is no farther than six inches from the corner of a tie.

The four-foot by five-foot portion of each of the roof beams has a bending capacity of 5,793 kip-ft about the major axis. Results from the analysis described in Section 7.4.1.3.3 show that 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 nine-foot section where the beam connects 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 Section 7.4.1.3.3.

The minimum thickness of the building exterior concrete walls and interior tornado missile shield walls is 18 inches, and the minimum thickness of the concrete roof slab is 14 inches. These minimum thicknesses are in accordance with NUREG-0800 Standard Review Plan 3.5.3 (Ref. 7.4-2), Table 1 for Region I, which is the worst-case region for tornado missile impact design.

Embedded plates, embedded anchors and concrete expansion anchors are designed to satisfy the requirements of governing codes. Concrete expansion anchors for QA 1 applications are either 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.

7.4.1.2 Design Criteria

Concrete sections for QA 1 structures are designed in accordance with ultimate strength design methods as specified in ACI 349 (Ref. 7.4-1). Ductility and impact design requirements of ACI 349, 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, Appendix B.

Loads and loading combinations used in design of QA 1 structures are specified in Section 7.4.1.3. Loads and loading combinations are determined using NUREG-0800 Standard Review Plan 3.8.4 (Ref. 7.4-3) and NUREG-1536 (Draft) (Ref. 7.4-4) as guides. These references were used because NUREG-1567 (Draft) had not been published at the time transfer facility design commenced. However, instead of a load factor of 1.25 on seismic load E', a load factor of 1.0 is used, which is compatible with the acceptable factor identified subsequently in NUREG-1567, Table 7-1. A comparison of loads and load combinations identified in Section 7.4.1.3 with those specified in NUREG-1567, Table 7-1, shows that the parameters used for transfer facility design envelop the requirements of NUREG-1567. In addition, loads used for transfer facility design are consistent with and envelop the requirements of ANSI/ANS 57.9 (Ref. 7.4-6), Section 6.17.1.

7.4.1.3 Design Analysis

This section describes loads, loading combinations and analysis methods used for design of transfer facility QA 1 reinforced concrete structures.

7.4.1.3.1 Loads

Loads used in analysis and design of QA 1 transfer facility reinforced concrete structures include the following.

- D Dead load
- L Live load
- F Hydrostatic fluid pressure load
- H Lateral soil pressure load
- T_o Thermal load
- R_o Pipe reaction load
- W Wind load
- F' Flood load
- E' Design earthquake seismic load
- W_t Tornado loads - including:
  - W_w Tornado wind pressure load
  - W_p Tornado-created differential pressure load
  - W_m Tornado-generated missile load

These loads are categorized into three areas: normal loads, severe environmental loads and extreme environmental loads. Values for these loads are based on the generic site design parameters identified in Chapter 3. Definitions for the loads in these categories are provided in the following sections for QA 1 transfer facility reinforced concrete structures.

7.4.1.3.1.1 Normal Loads

Normal loads are those encountered during normal operation. They include: dead loads, live loads, hydrostatic fluid pressure loads, soil pressure loads, thermal loads, and pipe reactions. The following definitions are provided for normal loads.

Dead Load - Defined as any load, including related internal moments and forces, that is constant in magnitude, orientation, and point of application. Dead loads include the mass of the structure, any permanent equipment loads, and any permanent hydrostatic loads that have constant fluid levels. The effects of differential settlement are considered when determining dead loads. For equipment supports, dead load also includes static and dynamic head and fluid flow effects. The weight of permanent items, such as roofing materials, wall materials, electrical equipment, cable trays, mechanical piping, and heating, ventilation and air conditioning (HVAC) equipment and ducts, are included in the dead load. Where actual equipment loads are known, they are applied to the design of structural systems and components. In addition, a minimum uniform load allowance of 50 lb/ft^2 is applied to all elevated floor, platform and roof areas to account for piping, cabletrays, conduits, HVAC ducts and other miscellaneous equipment for which the actual dead load contribution is not precisely known at the time the analysis or design is performed.

Live Load - Defined as any normal load, including related internal moments and forces, that may vary with intensity, orientation and/or location of application. Movable equipment loads, loads due to vibration and any support movement effects and operating loads are types of live loads. The following descriptions provide design requirements for various types of live loads.

- **Rain, Snow and Ice** - Described in Chapter 3, the design live load due to snow and ice is 50 lb/ft^2, which is the ground snow load (p_g). This snow load is equivalent to more than 9.5 inches of water, which is sufficient to bound the design peak rainfall of 19.4 inches in one hour, or 6.2 inches in five minutes, as identified in Chapter 3. Using standard architectural design provisions for roof slopes and parapet designs, the design load of 50 lb/ft^2 is adequate to account for any effects that may result from ponding of rainwater due to deflection of the supporting roof or the blockage of primary roof drains. Determination of roof snow and ice loads is in accordance with the requirements of American Society of Civil Engineers (ASCE) Standard 7-95 (Ref. 7.4-7), Section 7. An exposure factor of C_e = 1.0 is used to consider wind effects for analysis and design of roof structures resisting snow and ice loads. A thermal factor of C_t = 1.0 is used, since the transfer facility is a heated structure. An importance factor of I = 1.2 for Category IV is used for QA 1 structures. The effects of roof slope, shape, and potential for accumulation of snow drifts or excessive ice build-up is considered in accordance with guidance provided in ASCE Standard 7-95, Section 7.

- **Transportation Vehicle Loads and Heavy Floor Loads** - Loads due to vehicular truck and rail traffic in designated building areas are in accordance with standard loadings defined by the American Association of State Highway and Transportation Officials (AASHTO) and by the American Railways Engineers Association. Special heavy loading conditions resulting from transport of SNF transportation and storage casks on truck and rail transporters/carriages are considered. Considered cask weights bound the worst-case condition of all vendor designs handled in the transfer facility. Floor loadings from transportation, transfer and storage mode casks are also considered, along with sufficient allowance for any impact resulting from placing the moving loads on the floor or other areas of the structure. The heaviest cask handled in the transfer facility weighs 390,000 pounds, not including lifting devices and ancillary equipment.

- **Crane and Hoist Loads** - Design loads for permanently installed cranes and hoists envelop the fully-rated capacity of the equipment, including allowances for impact loads and test load requirements. The rated capacity of each of the two overhead bridge cranes in the transfer facility is 225 tons. Construction cranes will not be supported on the transfer facility structure. Crane test loads are considered in the design at 125% of the rated capacity of the cranes, increased by an additional 25% to account for impact. Concrete structures are only analyzed for crane test loads in service load combinations with an applied load factor of 1.1 instead of the 1.7 load factor used for other live loads. The factor is reduced because the crane test loads are a one-time load and are more precisely defined than normal operating loads, and because the tests are performed under controlled conditions. Minimum lateral design loads on crane runway supports are 20% 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% of the maximum crane wheel load. Seismic effects considered on fully loaded cranes and hoists are described in Section 7.4.1.3.1.3 for seismic loadings, due to the high frequency of cask lifting in the transfer facility.

- **Floor Live Loads** - A floor live load of 300 lb/ft^2 is applied in areas of heavy operation and to major working platforms. In general, other floor areas are designed for a live load of 100 lb/ft^2.

Hydrostatic Fluid Pressure Loads (F) - Are due to fluids held in internal building compartments, such as tanks. There are no reinforced concrete tanks in the transfer facility. 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 transfer facility structural analysis and design.

Soil Load (H) - Based on the density of the soil and includes the effects of groundwater. Since the CISF site is a dry, relatively flat site and the transfer facility is a slab-on-grade structure, no groundwater or soil pressure loads are exerted on building structures. Therefore, determination of lateral soil pressure loads is not necessary for transfer facility structural analysis or design.

Thermal Load (T_o) - Consist of thermally induced forces and moments resulting from operation and environmental conditions affecting the building structure. Thermal loads are based on the most critical transient or steady-state condition. Thermal expansion loads due to axial restraint, as well as loads resulting from thermal gradients, are considered. The ambient temperature values during normal operating conditions identified in Chapter 3 are used for structural analysis and design.

Pipe Reactions (R_o) - Are those loads applied by piping distribution system supports during normal operating conditions, based on the most critical transient or steady-state condition. There are no high-energy piping systems in the transfer facility. Normal piping loads are included in the 50 lb/ft^2 uniform dead load applied to structural elevated floor and roof systems. As such, there are no pipe reaction R_o loads applicable to transfer facility structural analysis or design.

7.4.1.3.1.2 Severe Environmental Loads

Severe environmental loads are those that could infrequently be encountered during the life of the transfer facility. They include: wind loads (W) and flood loads (F'). These loads are defined as follows.

Wind Loads (W) - Are those pressure loads generated by the design wind. These loads do not incorporate any loads associated with tornados (see Section 7.4.1.3.1.3 for tornado loads). The basic wind speed used to determe design wind loads on transfer facility walls and roof areas is 110 mph, as described in Chapter 3.

Wind loads are determined in accordance with the requirements of ASCE Standard 7-95 (Ref. 7.4-7), Section 6. Design wind pressures (p) and design wind forces (F) for transfer facility main wind-force resisting structures are determined in accordance with the following equations from ASCE Standard 7-95, Table 6-1.

$W = p = q_{z\ or\ h}GC_p - q_h(GC_{pi})$, for the transfer facility with a mean roof height ≥ 60 ft

where:

$q_{z\ or\ h}$ = velocity pressure. For windward wall pressure, q_z is calculated for height z above the ground at which pressure is applied. For leeward wall, sidewall and roof pressures, q_h is calculated using mean roof height h.

$= 0.00256K_zK_{zt}V^2I$

where:

K_z = normal wind velocity pressure exposure coefficient for different heights above ground, from Table 6-3 of ASCE Standard 7-95, Exposure Category C

K_{zt} = topographic factor from ASCE Standard 7-95, Section 6.5.5. Since the CISF site is flat with no isolated hills, the factor K_{zt} is taken as 1.0. (This topographic factor is also used for tornado wind load design.)

I = importance factor for normal wind load determination of 1.15 for important-to-safety SSCs (Category IV) as defined in ASCE Standard 7-95

V = basic wind speed = 110 mph

G = gust effect factor for normal wind loads, which equals 0.85 for Exposure Category C (open terrain), from ASCE Standard 7-95, Section 6.6.1

C_p = external pressure coefficient for windward wall, leeward wall, side wall or roof, from ASCE Standard 7-95, Figure 6-3. (These coefficients are also used for tornado wind load design.)

(Gc_{pi}) = product of internal pressure coefficient and gust effect factor for normal wind loads, from ASCE Standard 7-95, Table 6-4.

Flood Loads (F') - Are due to exterior flood waters from the design-basis flood exerting forces and moments on exterior building structures, or entering a building and exerting loads on interior building structures. As described in Chapter 3, the CISF is assumed to be located at a dry site; therefore, no exterior or interior flood loads are postulated for transfer facility structural analysis or design.

7.4.1.3.1.3 Extreme Environmental Loads

Extreme environmental loads are loads which are credible but are highly improbable. They include seismic loads (E') and tornado loads (W_t). These loads are defined as follows.

Seismic Loads (E') - Are loads generated by the design earthquake. In accordance with the requirements of Sections C.1.1. and C.2. of Regulatory Guide 1.29 (Ref. 7.4-8), structures for handling SNF and structures whose failure could impair other safety-related structures are required to be designed to accommodate a safe shutdown earthquake. For the CISF, these structures are synonymous with QA 1 and 5 structures. In addition, Regulatory Guide 1.143 (Ref. 7.4-9) requires that structures housing radioactive wastes (synonymous with QA 3 structures at the CISF) be designed to accommodate an operating basis earthquake. For the CISF, the design earthquake is similar to a safe shutdown earthquake, and no operating basis earthquake is required for CISF design. Therefore, it is appropriate to design QA 1, 3 and 5 structures to accommodate the design earthquake.

As specified in Chapter 3, design earthquake loads (E') are based on a 0.75g maximum peak horizontal seismic acceleration applied at the structure foundation/soil interface. Section 7.4.1.3.3 describes the seismic structural response analysis method used to determine seismic load effects on transfer facility QA 1 structures.

Seismic loads are determined by multiplying the dead load and a minimum of 25% of the live load on the structure, times 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 Section 3.1.4.2 of ASCE Standard 4-86 (Ref. 7.4-10), and the required functionality of the structure to support particular loading conditions. Since the cranes must support casks during a seismic event and remain functional, the full weight of the casks is included in the live load used to determine the seismic load on the crane support structures.

Tornado Loads (W_t) - Are loads generated by the design tornado specified for the CISF. They include loads due to tornado wind pressure (W_w), loads created by tornado-induced differential pressure (W_p), and loads resulting from tornado-generated missiles (W_m). The tornado load criteria from Chapter 3 apply to transfer facility structures.

- **Tornado Wind Pressure Loads** - Tornado wind loads (W_w) are those pressure loads generated by tornado wind velocity, which is the combined translational and rotational wind speed of 360 mph. Tornado wind loads are similar to those for basic design wind speed. NUREG-0800 Standard Review Plan 3.3.2 (Ref. 7.4-11) provides guidance for determining tornado loads for nuclear power plant structures, and this guidance is used for the CISF. NUREG-0800 Standard Review Plan 3.3.2 indicates that the criteria delineated in the document (now ASCE Standard 7-95) can be used to convert tornado wind velocity into effective structural pressure loads. Tornado wind pressure loads, W_w, are determined as follows.

$W_w = p_w = q_h G C_p$

where:

q_h = velocity pressure,
= $0.00256 K_z K_{zt} V^2 I$

where:

K_z = velocity pressure exposure coefficient for different heights above ground
= 1.0, since velocity pressure is constant with height for tornado winds as specified in NUREG-0800 Standard Review Plan 3.3.2

K_{zt} = topographic factor from ASCE Standard 7-95, Section 6.5.5 (Ref. 7.4-7)
= 1.0, since CISF design assumes a flat site with no isolated hills

V = tornado wind speed = 360 mph

I = importance factor
= 1.0, since a tornado is a highly improbable event

G = gust effect factor
= 1.0 for tornado winds, as specified by NUREG-0800 Standard Review Plan 3.3.2

C_p = external pressure coefficient for windward wall, leeward wall, side wall or roof, from ASCE Standard 7-95, Figure 6-3

Simplifying this formula for tornado wind pressure load determination:

$W_w = p_w = 0.00256 V^2 C_p$

- **Tornado Differential Pressure Loads** - Tornado-induced differential pressure (W_p) loads are those exerting an internal pressure loading on structures due to the negative pressure created by the tornado. The design pressure drop is 3.0 psi, which occurs at a rate of 2.0 psi/sec. This internal pressure is applied to the interior surfaces of the transfer facility exterior building walls and roof. The magnitude of this pressure is reduced for structures that are vented, as permitted by Section II (3) (b) of Standard Review Plan 3.3.2 (Ref. 7.4-11). Reduction in tornado differential pressure loads for transfer facility reinforced concrete structural design is discussed in Section 7.4.1.3.3.

- **Tornado Missile Loads** - Tornado-generated missile loads (W_m) are impact loads applied to structures due to strikes by any of the missile spectra criteria specified in Chapter 3. When converting tornado-generated missile loadings into structural loads, the effects of impact are considered. Consideration of tornado-generated missile impact loadings is discussed further in Section 7.4.1.3.3.

7.4.1.3.2 Loading Combinations

The following loading combinations are used for the design of QA 1 reinforced concrete transfer facility structures. As described in Section 7.4.1.2, these loading combinations are determined using NUREG-0800 Standard Review Plan 3.8.4 (Ref. 7.4-3) and NUREG-1536 (Draft) (Ref. 7.4-4) as guides. A comparison of these load combinations with those specified in NUREG-1567, Table 7-1, shows that these combinations envelop NUREG-1567 requirements.

These loading combinations are used in conjunction with the ultimate strength design method for reinforced concrete structural design. The value "U" is the section strength required to resist design loads based upon the ultimate strength design methods described in ACI 349 (Ref. 7.4-1). Loading combinations consider two conditions of structural loading: service load conditions and factored load conditions. Loads specified in each combination are defined in Section 7.4.1.3.1.

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 (Draft) (Ref. 7.4-5). Service load combinations include dead loads (D), live loads (L), hydrostatic fluid pressure loads (F), lateral soil pressure loads (H), design wind loads (W), flood loads (F'), thermal loads (T_o) and pipe reaction loads (R_o). Wind and flood loads are assumed to act simultaneously in these combinations, since it is reasonable for flood conditions to occur with high winds during a storm. Service load combinations used for design of QA 1 concrete structures are as follows.

$$U = 1.4D + 1.4F + 1.7L + 1.7H$$

$$U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7F'$$

$$U = 1.2D + 1.2F + 1.7W + 1.7F'$$

$$U = 1.05D + 1.05F + 1.275L + 1.275H + 1.275T_o + 1.275R_o$$

$$U = 1.05D + 1.05F + 1.275L + 1.275H + 1.275W + 1.275F' \; 1.275T_o + 1.275R_o$$

Factored load combinations represent the loading conditions that QA 1 structures could experience under extreme environmental conditions. Factored load combinations are comparable to the "Accident-Level Events and Conditions" loading combinations specified in NUREG-1567 (Draft). Factored load combinations include dead loads (D), live loads (L), hydrostatic fluid pressure loads (F), lateral soil pressure loads (H), thermal loads (T_o), pipe reaction loads (R_o), design earthquake loads (E') and tornado loads (W_t). Extreme environmental loads (i.e., seismic and tornado loadings) are not considered to act simultaneously because of the extremely low probability that an earthquake and a tornado could occur at the same time. Factored load combinations used for design of QA 1 concrete structures are as follows.

$U = D + F + L + H + T_o + R_o + E'$

$U = D + F + L + H + T_o + R_o + W_t$ (See note below)

$U = D + F + L + H + E'$

NOTE: The following combinations of W_t are considered, where W_w represents tornado wind pressure loads, W_p represents tornado-induced differential pressure loads, and W_m represents tornado-generated missile loads:

$W_t = W_w$

$W_t = W_p$

$W_t = W_m$

$W_t = W_w + 0.5W_p$

$W_t = W_w + W_m$

$W_t = W_w + 0.5W_p + W_m$

In addition to the service load and factored load combinations, the following loading combinations are checked to ensure overall stability of the transfer facility structure against the effects of overturning, sliding and flotation. These loading combinations are determined using NUREG-0800 Standard Review Plan 3.8.5 (Ref. 7.4-12) as a guide. When checking for overall structural stability, only the tornado load case of $W_t = W_w$ is considered. Neither tornado internal pressure loadings, W_p, nor tornado missile impact loadings, W_m, appreciably affect structure overturning, sliding or flotation for the transfer facility. The minimum safety factors ensured for each loading combination are presented in Table 7.4-1.

Table 7.4-1. Minimum Factors of Safety

Loading Combination	**Overturning**	**Sliding**	**Flotation**
D + F + H + W	1.5	1.5	-
D + F + H + E'	1.1	1.1	-
$D + F + H + W_t$	1.1	1.1	-
D + F + F'	-	-	1.1

Since the transfer facility is located above grade level and does not contain liquids, hydrostatic fluid pressure load (F) and lateral soil pressure load (H) do not result in any load components on the transfer facility structure. In addition, there is no flood load (F') since the generic site is defined as a dry site. Thus, a value of zero is used for load components F, H and F' in all loading combinations.

The following loading considerations are used when combining loads for transfer facility design.

- Live loads are applied fully to structural members, partially to members, totally removed from members, or shifted in location and pattern as necessary to obtain worst-case loading conditions for maximizing internal forces and moments for all load combinations and for investigating overall building stability. Impact forces due to moving loads are applied where appropriate.

- Appropriate construction loadings are considered in the service load combinations, as are construction methods and sequence, and appropriate loading conditions are applied to ensure structural integrity of partially erected or open structures.

- Where any load reduces the overall loading on a structural member, a load coefficient of 0.9 is applied to that load component in the loading combination. The reducing coefficient is used only for loads that are always present or that always occur simultaneously with other loads. The 0.9 reducing coefficient is used in lieu of the code-specified coefficient.

- Tornado loads are applied to roofs and all exterior walls of transfer facility QA 1 structures. Where the exterior walls do not establish the tornado pressure boundary, appropriate interior walls are designed as the tornado pressure boundary.

7.4.1.3.3 Structural Analysis and Design

Transfer facility QA 1 reinforced concrete structures are analyzed and designed to resist the loads and loading combinations specified in Sections 7.4.1.3.1 and 7.4.1.3.2. 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. The computer model used to analyze the transfer facility for the various loading conditions is described below. In addition, descriptions of the seismic and tornado loading analyses are provided.

7.4.1.3.4 Analysis Model

An ANSYS computer model has been generated for structural analysis of the QA 1 transfer facility structure. Figure 7.4-8 shows an isometric view of the ANSYS model developed for the transfer facility superstructure. The model includes both the primary moment-resisting reinforced concrete frames (columns and beams) which span 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.

All building columns and beams are represented as members in the ANSYS model, and all wall and roof concrete panels are modeled as plate elements. Appropriate member and element properties are used in the 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.

7.4.1.3.5 Seismic Analysis and Design

A dynamic seismic modal analysis is performed using the ANSYS model and the seismic load input of 0.75g applied at the building foundation/soil interface. The 0.75g seismic input is the horizontal acceleration, and the vertical seismic input is 2/3 of the horizontal acceleration, or 0.50g, as specified by Section 2.2.2.2 of ASCE Standard 4-86 (Ref. 7.4-10). Analysis methods used to determine seismic loadings from these acceleration input criteria conform to the requirements of ASCE Standard 4-86 and to Regulatory Guide 1.92 (Ref. 7.4-13).

Seismic loads are applied to the structural model simultaneously in the three orthogonal directions (two horizontal and one vertical) at the structure foundation, and the three-dimensional effect of each of these inputs is considered. Figure 1 of Regulatory Guide 1.60 (Ref. 7.4-14) is used to determine seismic responses in the two orthogonal horizontal directions, and Figure 2 of Regulatory Guide 1.60 is used to determine seismic responses in the vertical direction. The values in these figures are scaled based on the design earthquake horizontal acceleration of 0.75g. Appropriate consideration of the effects of structural member properties on structure frequency, stiffness and displacement are factored into the seismic analysis. A critical structural damping value of 7% is used to determine seismic loads on reinforced concrete structures in accordance with Regulatory Guide 1.61 (Ref. 7.4-15) for the design earthquake.

Colinear modal responses to each of the three directional earthquakes (e.g., all responses in the x-direction from the three-directional design earthquake input) are combined using the square root of the sum of the squares (SRSS) method described in ASCE Standard 4-86 (Ref. 7.4-10). The following formulas show how seismic forces and moments in the x-direction are calculated using the SRSS method. Similar formulas are used to calculate seismic forces and moments in the y and z directions.

$$\sum F_x = (\sum F_{x \text{ due to Ex'}}{}^2 + \sum F_{x \text{ due to Ey'}}{}^2 + \sum F_{x \text{ due to Ez'}}{}^2)^{1/2}$$

$$\sum M_x = (\sum M_{x \text{ due to Ex'}}{}^2 + \sum M_{x \text{ due to Ey'}}{}^2 + \sum M_{x \text{ due to Ez'}}{}^2)^{1/2}$$

All seismic responses from modes clustered within a 10% 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 combinations.

An additional eccentricity of the mass at each level under consideration (e.g., roof level) is included in the seismic analysis, equivalent to 5% of the maximum building dimension to account for variations in material densities, member sizes, architectural features, equipment loads, etc. This additional eccentricity is included per NUREG-0800 Standard Review Plan 3.7.2 (Ref. 7.4-16), Section II.11, to account for any accidental torsion.

Since the overhead bridge cranes are in operation most of the time, the building is analyzed for both cranes being fully loaded during the design earthquake event. 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% of the suspended load is applied horizontally in the direction perpendicular to the crane support beams, and 10% 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.

7.4.1.3.6 Tornado Missile Impact Analysis and Design

Provisions of NUREG-0800 Standard Review Plan 3.5.3, Subsection II (Ref. 7.4-2) and ACI 349, Appendix C (Ref. 7.4-1) are used in designing 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 over-stressing and damage is permitted for structures subjected to missile impact. The local effects of missile impact are analyzed to ensure that missiles cannot perforate through the concrete barriers, and to ensure that secondary missiles cannot be generated due to scabbing of structural components as a result of the initial missile penetration.

The modified National Defense Research Committee (NDRC) formula is used to estimate missile penetration, in order to determine the required missile barrier thicknesses to preclude perforation through the concrete barrier, and to avoid generation of secondary missiles as a result of scabbing. From Section 6.4.1.2.1, page 336 of ASCE No. 58 (Ref. 7.4-17), the following modified NDRC formula is used for determining missile penetration:

$x = [4KNWd(v_o/1{,}000d)^{1.80}]^{1/2}$, for $x/d \leq 2.0$

or:

$x = \{[KNW(v_o/1{,}000d)^{1.80}] + d\}$, for $x/d > 2.0$

where:

x = the penetration depth of the missile, in inches

K = concrete penetrability factor
 $= 180/(f_c')^{1/2}$

f_c' = ultimate concrete compressive strength, in psi

N = missile shape factor
 = 1.14 for sharp nose missile, such as the armor piercing shell
 = 1.00 for spherical end missile, such as the solid steel sphere missile

W = projectile weight, in pounds

v_o = striking velocity of projectile, in feet per second

d = effective projectile diameter, in inches

Once the penetration depth (x) of the missile is determined, the concrete thickness required to prevent either complete perforation through or scabbing of the concrete is determined by the following formulas, from Section 6.4.1.2.1, page 338 of ASCE No. 58.

Perforation:

$e/d = 1.32 + 1.24(x/d)$, for $1.35 \leq x/d \leq 13.5$

or:

$e/d = 3.19(x/d) - 0.718(x/d)^2$, for $x/d \leq 1.35$

where:

e = minimum thickness of concrete, in inches, required to prevent complete penetration of the missile. (Note: The perforation thickness is considerably greater than the penetration depth (x) due to scabbing of concrete from the rear face of the target.)

Scabbing:

$s/d = 2.12 + 1.36(x/d)$, for $0.65 \le x/d \le 11.75$

or:

$s/d = 7.91(x/d) - 5.06(x/d)^2$, for $x/d \le 0.65$

where:

s = minimum thickness of concrete, in inches, required to prevent scabbing from the rear face of the target. (Note: This thickness is required to preclude generation of secondary missiles as a result of missile impact on the outside face of the concrete structure.)

These modified NDRC formulas are used to analyze for local penetration, perforation and scabbing effects of tornado-generated missiles on concrete barriers. Assurance is made that concrete tornado missile barriers are of sufficient thickness to prevent complete perforation and generation of secondary missiles. The minimum wall and roof thicknesses specified in Section 7.4.1.1 are a lower boundary for CISF missile barrier design. Analyses of the local penetration, perforation and scabbing effects of tornado-generated missile impact will be conducted as part of the site-specific safety evaluation.

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 Section 6.4.2.1.2, page 347 of ASCE No. 58. 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 Section 6.4.2.2, page 362 of ASCE No. 58. These overall analyses will be conducted as part of a site-specific safety evaluation.

7.4.1.3.7 Tornado Pressure Analysis

When analyzing the transfer facility structure for tornado pressure, a design value for tornado differential pressure of 1.0 psi is used. The 3.0 psi differential pressure design parameter value has been limited to 1.0 psi by designing at least one of the overhead rollup doors (20-foot by 24-foot minimum area) to blow out at 0.15 psi, and thus vent the building internal pressure to relieve the 3.0 psi tornado pressure drop.

7.4.2 Storage Casks

Refer to vendor SARs listed in Table 3.1-1 for structural descriptions and evaluations of QA 1 - Important to Radiological Safety concrete storage casks.

Figure 7.4-1. Transfer Facility - Structural Plan at El. 101'-0"

Figure 7.4-2. Transfer Facility - Structural Plan at El. 150'-0"

Figure 7.4-3. Transfer Facility - Structural Longitudinal Section

Figure 7.4-4. Transfer Facility - Structural Cross Sections

Figure 7.4-5. Transfer Facility - Main Concrete Column Design

Figure 7.4-6. Transfer Facility - Main Concrete Column Load Interaction Curve

Figure 7.4-7. Transfer Facility - Main Concrete Roof Beam Design

Figure 7.4-8. Transfer Facility - ANSYS Computer Model

7.5 OTHER STRUCTURES, SYSTEMS, AND COMPONENTS IMPORTANT TO SAFETY

The transfer facility contains structural steel components that are QA 1 - Important to Radiological Safety, described in Section 7.5.1. In addition to the storage casks, vendor-specific systems also contain other QA 1 structures systems and components (SSCs), which are addressed in Section 7.5.2.

7.5.1 Transfer Facility Steel Structures

The following sections describe the design of QA 1 steel crane runway support beams and associated structures in the transfer facility. Criteria and analyses applicable to the design of these steel structures are also presented.

7.5.1.1 Design

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 QA 1 - Important to Radiological Safety since 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. In order 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 steel crane runway support beams are shown in plan on Figure 7.4-2 and in elevation on Figure 7.4-3.

The transfer facility steel crane runway support beams are constructed using ASTM A36 mild carbon steel rolled shapes and/or plate sections. 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 either A325 or A490. A307 bolts are used for attaching ancillary components or equipment to steel structures. Welding electrodes are compatible with the joined materials.

7.5.1.2 Design Criteria

Structural steel members for QA 1 applications are designed in accordance with elastic allowable strength design methods, as specified in Part 1 of American National Standards Institute/American Institute of Steel Construction (ANSI/AISC) N690 (Ref. 7.5-1).

Loads and loading combinations used in design of QA 1 steel structures are specified in Section 7.5.1.3, and are determined using NUREG-0800 Standard Review Plan 3.8.4 (Ref. 7.5-2) and NUREG-1536 (Draft) (Ref. 7.5-3) as guides. These references were used because NUREG-1567 (Draft) (Ref. 7.5-4) had not been published at the time transfer facility design began. A comparison of loads and load combinations identified in Section 7.5.1.3 with those specified in NUREG-1567, Table 7-1, shows that the parameters used for transfer facility design are comparable to the requirements of NUREG-1567. In addition, loads used for transfer facility design are consistent with and envelop the requirements of ANSI/American Nuclear Society (ANS) 57.9 (Ref. 7.5-5), Section 6.17.1.

7.5.1.3 Design Analysis

This section describes loads, loading combinations and analysis methods used for design of transfer facility QA 1 structural steel.

7.5.1.3.1 Loads

Loads used in analysis and design of QA 1 transfer facility structural steel include the following.

- D Dead load
- L Live load
- F Hydrostatic fluid pressure load
- H Lateral soil pressure load
- T_o Thermal load
- R_o Pipe reaction load
- W Wind load
- F' Flood load
- E' Design earthquake seismic load
- W_t Tornado loads, including:
  - W_w Tornado wind pressure load
  - W_p Tornado-created differential pressure load
  - W_m Tornado-generated missile load

These loads are categorized into three areas: normal loads, severe environmental loads and extreme environmental loads. Their values are based on the generic site design parameters identified in Chapter 3. The following sections define loadings for QA 1 transfer facility steel structures, as compared to the definitions provided in Section 7.4.1.3.1 for reinforced concrete structures.

7.5.1.3.1.1 Normal Loads

Normal loads are those encountered during normal operation, and include dead loads (D), live loads (L), hydrostatic fluid pressure loads (F), soil pressure loads (H), thermal loads (T_o), and pipe reactions (R_o). These loads are defined as follows:

Dead Load (D) - Dead loads on QA 1 steel structures are the same as are defined for concrete structures in Section 7.4.1.3.1.1.

Live Load (L) - Live loads on QA 1 steel structures are defined as follows.

- **Rain, Snow and Ice** - No rain, snow or ice loads are exerted on QA 1 structural steel members in the transfer facility.

- **Transportation Vehicle Loads and Heavy Floor Loads** - No vehicle or heavy floor loads are exerted on QA 1 structural steel members in the transfer facility.

- **Crane and Hoist Loads** - 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. Construction cranes will not be supported on transfer facility QA 1 structural steel members. Crane test loads are considered in the design at 125% of the rated capacity of the cranes. The test loads are increased by an additional 25% to account for impact. Test loads are checked only in service load combinations. Supporting steel structures for pendant-operated or remote-operated traveling cranes and trolley hoists are designed for 110% of the cranes' rated load capacity to account for impact, as specified by ANSI/AISC N690 (Ref. 7.5-1), Section Q1.3.2. Design loads for motor-operated trolleys and cab-operated traveling cranes are increased by 25% 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% 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 stiffnesses of the end supports. Minimum longitudinal design loads on supports for each crane rail are 10% of the maximum crane wheel load. Seismic effects on fully loaded cranes and hoists are described in Section 7.5.1.3.1.3 for seismic loadings. Consideration of these effects is necessary due to the high frequency of cask lifting in the transfer facility.

- **Floor Live Loads** - No floor live loads are exerted on QA 1 structural steel members in the transfer facility.

Hydrostatic Fluid Pressure Loads (F) - Hydrostatic fluid pressure loads on steel structures are the same as those defined for concrete structures in Section 7.4.1.3.1.1, and none are exerted on QA 1 structural steel members.

Soil Load (H) - Lateral soil pressure loads on steel structures are the same as defined for concrete structures in Section 7.4.1.3.1.1, and none are exerted on QA 1 structural steel members.

Thermal Load (T_o) - Thermal loads on steel structures are the same as defined for concrete structures in Section 7.4.1.3.1.1.

Pipe Reactions (R_o) - Pipe reaction loads on steel structures are the same as defined for concrete structures in Section 7.4.1.3.1.1, and none are exerted on QA 1 steel structures.

7.5.1.3.1.2 Severe Environmental Loads

Severe environmental loads are those loads that could infrequently be encountered during the life of the transfer facility, including wind loads (W) and flood loads (F'). These loads are defined as follows.

Wind Loads (W) - Wind loads on steel structures are the same as defined for concrete structures in Section 7.4.1.3.1.2, and none are exerted on QA 1 structural steel members.

Flood Loads (F') - Flood loads on steel structures are the same as defined for concrete structures in Section 7.4.1.3.1.2, and none are exerted on QA 1 structural steel members.

7.5.1.3.1.3 Extreme Environmental Loads

Extreme environmental loads are those loads which are credible but highly improbable, including seismic loads (E') and tornado loads (W_t). These loads are defined as follows:

Seismic Loads (E') - Seismic loads on QA 1 steel structures are the same as are defined for concrete structures in Section 7.4.1.3.1.3. Since the two overhead bridge cranes must support casks during a seismic event and remain functional, the full weight of the casks is included in the live load used to determine the seismic load on the crane support structures.

Tornado Loads (W_t) - Tornado loads on QA 1 steel structures are the same as defined for concrete structures in Section 7.4.1.3.1.3. No QA 1 steel structures are subjected to tornado wind (W_w), differential pressure (W_p) or tornado-generated missile impact (W_m) loadings. The concrete missile barrier walls of the transfer facility protect all QA 1 SSCs inside the building 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.

7.5.1.3.2 Loading Combinations

The following loading combinations are used for the design of transfer facility QA 1 structural steel. As described in Section 7.5.1.2, these loading combinations are determined using NUREG-0800 Standard Review Plan 3.8.4 (Ref. 7.5-2) and NUREG-1536 (Draft) (Ref. 7.5-3) as guides. A comparison of these load combinations with those specified in NUREG-1567 (Ref. 7.5-4), Table 7-1 shows that these combinations are comparable to the requirements of NUREG-1567.

These loading combinations are used in conjunction with elastic design methods for structural steel. The value "S" is the required section strength based on allowable stresses defined in ANSI/AISC N690 (Ref. 7.5-1). Loading combinations consider two structural loading conditions: service load conditions and factored load conditions. Loads specified in each combination are defined in Section 7.5.1.3.1.

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 (Draft) (Ref. 7.5-4). Service load combinations include dead loads (D), live loads (L), hydrostatic fluid pressure loads (F), lateral soil pressure loads (H), design wind loads (W), flood loads (F'), thermal loads (T_o) and pipe reaction loads (R_o). Wind and flood loads are assumed to act simultaneously in these combinations, since it is reasonable for flood conditions to occur with high winds during a storm. Service load combinations used for design of QA 1 steel structures are as follows.

$$S = D + F + L + H$$

$$S = D + F + L + H + W + F'$$

$$1.5S = D + F + L + H + T_o + R_o$$

$$1.5S = D + F + L + H + T_o + R_o + W + F'$$

Factored load combinations represent the loading conditions that QA 1 structures could experience under extreme environmental conditions. Factored load combinations are comparable to the Accident-Level Events and Conditions loading combinations specified in NUREG-1567 (DRAFT) (Ref. 7.5-4). Factored load combinations include dead loads (D), live loads (L), hydrostatic fluid pressure loads (F), lateral soil pressure loads (H), thermal loads (T_o), pipe reaction loads (R_o), design earthquake loads (E') and tornado loads (W_t). Extreme environmental loads (i.e., seismic and tornado loadings) are not considered to act simultaneously because of the extremely low probability that an earthquake and a tornado could occur at the same time. Factored load combinations used for design of QA 1 steel structures are as follows:

$$1.6S = D + F + L + H + T_o + R_o + E'$$

$1.6S = D + F + L + H + T_o + R_o + W_t$

$1.7S = D + F + L + H + E'$

NOTE: The following combinations of W_t are considered where W_w is tornado wind pressure loads, W_p is tornado-induced differential pressure loads and W_m is tornado-generated missile loads:

$W_t = W_w$

$W_t = W_p$

$W_t = W_m$

$W_t = W_w + 0.5W_p$

$W_t = W_w + W_m$

$W_t = W_w + 0.5W_p + W_m$

Since QA 1 structural steel is 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 flotation are not applicable to structural steel design.

The following loading considerations are used when combining loads in transfer facility design:

- Live loads are fully applied to structural members, partially to the members, totally removed from the members, or shifted in location and pattern as necessary to obtain the worst-case loading conditions for maximizing internal forces and moments for all load combinations and for investigating overall building stability. Impact forces due to moving loads are applied where appropriate.

- Appropriate construction loadings are considered in service load combinations. Construction methods and sequence are also considered, and appropriate loading conditions are applied to ensure structural integrity of partially erected or open structures.

- Where any load reduces the overall loading on a structural member, a load coefficient of 0.9 is applied to that load component in the loading combination. The reducing coefficient is only used for loads that are always present or that always occur simultaneously with other loads. The 0.9 reducing coefficient is used in lieu of the code specified coefficient.

7.5.1.3.3 Structural Analysis and Design

Transfer facility QA 1 structural steel components are analyzed and designed to resist the loads and loading combinations specified in Sections 7.5.1.3.1 and 7.5.1.3.2. 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. (No tornado loads are present on QA 1 structural steel components.) For determining seismic load effects on structural steel components, a damping value of 4% is used for welded structures, and a damping value of 7% is used for bolted structures, as required by Regulatory Guide 1.61 (Ref. 7.5-6).

The QA 1 steel crane runway support beams are included in the ANSYS analysis model that is described in Section 7.4.1.3.4. Beams are analyzed and designed for worst-case crane wheel loads, assuming both of the overhead bridge cranes are fully loaded to their rated capacity. Loadings on the beams from the cranes are appropriately increased for impact effects as described in Section 7.5.1.3.1.1 for live crane and hoist loads. Both cranes are assumed to be 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 supports the suspended load on each crane, lateral seismic load contributions from the 225-ton suspended loads are considered to be similar to lateral effects due to trolley movement. That is, 20% of the suspended load is applied horizontally in the direction perpendicular to the steel crane runway support beams and 10% of the suspended load is applied horizontally along the longitudinal axis of the steel crane runway support beams.

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 to each other. 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.

7.6 OTHER STRUCTURES, SYSTEMS, AND COMPONENTS SUBJECT TO NRC APPROVAL

This section describes the structural design, design criteria and design analysis for the storage pads, miscellaneous QA Classification structures in the transfer facility, the fire protection pump building, the security complex and the inspection gatehouse. These structures are classified as QA 3, QA 4, QA 5, QA 6 and QA 7.

7.6.1 Storage Pads

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 (Ref. 7.6-1) as permitted by NUREG-1567 (Ref. 7.6-2). The storage pads are designed as QA 5 structures, Important to Potential Interaction. Construction of the pads is to ACI 318 (Ref. 7.6-3), and is conventional quality. The following sections describe the storage pad design.

7.6.1.1 Storage Pad Design

The design loading combinations for the storage pads are in accordance with ACI 349. However, the earthquake load applied is the design earthquake seismic load (E') rather than the safe shutdown earthquake load (E_{ss}) or the operating basis seismic load (E_o) specified by ACI 349. In accordance with the requirements of Sections C.1.1 and C.2 of Regulatory Guide 1.29 (Ref. 7.6-4), structures whose failure could impair other safety-related structures (such as a storage cask) are designed to accommodate a safe shutdown earthquake. The CISF design earthquake specified in Chapter 3 is similar to a safe shutdown earthquake, and no operating basis earthquake is required for CISF design. Therefore, it is appropriate to design the concrete storage pads to accommodate design earthquake E' specified in Chapter 3.

Each concrete pad that supports a Horizontal Storage Module (HSM) is approximately 40 feet wide (maximum for BWR canisters) and 101 to 104 feet long. In front of each HSM entrance are two 20-foot approach aprons, 18 and 8 inches thick, respectively. The pads are spaced so that there are at least 100 feet between the HSM entrance and the facing cask, to allow maneuverability of the transfer trailer and hydraulic ram system when performing storage operations. Each concrete pad can contain up to a total of 20 VECTRA NUHOMS® System HSMs set back-to-back. There is a six-inch air gap between each HSM on the pad, and a two-foot concrete shield wall on the outside wall of each end HSM. The concrete pads can be joined at the ends by concrete expansion joints to form rows. (See Figure 7.6-1.)

The storage pads, structurally independent of one another, are approximately 60 feet wide by 80 feet 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 pounds, the Westinghouse Large MPC System per Table 4.2-1. 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 feet apart to allow maneuverability of the transporters during storage operations.

The storage pads are seismically designed for 0.75g horizontal ground motion, without ground faulting. The only structure adjacent to a storage pad is a second storage pad or a storage cask. Since the storage pads are normally loaded with storage casks, earthquake loads are combined with the cask live loads.

The concrete pads are three feet thick with No. 11 reinforcing bars spaced at 12 inches on-center each way, top and bottom, as shown in Figure 7.6-1. Reinforcing steel is lap spliced for No. 11 bars and smaller. The concrete has a minimum 28-day compressive strength of 3,000 psi, and the reinforcing steel has a minimum yield strength of 60,000 psi.

7.6.1.2 Storage Pad Design Criteria

The concrete storage pads are designed in accordance with ultimate strength design methods as specified in ACI 349.

7.6.1.3 Storage Pad Design Analysis

This section describes the loads, loading combinations and analysis methods used for design of the reinforced concrete storage pads.

7.6.1.3.1 Loads

Loading combinations considered in the analysis and design of the QA 5 storage pads include the following.

- D Dead load
- L Live load
- F Hydrostatic fluid pressure load
- H Lateral soil pressure load
- T_o Thermal loads
- R_o Pipe reactions
- W Wind load
- F' Flood load
- E' Design earthquake seismic load
- W_t Tornado loads

As defined in Section 7.4, these loads are categorized into three areas: normal loads, severe environmental loads and extreme environmental loads. Load values are based on the CISF site design parameters listed in Chapter 3. Specific application of these loads for the concrete storage pads is presented in the following section.

7.6.1.3.1.1 Normal Loads

Normal loads are those that are encountered during normal operation. They include dead loads (D), live loads (L), hydrostatic fluid pressure loads (F), soil pressure loads (H), thermal loads (T_o) and pipe reactions (R_o). These loads are defined as follows:

Dead Load - For the analysis and design of the storage pads, there are no permanent hydrostatic loads and differential settlement loads are considered to be zero. The storage pad dead load is the mass of the reinforced concrete storage pads and the storage casks.

Live Load - The following descriptions provide design requirements for various types of live loads for concrete storage pad design.

- **Rain, Snow and Ice** - Since the storage pads are level with 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.

- **Storage Cask Transporter Loads** - Special heavy loading conditions resulting from transport of SNF storage casks on the storage pads are considered. Cask weights considered bound the worst-case condition of all vendor designs handled on the storage pads. The heaviest cask handled on the storage pad weighs 390,000 pounds.

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

Soil Load - Since the CISF site is a dry, relatively flat site and the storage pads are slab-on-grade structures, no groundwater or net soil pressure loads are exerted on the concrete pads. Therefore, determination of lateral soil pressure loads is not necessary for storage pad structural analysis or design.

Thermal Load - 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. Note that postulated pipe break (T_a) thermal loads in the concrete pads are not considered since there is no process piping in or on the storage pads.

Pipe Reactions - There are no pipe reaction R_o loads applicable to concrete pad structural analysis or design. Similarly, there are no loads on the concrete pads generated by a postulated pipe break (Ra) or differential pressure loads (Pa) generated by a postulated pipe break. There are no loads appropriate to concrete pad design from jet impingement (Y_j), from missile impact due to pipe break (Y_m), or due to reaction of broken pipes (Y_r).

7.6.1.3.1.2 Severe Environmental Loads

Severe environmental loads are those that could be encountered infrequently during the life of the storage pads. They include: wind loads (W) and flood loads (F'). These loads are defined as follows.

Wind Loads - As the storage pads are level with the adjacent ground, wind loads are not considered further in storage pad analysis and design.

Flood Loads - As described in Chapter 3, the CISF is assumed to be located at a dry site; therefore, no flood loads are postulated for storage pad structural analysis or design.

7.6.1.3.1.3 Extreme Environmental Loads

Extreme environmental loads are those which are credible but are highly improbable. They include: seismic loads (E') and tornado loads (W_t). These loads are defined as follows.

Seismic Loads - Seismic loads are generated by the CISF design earthquake. In accordance with the requirements of Sections C.1.1 and C.2 of Regulatory Guide 1.29 (Ref. 7.6-4), structures for handling SNF and structures whose failure could impair other safety-related structures are required to be designed to accommodate a safe shutdown earthquake. As specified in Chapter 3, design earthquake loads (E') are based on 0.75g maximum peak horizontal seismic acceleration, which is applied at the structure foundation/soil interface. Section 7.6.1.3.3 describes the seismic structural response analysis method used to determine seismic load effects on the storage pads. Seismic loads are determined by multiplying the dead load on the storage pad by the acceleration values obtained in the structural response analysis. The storage casks are considered part of the storage pad dead load, since they are always on the pads and there is high confidence in the magnitude and location of the cask loads.

Tornado Loads - Tornado loads are not considered in the design of the storage pads.

7.6.1.3.2 Loading Combinations

Loading combinations used in the QA 5 design of the storage pads are from ACI 349 (Ref. 7.6-1). The value "U" is the section strength required to resist design loads, based on the ultimate strength design methods described in ACI 349, and is given by these equations.

$$U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7R_o$$

$$U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7E_o + 1.7R_o$$

$$U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7R_o$$

$$U = D + F + L + H + T_o + R_o + E_{ss}$$

$U = D + F + L + H + T_o + R_o + W_t$

$U = D + F + L + H + T_a + R_a + 1.25P_a$

$U = D + F + L + H + T_a + R_a + 1.15P_a + 1.0(Y_r + Y_j + Y_m) + 1.15E_o$

$U = D + F + L + H + T_a + R_a + 1.0P_a + 1.0(Y_r + Y_j + Y_m) + 1.0E_{ss}$

$U = 1.05D + 1.05F + 1.3L + 1.3H + 1.05T_o + 1.3R_o$

$U = 1.05D + 1.05F + 1.3L + 1.3H + 1.3E_o + 1.05T_o + 1.3R_o$

$U = 1.05D + 1.05F + 1.3L + 1.3H + 1.3W + 1.05T_o + 1.3R_o$

Loading combinations involving E_o are not considered further, since the CISF is designed for seismic loads E', described in Chapter 3. For loading combinations involving E_{ss}, the CISF design earthquake load E' is substituted for E_{ss}, as described in Section 7.6.1.1.

F and F' are substituted for loading combinations using F above. Note that this has no impact on concrete pad design, since hydrostatic fluid loads are not applicable.

As described in Section 7.6.1.3.1.1, T_o, T_a, R_o, and R_a are not applicable to design of the concrete pads.

7.6.1.3.3 Structural Analysis and Design

Using a finite element computer program called ANSYS, structural analysis of the storage pads determines that they provide adequate strength to support the design loading combinations.

The computer model, consisting of 768 square flat plate elements, each 2.5 feet by 2.5 feet, is shown in Figure 7.6-2. Each of the 825 nodes is numbered. Nodes are located at the edges of the plate elements, each plate having four nodes. The storage casks locations are outlined in the figure. Incremental cask loading positions are considered in the loading combinations in order to maximize internal forces and moments.

The computer model considers the pad to be supported by springs at each node. These springs represent the soil-to-pad structural interaction in the computer analysis. Springs are calculated using the subgrade properties contained in Chapter 2.

The computer analysis of the storage pads consists of static and dynamic conditions. Static analysis evaluates the dead and live loading combinations. Dynamic analysis considers the pad response to the CISF design earthquake. Both analyses are discussed below.

7.6.1.3.3.1 Static Analysis

Cask dead loading is applied to the nodes in proportion to the contributing area of the plate covered by the cask. Nine plate elements are completely covered by the cask, and 12 are partially covered. The distributed loads of the cask are collected and applied as point loads at each node.

Vertical springs are used to model soil-structure interaction. The vertical properties of the springs are calculated by multiplying the modulus of subgrade reaction of 144 kips per square foot by the tributary area per node of the plate elements. The interior springs have a spring constant of 75 kips per inch; along the plate edges, the spring constants are 37.5 kips per inch; and at the plate corners, the spring constants are 18.75 kips per inch.

Cask loading patterns are 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 worst-case loading pattern that produces the maximum bending moment in the pad is determined. The maximum bending moment for any loading combination is 70.6 kip feet per foot.

The ultimate moment capacity of the storage pads as determined from ultimate strength concrete design per ACI 349 is 216 kip feet per foot. The actual maximum bending moment is 70.6 kip feet per foot, which is less than the bending moment capacity of the concrete storage pad. Therefore, the pad static design is acceptable.

Soil-bearing pressures may be calculated by the varying 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 square foot, which is less than the 4.0 kips per square foot specified for design in Chapter 2. Therefore, the loads applied to the soil by the concrete pads are acceptable and within the specified capacity of the soil.

7.6.1.3.3.2 Dynamic Analysis

Dynamic analysis is performed to determine the storage pad maximum bending moments during seismic events. 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 maximum dynamic cask loadings are established by assuming each cask on the storage pad is about to tip over, concentrating its vertical load over a limited area of its footprint. The direction of this postulated impending cask tipover is 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 feet per foot. The ultimate moment capacity of the storage pad is 216 kip feet per foot, which is larger than the actual dynamic moment of 193.7 kip feet per foot. Therefore, the dynamic analysis of the pads produces acceptable pad structural behavior. Dynamic soil pressure is calculated to be 5.33 ksf, which is equal to the allowable dynamic soil pressure of 4/3 times 4,000 ksf.

7.6.1.3.3.3 Evaluation of Postulated Cask Tipover Events

As pointed out in Chapter 3, storage cask systems selected for use at the CISF are designed not to tip over while stored 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 suppliers have taken credit for the deformation and crushing of the concrete storage pads, using techniques such as those described in EPRI NP-7551 (Reference 7.6-11).

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 described in Chapter 2, and the storage pad configuration described above, 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.

Making the subgrade and storage pad construction more robust can actually be non-conservative for the case of a postulated tipover. A relatively rigid storage pad and subgrade will result in a harder "target" for the cask tipover, increasing deceleration forces. Therefore, final evaluation of this subject is extremely site-specific and must be deferred until in-situ foundation information is available.

7.6.2 Other QA Classification Structures

This section describes the structural design of other CISF QA 3, QA 4, QA 5, QA 6 and QA 7 structures. Structures included in this section are the miscellaneous structures in the transfer facility (QA 3, QA 4, QA 5, QA 6 and QA 7), fire protection pump building (QA 4 and QA 7), security complex (QA 6), and inspection gatehouse (QA 6).

The transfer facility 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 are generally QA 3, QA 4, QA 5, QA 6 and QA 7.

The fire protection pump building is a single-story, slab-on-grade structure. The exterior walls are load-bearing 12-inch concrete block. The roof structure consists of two-inch light-weight 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 design, design criteria, and design analysis for QA 3, QA 4, QA 5, QA 6 and QA 7 concrete and steel structures are described in the following sections.

7.6.2.1 Design of QA 3, QA 4, QA 5, QA 6 and QA 7 Structures

The detailed design of these structures is site dependent and will be included as part of a site-specific license application. The design criteria and design analysis are described in the following sections.

7.6.2.2 Design Criteria for QA 3, QA 4, QA 5, QA 6 and QA 7 Concrete and Steel Structures

Concrete and steel design criteria for QA 3, QA 4, QA 5, QA 6 and QA 7 structures are presented in this section. Specific design criteria for various types of concrete and steel structures are delineated in this section.

7.6.2.2.1 Concrete Structures - QA 3, QA 4, QA 5, QA 6 and QA 7

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 (Ref. 7.6-3). All structural concrete used in construction of these structures has a minimum design compressive strength of 3,000 psi. All reinforcing steel used in these structures has a minimum design yield strength of 60,000 psi.

Design of embedments and expansion anchors is in accordance with conventional codes or vendor-supplied design data. Concrete expansion anchors for QA 3, QA 4, QA 5, QA 6 and QA 7 structures are of undercut or wedge type. The minimum design safety factor is 3.0 for undercut expansion anchors and 4.0 for wedge expansion anchors.

7.6.2.2.2 Steel Structures - QA 3, QA 4, QA 5, QA 6 and QA 7

Design of QA 3, QA 4, QA 5, QA 6 and QA 7 steel structures is in accordance with elastic design methods specified in the American Institute of Steel Construction (AISC) Manual of Steel Construction (Ref. 7.6-5).

All structural steel materials used in construction of these structures consists of American Society for Testing and Materials (ASTM) A36 rolled shapes, ASTM A500 Grade B tube shapes, and 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 used for primary structural connections are either A325 or A490. A307 bolts are used for attaching ancillary components or equipment to structures, but not for primary structural member connections. Welding electrodes are selected to be compatible with the materials being joined.

7.6.2.3 Design Analysis of QA 3, QA 4, QA 5, QA 6 and QA 7 Structures

This section describes the loads, loading combinations, and analysis methods used for design of QA 3, QA 4, QA 5, QA 6 and QA 7 structures.

7.6.2.3.1 Loads

Loads for structures in this section are as described in Section 7.6.1.3.1.

7.6.2.3.2 Loading Combinations

The loading combinations used to design QA 3, QA 4, QA 5, QA 6 and QA 7 structures are as presented below.

7.6.2.3.2.1 QA 3 and QA 5 Structures

Loading combinations for design of QA 3 - Important to Radioactive Waste Control and QA 5 - Important to Potential Interaction structures are in accordance with conventional structural design codes and standards. However, the earthquake load applied is the design earthquake seismic load (E') rather than the conventional seismic load (E_c). Since QA 3 structures need only maintain their structural integrity to prevent release of low-level radioactive wastes, and QA 5 structures need only maintain their structural integrity to avoid interaction with nearby QA 1 structures, systems or components (SSCs) during a design earthquake, it is sufficient to design them to conventional code and standard requirements while applying the design earthquake load (E'). This approach is in agreement with the precedent set for design of radwaste SSCs for nuclear power plants, which is delineated in Regulatory Guide 1.143 (Ref. 7.6-6).

7.6.2.3.2.2 QA 4, QA 6 and QA 7 Structures

Loading combinations for design of QA 4 - Important to Fire Protection, QA 6 - Important to Physical Protection of Facility and Materials and QA 7 - Important to Occupational Radiological Exposure structures are in accordance with conventional structural design codes and standards. These structures are designed in accordance with conventional structural loading combinations of the following robust loadings: dead loads (D), live loads (L), hydrostatic fluid pressure loads (F), lateral soil pressure loads (H), thermal loads (T_o), pipe reaction loads (R_o), design wind loads (W), flood loads (F'), and conventional seismic loads (E_c).

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 (Ref. 7.6-7)
- ACI 318, Building Code Requirements for Reinforced Concrete (Ref. 7.6-3)
- AISC Manual of Steel Construction, Allowable Stress Design with "Specification for Structural Steel Buildings" (Ref. 7.6-5).

Where requirements of these codes overlap or vary, the more stringent loading combinations or conditions are used.

7.6.2.3.3 Structural Analysis and Design of QA 3, QA 4, QA 5, QA 6 and QA 7 Structures

Requirements and procedures for analyzing structures are defined in this section. General analysis requirements and procedures are outlined, as well as the special case of seismic analysis.

7.6.2.3.3.1 General Structural Analysis Requirements

Structures are analyzed for the loads specified in Section 7.6.2.3.1 and loading combinations specified in Section 7.6.2.3.2, in order to determine internal member forces and moments to be used in design. Appropriate consideration is given to the load distribution on the structure (e.g., point loads, uniformly distributed loads or varying distribution of loads) 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. When performing computer-based structural analyses of QA Classification structures, appropriately QA-qualified computer programs are used.

Analyses are performed using equivalent static loadings, with appropriate consideration of impact effects for moving loads.

Allowable stresses due to wind or seismic loadings are increased as permissible in accordance with code requirements for the design of QA 3, QA 4, QA 5, QA 6 and QA 7 structures.

While QA 3 and QA 5 structures are designed for design earthquake loadings, the Nuclear Regulatory Commission (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 QA 3 or QA 5 structures for the large design earthquake 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 (Ref. 7.6-8).

Similarly, QA 4, QA 6 and QA 7 SSCs are not designed to withstand tornado loadings.

When analyzing foundations to accommodate structural loadings, the maximum allowable soil bearing capacities in Chapter 2 are not exceeded.

7.6.2.3.3.2 Seismic Analysis

Analysis for seismic loadings is performed to ensure integrity of structural systems. The following subsections differentiate between analysis requirements for various QA Classification structures.

QA 3 and QA 5 Structures - The design earthquake input acceleration of 0.75g specified in Section 7.6.1.3.1.3 is applied at the building foundation of QA 3 and QA 5 structures. Analysis for converting the design earthquake acceleration into seismic loadings on QA 3 and QA 5 structures follows the procedures defined in Section 7.4. Seismic loads (E') are applied to structures in the three orthogonal directions, and the three-dimensional effects of each of these inputs are considered. Combination of seismic load forces and moments is performed using the SRSS method or the 100-40-40 Percent Rule described in American Society of Civil Engineers (ASCE) Standard 4-86 (Ref. 7.6-9) to determine the resultant design earthquake loads on structural components.

QA 4, QA 6 and QA 7 Structures - Seismic loads (E_c) on QA 4, QA 6 and QA 7 structures are determined in accordance with the requirements of Section 9 of ASCE 7-95 (Ref. 7.6-10). Conventional seismic loads for these structures are determined for an effective peak acceleration (A_a) coefficient of 0.20 and an effective peak velocity-related acceleration (A_v) coefficient of 0.20. These conventional seismic accelerations are selected for the generic site, since they envelop earthquake accelerations for most of the continental United States.

The following building classification categories from Table 1-1 of ASCE 7-95 are used when determining seismic loads for conventional quality structures.

Table 7.6-1. Building Classification Categories

Type of Structure	Category
QA 4 (Important to Fire Protection)	IV
QA 6 (Important to Physical Protection of Facility and Materials)	II
QA 7 (Important to Occupational Radiological Exposure)	II

Figure 7.6-1 Concrete Storage Pad, Plan and Section

Figure 7.6-2 Concrete Storage Pad Computer Model

7.7 REFERENCES

Section 7.4

7.4-1 ACI 349-90. *Code Requirements for Nuclear Safety-Related Concrete Structures.* American Concrete Institute.

7.4-2 NUREG-0800. *Standard Review Plan 3.5.3, Barrier Design Procedures.* U.S. NRC. July 1981.

7.4-3 NUREG-0800, *Standard Review Plan 3.8.4, Other Seismic Category I Structures.* U.S. NRC.

7.4-4 NUREG-1536 (Draft). *Standard Review Plan for Dry Cask Storage Systems.* U.S. NRC.

7.4-5 NUREG-1567 (Draft). *Standard Review Plan for Spent Fuel Dry Storage Facilities.* U.S. NRC.

7.4-6 ANSI/ANS-57.9-1992. *Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type).* American National Standards Institute and American Nuclear Society. 1992.

7.4-7 ASCE Standard 7-95. *Minimum Design Loads for Buildings and Other Structures.* American Society of Civil Engineers. 1995.

7.4-8 Regulatory Guide 1.29. *Seismic Design Classification.* U.S. NRC.

7.4-9 Regulatory Guide 1.143. *Design Guidance for Radioactive Waste Management Systems, Structures and Components Installed in Light-Water-Cooled Nuclear Power Plants.* U.S. NRC.

7.4-10 ASCE Standard 4-86. *Seismic Analysis of Safety-Related Nuclear Structures.* American Society of Civil Engineers. 1986.

7.4-11 NUREG-0800. *Standard Review Plan 3.3.2, Tornado Loadings.* U.S. NRC.

7.4-12 NUREG-0800. *Standard Review Plan 3.8.5, Foundations.* U.S. NRC.

7.4-13 Regulatory Guide 1.92. *Combining Modal Responses and Spatial Components in Seismic Response Analysis.* U.S. NRC.

7.4-14 Regulatory Guide 1.60. *Design Response Spectra for Seismic Design of Nuclear Power Plants.* U.S. NRC.

7.4-15 Regulatory Guide 1.61. *Damping Values for Seismic Design of Nuclear Power Plants.* U.S. NRC.

7.4-16 NUREG-0800. *Standard Review Plan 3.7.2, Seismic System Analysis.* U.S. NRC.

7.4-17 ASCE No. 58. *Structural Analysis and Design of Nuclear Plant Facilities.* U.S. NRC.

Section 7.5

7.5-1 ANSI/AISC N690. *Nuclear Facilities - Steel Safety-Related Structures for Design, Fabrication and Erection.* American National Standards Institute and American Institute of Steel Construction.

7.5-2 NUREG-0800. *Standard Review Plan 3.8.4. Other Seismic Category I Structures.* U.S. NRC.

7.5-3 NUREG-1536 (Draft). *Standard Review Plan for Dry Cask Storage Systems.* U.S. NRC.

7.5-4 NUREG-1567 (Draft). *Standard Review Plan for Spent Fuel Dry Storage Facilities.* U.S. NRC.

7.5-5 ANSI/ANS-57.9-1992. *Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type).* American National Standards Institute and American Nuclear Society.

7.5-6 Regulatory Guide 1.61. *Damping Values for Seismic Design of Nuclear Power Plants.* U.S. NRC.

Section 7.6

7.6-1 ACI 349. *Code Requirements of Nuclear Safety-Related Concrete Structures.* American Concrete Institute.

7.6-2 NUREG-1567. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* U.S. NRC.

7.6-3 ACI 318-95. *Building Code Requirements for Reinforced Concrete.* American Concrete Institute.

7.6-4 Regulatory Guide 1.29. *Seismic Design Classification.* U.S. NRC.

7.6-5 AISC Manual of Steel Construction. *Allowable Stress Design with "Specification for Structural Steel Buildings."* American Institute of Steel Construction.

7.6-6 Regulatory Guide 1.143. *Design Guidance for Radioactive Waste Management Systems, Structures and Components Installed in Light-Water-Cooled Nuclear Power Plants.* U.S. NRC.

7.6-7 *Uniform Building Code*. International Conference of Building Officials.

7.6-8 Regulatory Guide 1.117. *Tornado Design Classification.* U.S. NRC.

7.6-9 ASCE Standard 4-86. *Seismic Analysis of Safety-Related Nuclear Structures.* American Society of Civil Engineers.

7.6-10 ASCE 7-95. *Minimum Design Loads for Buildings and Other Structures*. American Society of Civil Engineers.

7.6-11 EPRI NP-7551. *Structural Design of Concrete Storage Pads for Spent-Fuel Casks.* Electrical Power Research Institute. April 1993.

8. THERMAL EVALUATION

The purpose of this chapter is to demonstrate that the CISF structures, systems, and components (SSCs) important to safety and fuel material temperatures remain within allowable values or criteria for normal, off-normal, and accident conditions.

The design of the CISF is based on the use of cask systems that have been certified under 10 CFR 72. Chapter 3 identifies additional design criteria that cask systems must meet in order to be used at the CISF. The CISF thermal evaluation relies on the vendor analyses performed to obtain certification of the candidate cask systems. The design of the CISF ensures that the receipt, handling, transfer, storage and monitoring of the vendor cask systems is in accordance with the vendor's safety analyses and limiting conditions for operation.

Because the CISF thermal evaluation relies on the cask vendor analyses, the format of this chapter does not follow the recommended format presented in NUREG-1567. Only that information which is applicable to the actual CISF design is presented.

This TSAR seeks NRC concurrence that:

- If the thermal design and licensing criteria for previously reviewed and approved cask systems bound the generic site characteristics and operational limitations described in Chapter 3 of this TSAR, then additional CISF site-specific thermal analyses are not necessary based upon the proposed CISF design.

- CISF design, operation and administrative features as described in the TSAR are sufficient to ensure that cask contents and SSCs important to safety remain within their approved operating temperature ranges.

8.1 THERMAL DESIGN CRITERIA AND FEATURES

This section presents the thermal design criteria for the CISF site and summarizes thermal safety design and licensing bases applicable to CISF transportation and storage systems. Site design features and thermal safety evaluation assumptions are presented to demonstrate consistency with transportation and storage system design and licensing bases.

8.1.1 Criteria

Consistent with design and regulatory guidance, thermal safety is demonstrated for all CISF cask systems by the vendor SARs which demonstrate fuel cladding integrity under all identified thermal loading conditions. Thermal assessments verify that the CISF site characteristics and environmental conditions are bounded by the vendor's cask thermal analyses.

8.1.2 Features

CISF storage and transportation systems are designed to ensure that the stored materials remain within thermal loading conditions under normal, off-normal and accident-level conditions during all operations, transfers and storage. Information on thermal loading conditions is presented within individual vendor cask SARs. The vendor SARs present data to verify that their dry storage system designs are analyzed so that acceptable fuel cladding temperatures are maintained throughout the CISF storage period. Spent nuclear fuel storage confinement features provide a passive cooling function for the cask systems by air convection.

Design features and design assumptions included in the CISF design are summarized as follows.

- The transfer facility does not provide any thermal protection features for the cask systems. The transfer facility is equipped with heating, ventilation and air conditioning (HVAC) to prevent exposure to extreme temperatures under normal operating conditions. The HVAC is for operational comfort during transfers, not for off-normal ambient temperature control.

- The CISF operations described in Chapters 4 and 5 do not place any vendor cask system in a thermal condition for which their designs have not been qualified.

- The fire parameters that have been accepted for characterizing the heat transfer of the cask systems during an in-storage fire are identified in Chapter 4. A postulated fire at the CISF would be limited in magnitude, due to the limited amount of combustible material and due to controls in and around the site ensuring that fires would be of short duration and extinguishable by trained personnel.

8.2 STORED MATERIAL SPECIFICATIONS

Spent nuclear fuel characteristics considered in the cask system thermal safety evaluations are documented in the vendor SARs.

8.3 THERMAL ASSESSMENT

No thermal safety analyses are performed beyond those presented in the vendor SARs.

9. RADIATION PROTECTION

This chapter describes the radiation protection features of the CISF that ensure radiation exposures to workers and the public meet NRC regulatory criteria and are maintained ALARA. These radiation protection features include facility design criteria, operational features and the Radiation Protection program. This chapter also evaluates radiation doses to the public and to workers from CISF operations.

This TSAR seeks NRC concurrence that:

- The design and operating procedures provide an acceptable means for controlling occupational radiation exposure within the limits of 10 CFR Part 20 and for meeting the ALARA objectives of 10 CFR Part 72.24(e).
- The TSAR includes adequate projections of expected quantities of liquid and gaseous effluent releases in compliance with 10 CFR Part 72.24(l).
- The information presented provides reasonable assurance that the proposed activities can be conducted in a safe manner in compliance with 10 CFR Part 72.40(a).
- Analyses show that releases to the general environment during normal operations and anticipated occurrences will be within 10 CFR Part 72.104.
- The design of the CISF provides suitable shielding for radiation protection during normal operations in compliance with 10 CFR Part 72.128(a).

9.1 ENSURING THAT OCCUPATIONAL RADIATION EXPOSURES ARE ALARA

9.1.1 Policy Considerations

The CISF is designed and operated to provide radiation protection for workers in conformance with applicable regulatory criteria so that occupational radiation exposures are maintained ALARA.

Operation of the CISF is in accordance with an ALARA policy that includes, as a minimum, the following criteria.

- Maintain radiological releases and exposures to personnel below the applicable limits of 10 CFR Part 20
- Ensure that all exposures are kept ALARA, with technological, economic and social factors taken into consideration
- Integrate appropriate radiation protection controls into all work activities
- Ensure that all personnel understand and follow ALARA procedures
- Restrict access to radiation areas
- Track individual and collective doses to identify trends and causes
- Conduct periodic training and exercises 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
- Integrate ALARA considerations into plant design and procedure change activities.

9.1.2 Design Considerations

The CISF design reflects consideration of the ALARA principles given in NRC Regulatory Guide 8.8 (Ref. 9.1-1) and the applicable criteria of 10 CFR 72. Specific ALARA considerations in the CISF design include the following.

- Design of SSCs that require maintenance or repair to minimize maintenance frequency and personnel stay times in radiation areas
- Robotic and remotely operated equipment and remote video systems to minimize personnel exposure to radiation sources
- Placement of operations personnel in shielded, remote operating stations

- Use of dedicated, shielded transporters for moving casks to the storage area
- Placement of administrative, security and radiation protection activities away from radiation areas
- Use of permanent and temporary radiation shielding
- Area radiation monitoring with local and remote readouts in the transfer facility
- Continuous remote monitoring of casks in the storage area
- Access restrictions for radiation areas
- Ventilation systems for 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 if accident-level events occur
- Cask venting systems that connect directly to the transfer facility ventilation system to reduce radiological release concentrations and to allow monitoring
- Decontamination facilities for transportation casks to reduce radiological contamination of other SSCs and personnel during cask handling.

9.1.3 Operational Considerations

Operating plans and procedures are developed in accordance with NRC Regulatory Guides 8.8 and 8.10 (Ref. 9.1-2), which reflect consideration of ALARA principles. The following are included in these operating plans and procedures.

- Storage cask preparation (for loading) away from radiation areas, including testing and alignment of cask fixtures
- Preventive and corrective maintenance on cranes, robotics, lighting, instrumentation and other handling equipment during times when no casks are being processed in the transfer facility or, alternatively, outside radiation areas
- Dry runs during start-up testing to determine probable radiation exposures, and results factored into operating procedures and facility design
- Pre-operational and continuing training for operations personnel, including dry runs, on procedures to minimize radiation exposures
- Contingency procedures for off-normal occurrences and accidents, including recovery operations

- Continuing operations research on procedures, handling equipment, instrumentation and personnel protective equipment to minimize radiation exposures.

9.2 RADIATION SOURCES

This section describes the types and potential magnitudes of radiation sources at the CISF that could contribute to worker or public radiation exposures.

9.2.1 Characterization of Sources

There are three potential sources of radiation used in analysis for the CISF design.

- Direct gamma and neutron radiation from SNF
- External radioactive contamination on the surfaces of transportation casks and canisters, which serves as a potential source of both airborne radioactive material and liquid radioactive waste
- Radioisotopes associated with releases from the casks or canisters (fission gases and particulate, including fission products and activated corrosion products).

The following sections discuss the characteristics of each of these radiation sources.

9.2.1.1 Spent Nuclear Fuel

For purposes of performing the site boundary radiation analyses for the CISF, a conservative source term was used, based on the Westinghouse Large MPC System with 40,000 MWD/MTU burnup and five years decay (Ref. 9.2-1). Table 9.2-1 shows this total source term for the pressurized water reactor (PWR) and boiling water reactor (BWR) MPCs. Since the PWR MPC gamma source term is higher than that for the BWR MPC, the PWR MPC is used as the representative storage mode for the CISF radiation analysis. The PWR MPC normalized fuel source terms are listed by energy group in Tables 9.2-2 and 9.2-3. The axial distribution of the source term is given in Table 9.2-4.

Table 9.2-1. Large MPC Fuel Source Term Used for CISF Radiation Analyses

Fuel Type	**Burnup (MWD/MTU**	**Decay Time (Years)**	**Source Term (/sec/assy)**		**Source Term (/sec/canister)**	
			Fuel Gamma	**Fuel Neutron**	**Fuel Gamma**	**Fuel Neutron**
B&W 15x15	40,000	5	6.89E15	2.60E8	1.45E17	5.46E9
GE 7x7	40,000	5	2.95E15	1.71E8	1.18E17	6.84E9

Table 9.2-2. Normalized Active Fuel Region Photon Source Term

PWR Peak Assembly - 5-Year Decay						
			Normalized		**Assembly Total**	
Group	**E Range (Mev)**	**E Avg (Mev)**	**Gammas per sec**	**Mev/sec**	**Gammas per sec**	**Mev/sec**
1	8.0-10.0	9.000	1.73E-11	1.56E-10	1.19E5	1.07E6
2	6.5-8.0	7.250	8.13E-11	5.90E-10	5.60E5	4.06E6
3	5.0-6.5	5.750	4.15E-10	2.39E-09	2.86E6	1.64E7
4	4.0-5.0	4.500	1.03E-09	4.66E-09	7.13E6	3.21E7
5	3.0-4.0	3.500	1.72E-06	6.01E-06	1.18E10	4.14E10
6	2.5-3.0	2.750	1.39E-05	3.81E-05	9.55E10	2.63E11
7	2.0-2.5	2.250	4.54E-04	1.02E-03	3.13E12	7.04E12
8	1.66-2.0	1.830	1.86E-04	3.40E-04	1.28E12	2.34E12
9	1.33-1.66	1.495	1.12E-02	1.68E-02	7.73E13	1.16E14
10	1.0-1.33	1.165	4.35E-02	5.07E-02	3.00E14	3.49E14
11	0.8-1.0	0.900	5.40E-02	4.86E-02	3.72E14	3.35E14
12	0.6-0.8	0.700	3.76E-01	2.63E-01	2.59E15	1.81E15
13	0.4-0.6	0.500	1.20E-01	5.98E-02	8.23E14	4.12E14
14	0.3-0.4	0.350	1.09E-02	3.80E-03	7.49E13	2.62E13
15	0.2-0.3	0.250	1.61E-02	4.02E-03	1.11E14	2.77E13
16	0.1-0.2	0.150	5.93E-02	8.89E-03	4.08E14	6.13E13
17	0.05-0.1	0.075	7.05E-02	5.29E-03	4.86E14	3.64E13
18	0.01-0.05	0.030	2.38E-01	7.15E-03	1.64E15	4.92E13
Total			**1.00E0**	**4.70E-01**	**6.89E15**	**3.24E15**

Table 9.2-3. Normalized PWR MPC Active Fuel Region Neutron Source Term

Group	Energy Range (Mev)	Average Energy (Mev)	Normalized[1]	Neutrons/sec
1	0.1 - 0.4	0.25	3.7759E-02	2.06E8
2	0.4 - 0.9	0.65	1.9289E-01	1.05E9
3	0.9 - 1.4	1.15	1.7702E-01	9.67E8
4	1.4 - 1.85	1.625	1.3096E-01	7.15E8
5	1.85 - 3.0	2.425	2.3304E-01	1.27E9
6	3.0 - 6.43	4.715	2.0980E-01	1.15E9
7	6.43 - 20.0	13.215	1.8428E-02	1.01E8
Total			**1.000**	**5.46E9[2]**

[1] Fraction of total neutrons/sec in each energy group

[2] 5.46E9 n/sec-MPC = 2.60E8 n/sec-assembly x 21 assemblies/MPC

Table 9.2-4. PWR MPC Axial Source Term Distributions - PWR 5-Year Decay

Neutron Region	Fuel Height (%)	MPC Source (n/sec)	Weight	Gamma Region	Fuel Height (%)	Source (Ph/sec)	Weight
				1	0.0		**2.59E-01**
1	2.5	4.457E8	0.085	2	2.5	7.663E16	5.18E-01
				3	5.0		**6.60E-01**
2	7.5	2.240E9	0.427	4	7.5	1.186E17	8.02E-01
				5	10.0		**8.62E-01**
3	12.5	3.814E9	0.727	6	12.5	1.363E17	9.22E-01
				7	15.0		**9.39E-01**
4	17.5	4.400E9	0.839	8	17.5	1.413E17	**9.56E-01**
				9	20.0		**9.71E-01**
5	22.5	4.970E9	0.948	10	22.5	1.458E17	9.86E-01
				11	25.0		**9.88E-01**
6	27.5	5.032E9	0.960	12	27.5	1.463E17	9.90E-01
				13	30.0		**9.90E-01**
7	32.5	5.052E9	0.964	14	32.5	1.464E17	9.91E-01
				15	35.0		**9.91E-01**
8	37.5	5.073E9	0.968	16	37.5	1.466E17	9.92E-01
				17	40.0		**9.93E-01**
10	42.5	5.094E9	0.972	18	42.5	1.468E17	9.93E-01
				19	45.0		**9.94E-01**
11	47.5	5.115E9	0.976	20	47.5	1.469E17	9.94E-01
				22	50.0		**9.95E-01**
12	52.5	5.158E9	0.984	23	52.5	1.472E17	9.96E-01
				24	55.0		**9.97E-01**
13	57.5	5.179E9	0.988	25	57.5	1.474E17	9.97E-01
				26	60.0		**9.98E-01**
14	62.5	5.200E9	0.992	27	62.5	1.475E17	9.98E-01
				28	65.0		**9.99E-01**
15	67.5	5.243E9	1.000	29	67.5	1.478E17	1.00E0
				30	70.0		**1.00E0**
16	72.5	5.221E9	0.996	31	72.5	1.477E17	9.99E-01
				32	75.0		**9.96E-01**
17	77.5	5.073E9	0.968	33	77.5	1.466E17	9.92E-01
				34	80.0		**9.72E-01**
18	82.5	4.326E9	0.825	35	82.5	1.407E17	9.52E-01
				36	85.0		**9.24E-01**
19	87.5	3.428E9	0.654	37	87.5	1.325E17	8.96E-01
				38	90.0		**8.32E-01**
20	92.5	1.895E9	0.361	39	92.5	1.135E17	7.68E-01
				40	95.0		**6.37E-01**
21	97.5	4.115E8	0.078	41	97.5	7.493E16	5.07E-01
				42	100.0		**2.53E-01**

NOTE: In the above table, the values in regular type were taken from Ref. 9.2-1; values in bold type were interpolated from the Ref. 9.2-1 values.

Radiation sources and dose rates associated with occupational exposure estimates are based primarily on information presented in the vendor SARs. These values are generally typical of actual industry dose rates measured for transportation and storage casks. The Westinghouse MPC System data reflects dose rates and total doses based upon design-basis SNF characteristics.

In addition to the fuel source term, activation of fuel assembly top and bottom end fittings result in a significant activation source term, principally Co-60. A conservative decay time of five years was assumed. This activation source term is provided in Table 9.2-5.

Table 9.2-5. PWR End Fitting Activation Source Term

Energy Range (Mev)	**Average Energy (Mev)**	**Gamma Fraction**	**Gammas/sec**
Top End Fitting			
1.0 - 1.33	1.165	0.780	1.595E14[3]
1.33 - 1.66	1.495	0.220	4.501E13[3]
Bottom End Fitting			
1.0 - 1.33	1.165	0.780	1.485E14[4]
1.33 - 1.66	1.495	0.220	4.189E13[4]

9.2.1.2 Radiation Sources for Air Scatter Analysis

The QAD computer code was used for the Westinghouse Large MPC System to provide gamma dose rates and fluxes on the sides and at the top of the storage cask. This was then used as input to the air scattering models used in the MicroSkyshine computer code. The MCNP computer code was used to project neutron dose rates and fluxes on the sides and at the top of the storage cask. This value was then used as input to the air scattering models used in the SKYSHINE computer code. Tables 9.2-6 through 9.2-10 provide dose rates and fluxes for this input.

[3] Gammas/sec = Gamma fraction x 7.49094E10 gammas/sec-Ci x 130 Ci/assembly x 21 assemblies/MPC

[4] Gammas/sec = Gamma fraction x 7.49094E10 gammas/sec-Ci x 121 Ci/assembly x 21 assemblies/MPC

Table 9.2-6. Direct Radial Dose Rates

Location	Dose Rate (mrem/hr)	Dose Rate (mrem/yr)
Contact	22.7	1.99E5
1 meter	14.5	1.27E5
2 meters	10.05	8.81E4

Table 9.2-7. Top End Dose Rates

Location	Distance	Fuel Dose Rate (mrem/hr)	End Fitting Dose Rate (mrem/hr)	Total Dose Rate (mrem/hr)
Top shield	Contact	1.36	3.36	4.72
Top shield	1 meter	0.84	2.27	3.11
Top vent	Center	172.6	498.4	671.10

Table 9.2-8 Large PWR MPC Storage Mode Neutron Dose Rates

Location	Dose Rate (mrem/hr)
MCNP Calculations	
Radial centerline, contact	<1
Center of top vent	1.88e2
Average over top vent	1.68e2
Top shield, r = 47 cm	4.2
Average over top shield	6.8

Table 9.2-9. Large PWR MPC Storage Mode Top Vent Gamma Fluxes

Energy Range (MeV)	Average Energy (MeV)	Source Term (γ/cm^2-sec)		
		Fuel	End Fitting	Total
0.01 - 0.05	0.03	1.99E-20	0	1.99E-20
0.05 - 0.1	0.075	1.37E-20	0	1.37E-20
0.1- 0.2	0.15	3.94E-16	0	3.94E-16
0.2 - 0.3	02.5	5.06E-05	0	5.06E-05
0.3 - 0.4	0.35	9.40E-02	0	9.40E-02
0.4 - 0.6	0.50	1.10E2	0	1.10E2
0.6 - 0.8	0.70	6.67E3	0	6.67E3
0.8 - 1.0	0.90	5.78E3	0	5.78E3
1.0 - 1.33	1.165	2.26E4	9.36E4	1.16E5
1.33 - 1.66	1.495	2.22E4	7.91E4	1.01E5
1.66 - 2.0	1.83	8.81E2	0	8.81E2
2.0 - 2.5	2.25	4.44E3	0	4.44E3
2.5 - 3.0	2.75	2.44E2	0	2.44E2
3.0 - 4.0	3.5	5.04E1	0	5.04E1
4.0 - 5.0	4.5	4.25E-02	0	4.25E-02
5.0 - 6.5	5.75	2.00E-02	0	2.00E-02
6.5 - 8.0	7.25	3.84E0	0	3.84E0
8.0 - 10.0	9.0	7.18E0-4	0	7.18E-04

Table 9.2-10. Large PWR MPC Storage Mode Top Vent Neutron Source Term

Energy (Mev)	Flux at Center of Top Vent (n/cm^2-sec)	Average Flux over Top Vent (n/cm^2-sec)
0.01	1.94E3	1.74E3
0.1	1.05E3	9.94E2
0.5	1.18E3	1.04E3
1.5	3.42E2	2.95E2
2.5	2.13E1	2.83E1
5.0	5.19E0	1.02E1
Total	4.55E3	4.11E3

In addition to the top vent, the MPC storage mode has eight bottom air inlet vents, spaced around the sides of the unit, at 2.15 inches above the base. These vents are shown in Figure 9.3-2. The vents are rectangular, 4 inches by 12 inches. A qualitative analysis can be performed using dose rate results from the vendor (Ref. 9.2-1) to determine the effect of radiation streaming through these vents. The total surface area of the vents is 0.0041 of the total unit radial surface area. The vendor reported the following calculated dose rates at the vent opening based upon whether a carbon steel or depleted uranium shield was used in the canister design.

Carbon steel shield: 52 mrem/hr (gamma plus neutron)
Depleted uranium shield: 240 mrem/hr (gamma plus neutron)
Radial surface: 22 mrem/hr (gamma plus neutron)

Using these values, an "area-weighted" vent radial dose rate contribution was calculated:

Carbon steel shield: 0.2 mrem/hr
Depleted uranium shield: 0.98 mrem/hr

Therefore, the maximum vent contribution to the total radial dose rate is approximately 1% for the carbon steel shield and 4% for the depleted uranium shield. Given the other conservatisms in the calculations, it is reasonable to neglect the bottom vent contribution.

9.2.1.3 External Radioactive Contamination

Transportation casks, including transportable storage casks, arriving at the CISF may be externally contaminated from immersion in a fuel pool during loading at a utility site. Prior to transport from the utility site, a cask must meet the requirements of 10 CFR 71.87 for non-fixed contamination (10^{-5} $\mu Ci/cm^2$ or 22 dpm/cm^2). Some casks arriving at the CISF may exceed the above limit due to cask "weeping" in transit, therefore, decontamination will be required at the CISF. 10 CFR 71.87 allows a factor-of-10 increase in contamination during transport; therefore, a reasonable maximum for cask contamination due to weeping is 10^{-4} $\mu Ci/cm^2$ (220 dpm/cm^2). The principal constituent of external contamination is expected to be Cs-137.

External contamination of SNF canisters is controlled during loading by the utilities. Typical methods of minimizing contamination include filling the annulus between the canister and transfer cask with demineralized water, using an inflatable seal over the annulus, and conducting post-filling inspections and decontamination. These precautions should result in minimal external contamination of canisters. However, for purposes of CISF design, a non-fixed surface contamination limit of 1.4×10^{-4} $\mu Ci/cm^2$ (300 dpm/cm^2) is established. This contamination level is assumed for all casks and canisters in the storage area for purposes of estimating potential off-site releases.

External cask/canister contamination is also the potential source of liquid radioactive waste within the CISF. Once casks are decontaminated, the liquid effluent is collected by the radioactive waste collection system, which is described in Chapter 6. Expected maximum concentrations are less than 10^{-5} $\mu Ci/cm^3$ Cs-137.

9.2.1.4 Fission Gases

There are no events that have the potential for fission gas release; therefore no source terms are reported. The cask vendors perform analyses for their cask systems which involve these source terms. These analyses are included in Chapter 12 by reference.

9.2.2 Airborne Radioactive Material Sources

The potential for significant airborne radioactive contamination at the CISF is small due to the inherent protection provided by the canistered and dual-purpose cask systems. However, there are two possible sources of airborne radioactive materials: airborne dispersion of external non-fixed contamination on transportation casks or canisters during normal operations, and releases associated with a postulated confinement barrier breach.

9.2.2.1 Normal Operations

As discussed in Section 9.2.1, external contamination on transportation casks and transportable storage casks could be up to 220 dpm/cm^2, or 10 times the transportation limit of 10 CFR 71.87. When there is significant non-fixed contamination, the cask is decontaminated, thereby reducing the potential for the surface contamination to become an airborne source within the transfer facility. In addition, the SNF canister external contamination may become a source for airborne radioactive material both inside the transfer facility and in the storage area. For design purposes, the airborne source term of the storage area is limited to an external contamination level of 300 dpm/cm^2 for all casks and canisters. This ensures that potential radiation doses at the site boundary from normal operations effluents and direct radiation are less than the 25 mrem/yr criterion of 10 CFR 72.104. Contamination in excess of this limit is reduced using standard decontamination methods.

Potential airborne radioactivity resulting from loose surface contamination on canisters is detected by sampling the transportation cask annulus space prior to opening the cask. The samples and the remainder of the annulus volume are vented directly to the facility HVAC system via a flexible hose, thereby precluding this source from producing airborne radioactivity in the transfer facility.

Any airborne radioactive material in the transfer facility is released through the transfer facility HVAC system, which is described in Chapter 4. The expected maximum levels of surface contamination on transportation casks and canisters will not produce significant airborne radionuclide concentrations within the transfer facility. Continuous air monitors provide direct feedback of airborne conditions in working areas.

9.2.2.2 Accidents

The potential for leakage of SNF fission gases from casks/canisters during storage due to breach of confinement barriers resulting from accidents is addressed in Chapter 12 of this TSAR. Site boundary doses due to accidents will meet the 5 rem criterion of 10 CFR 72.106.

9.3 RADIATION PROTECTION DESIGN FEATURES

9.3.1 Installation Design Features

The general ALARA design considerations described in Section 9.1.2 are reflected in the specific design features at the CISF that enhance radiation protection and reduce occupational exposures. These design features include the following.

9.3.1.1 Facility Location

The location of the CISF is undetermined. However, in general, the CISF will be located away from population areas, to the extent feasible.

9.3.1.2 Use of Restricted Areas Within the Controlled Area

Within the controlled area, a restricted area is established to control access to radiation areas in order to maintain worker exposures ALARA.

9.3.1.3 Location of the Restricted Area on the Site

The restricted area is located on the site such that a minimum distance from any stored SNF to the site boundary is at least 700 meters (2,300 feet) in order to maintain exposures to the public within regulatory limits.

9.3.1.4 Location of Transfer Routes Within the Site

Transfer routes of SNF on site are located to minimize distances, to minimize interaction with other site vehicular traffic, to remain within the restricted area, and to maintain an acceptable distance to the site boundary.

9.3.1.5 Remote Video Inspection Systems

Remote video inspection systems are used at the inspection gatehouse and in the storage area to reduce personnel exposures from inspection activities. Security inspections are performed at the inspection gatehouse for incoming casks and in the storage area with the assistance of remote video systems. Both areas have sufficient lighting to support the use of remote video monitoring.

9.3.1.6 Transfer Facility ALARA Design Features

The following design features are used to reduce occupational radiation exposure in the transfer facility. A detailed description of these design features is included in Chapter 4.

- Gantry-mounted robotic arm
- Video cameras to aid operators in observing tasks performed by the robot via closed-circuit television (CCTV) monitors
- Transfer facility work platform robotic arms
- Automated cask support and alignment devices to reduce personnel exposures when performing tasks in radiation areas
- Shielded remote operator stations to allow operators to perform cask handling activities while reducing personnel exposures
- Remote/long-handled tools
- Cask decontamination subsystem.

9.3.2 Access Control

Access control at the CISF is provided both for radiation protection of authorized personnel and for physical protection of the facility. Two access control boundaries are defined in 10 CFR 72.104(a) and 10 CFR 20.105: the controlled area (site) boundary and the restricted area boundary. These boundaries, in turn, define the controlled area, the restricted area and the unrestricted area, described below. The locations of these boundaries are determined by the radiation analyses described in Section 9.4.1.

9.3.2.1 Controlled Area

The controlled area (site) boundary is established at 700 meters (2,300 feet) from any stored SNF as determined by analysis in Section 9.4.1. Public access to the controlled area is controlled as described in Section 4.9 of this TSAR. Control can be accomplished through ownership of the property or through coordination of access restrictions with state/local officials.

9.3.2.2 Restricted Area

The restricted area is defined in 10 CFR 20.105(b) as the area within which the radiation dose rate could exceed 2 mrem/hr. The restricted area includes the storage area, the transfer facility and the cask queuing area as shown in Figure 4.1-1 of this TSAR. The restricted area boundary is established at least 50 meters (200 feet) from any stored SNF as determined by analysis in Section 9.4.1. Unescorted access to the restricted area is limited to radiation workers, and the use of personnel dosimetry is required as described in Section 9.5.2. Access to the restricted area is controlled by security barriers as described in Section 4.9. Entry to the restricted area is through the security complex or the inspection gatehouse.

Within the restricted area, no areas are permanently designated as contaminated areas, since under normal conditions little or no exposure of personnel to radioactive contamination is expected. However, in case of potential contamination exposure, the following provisions are made.

- Mobile access barriers and equipment to provide temporary access and contamination control
- Male and female change rooms, including lavatories and showers
- Personnel protective clothing
- Personnel contamination monitoring stations
- Emergency personnel decontamination stations.

9.3.2.2.1 Unrestricted Area

The unrestricted area is defined in 10 CFR 20.105(a) as the work area within the site boundary where the radiation dose does not exceed 500 mrem/yr, based on 2,000 hr/yr occupancy. Access to the unrestricted area is not controlled for plant personnel. To ensure that the dose criteria in 10 CFR 20.105(a) are met, an unrestricted area setback distance is established at a minimum of 200 meters (660 feet) from stored SNF (Section 9.4.1) and at 50 meters (200 feet) from the transportation cask queuing area (Section 9.3.3.2). The temporary site support facilities area also meets the setback distance criteria. In addition, as described in Chapter 4, a 200 meter (660 feet) distance from any storage cask is maintained by crews constructing new storage pads in the storage area.

9.3.3 Shielding

Radiation shielding is used at the CISF for protecting workers and the public. Two basic types of permanent radiation shielding are employed: shielding on transportation casks and storage casks, and permanent shield walls within the transfer facility. In general, the shielding design basis at the CISF is to maintain personnel radiation exposures ALARA. However, two specific design criteria are used: (1) limit the maximum exposure to an individual worker in normally occupied areas (2,000 hr/yr) to 500 mrem/yr, or 0.25 mrem/hr; and (2) support a general design ALARA goal of limiting average operating personnel doses for intermittently occupied areas to less than 1 rem per year per person, or 20% of the 10 CFR Part 20.1201 regulatory criteria. Specific descriptions of shielding for each area of the CISF are provided in the following sections.

9.3.3.1 Transfer Facility Shielding

Radiation shielding within the transfer facility is provided by the concrete walls of the facility. The transfer facility is within the restricted area, therefore general area radiation dose rates may be greater than 2.0 mrem/hr when a cask is being handled. To reduce occupational radiation exposures to ALARA, four areas of the transfer facility have been shielded so that occupational doses will be less than 500 mrem/yr, based on 2,000 hr/yr occupancy, or an average of < 0.25 mrem/hr:

- Locker room/canteen area on elevation 101'
- Crane operating room in the receiving area on elevation 131'
- Remote operating area below the crane operating room on elevation 101'
- Remote operating cubicles in the transfer area on elevation 101'.

The locker room/canteen area is shielded by the 18-inch-thick exterior wall of the transfer facility, which provides a shielding factor of almost 300 for 0.5-Mev gamma rays. The closest approach of a transportation cask to the locker room is about 22 feet. For a transportation cask at the 10 CFR 71 limit of 10 mrem/hr at two meters, the resultant dose rate in the locker rooms/canteen area is substantially less than 0.25 mrem/hr.

The remote operating room on elevation 101', below the crane operating room, is also protected by the 18-inch-thick structural walls of the transfer facility. The room has no windows, and the door is placed so that there is no radiation streaming into the room from the receiving area. The resultant dose rate in this area is substantially less than 0.25 mrem/hr.

The crane operating room on elevation 131' is shielded by a combination of 10-inch-thick concrete walls or equivalent, and a leaded glass observation window. The walls and window are designed to provide a shielding factor of at least 10. During cask handling operations, the average approach distance of a cask to the crane operating room is about 50 feet. For a cask reading 10 mrem/hr at two meters, the resultant dose rate is substantially less than 0.25 mrem/hr.

The four remote operating cubicles in the transfer area are shielded by 12 inches of concrete or equivalent, about a 1/25 value shielding thickness. The cubicles have no windows, and the cubicle entrance is placed so that there is no radiation streaming from the transfer area. The average distance from a cubicle to a transfer station is about 20 feet. For casks averaging 10 mrem/hr at two meters, the resultant dose rate is substantially less than 0.25 mrem/hr.

In addition to permanent shielding, portable shielding may be used for certain cask handling operations that require personnel to perform tasks near the casks. This portable shielding is cask-specific and is supplied by cask vendors.

9.3.3.2 Transportation Cask Queuing Area Shielding

All transportation casks received at the CISF shall comply with 10 CFR 71 dose rate limits: 200 mrem/hr contact and 10 mrem/hr at two meters. Temporary access control using portable barriers is set up when transportation casks are temporarily stored in the queuing area to restrict access to areas where the dose rate exceeds 2 mrem/hr. Based on five casks parked end-to-end in the queuing area, and assuming dose rates from each cask at the 10 CFR 71 limits, a minimum distance of 50 meters (200 feet) is needed to maintain the dose rate at less than 2mrem/hr, the unrestricted access limit for areas of low occupancy.

9.3.3.3 Storage Area Shielding

The CISF storage area design basis is 10 mrem/hr total dose rate (gamma plus neutron) at two meters radially from an individual cask/storage mode surface, as described in Section 9.4.1. To reduce personnel exposures during transfer of cask/canister systems from the transfer facility to the storage area, on-site transporters are provided with shielding to reduce the dose rate to the transporter operator to less than 1 mrem/hr.

9.3.3.3.1 Storage Mode Shield Design

The CISF is designed to accept SNF in cask systems that have been certified by the NRC. The shield designs for these systems are described in the vendor SARs. To establish the design basis for the CISF, an independent shielding analysis was performed on one cask system that is judged to be representative of all the systems, the Westinghouse Large MPC System. The basis for the analysis is described in the following sections. The results are presented in Section 9.4.1.

9.3.3.3.2 MPC Source and Shielding Configuration

The Westinghouse Large MPC System is a cask/canister design consisting of a stainless steel canister (the MPC) with an internal basket containing the SNF, and a concrete and steel storage unit. The Large MPC System accommodates either 21 PWR or 40 BWR assemblies.

For the CISF analysis, the long version of the PWR MPC with carbon steel shields was used. Figures 9.3-1 and 9.3-2 show sketches of the MPC assembly and the MPC storage unit.

The model of the MPC storage system used for the shielding analysis is shown in Figure 9.3-3. Dimensions are given in Table 9.3-1. The composition of the fuel region (fuel plus guide tubes) is given in Table 9.3-2. Compositions for other shields are given in Table 9.3-3.

Table 9.3-1. Large PWR MPC Storage Mode Dimensions

Dimension[5]	Description	cm	inches
a	Fuel region height	360.17	141.8
b	Fuel plenum height	15.24	6
c	Fuel top end fitting height	9.32	3.67
d	Void	15.49	6.1
e	Shield backing plate	1.91	0.756
f	Shield plate (carbon steel)	14.94	5.875
g	MPC lid	8.26	3.25
h	Void	15.24	6
I	Storage mode backing plate	0.64	0.25
j	Storage mode shield	15.24	6
k	Storage mode top cover	7.62	3
l	Top vent radius	24.13	9.5
m	Radial void	9.43	3.713
n	MPC side	1.57	0.62
o	Radial void	10.16	4
p	Concrete shield	96.52	38
q	Storage mode radius	190.5	75.0
r	Fuel region radius	72.82	28.67
s	Bottom end fitting	6.99	2.75
t	MPC bottom plate	21.9	8.63
u	Support structure	37.6	14.8
v	Support structure	15.9	6.25
w	Storage unit bottom lid	7.6	3.0

[5] Refer to Figure 9.3-3 for dimension references.

Table 9.3-2. Large PWR MPC Fuel Region Compositions

Fuel

Element	Region 1 Mass (g)	Region 2 Mass (g)	Region 3 Mass (g)	Total Mass (g)	Total Density (g/cc)
Zr	1.044E5	8.355E5	1.254E6	2.194E6	0.3601
O	5.751E4	4.603E5	6.910E5	1.209E6	0.1984
U	4.277E5	3.423E6	5.137E6	8.988E6	1.475

Fuel Guide Tubes

Element	Density (at/b-cm)	Atomic Weight (A)	Guide Tube Density (g/cc)	Mass (g)	Fuel Region Density (g/cc)
Al	1.169E-02	27	0.5048	1.304E5	2.22E-02
B[6]	4.0297E-03	11	0.0736	1.902E4	3.121E-03
C	1.2459E-03	12	0.0248	6.408E3	1.052E-03
Cr	1.1698E-02	52	1.010	2.61E5	4.283E-02
Fe	4.1913E-02	56	3.898	1.007E6	1.653E-01
Mn	1.3025E-03	55	0.119	3.075E4	5.046E-03
Mo	9.3213E-04	96	0.1486	3.84E4	6.301E-03
Ni	7.3158E-03	59	0.7168	1.852E5	3.039E-02
Si	1.2739E-03	28	0.0592	1.5305E4	2.516E-03

[6] Boron density is total of B-10 and B-11 values from Ref. 9.2-1, Table 5.3-6.

Table 9.3-3. Large MPC Storage System Shield Compositions

Plenum

Element	Z	A	At/b-cm	Atom Fraction	Density (g/cc)
Zr	40	91	1.869E-03	1.000	2.825E-01

Top End Fitting

Element	Z	A	At/b-cm	Atom Fraction	Density (g/cc)	g/cc (1-VF)[7]
C	6	12	3.111E-04	3.742E-03	6.199E-03	3.738E-04
Si	14	28	1.662E-03	1.999E-02	7.728E-02	4.660E-03
Cr	24	52	1.526E-02	1.835E-01	1.318E0	7.946E-02
Mn	25	55	1.699E-03	2.043E-02	1.552E-01	9.357E-03
Fe	26	56	5.467E-02	6.575E-01	5.084E0	3.066E-01
Ni	28	59	9.543E-03	1.148E-01	9.350E-01	5.638E-02
Total			8.315E-02	1.000	7.575E0	4.568E-01

[7] VF = Void Fraction (0.9397)

Table 9.3-3. Large MPC Storage System Shield Compositions (cont'd.)

Bottom End Fitting

Element	Z	A	At/b-cm	Atom Fraction	Density (g/cc)	g/cc (1-VF)[8]
C	6	12	3.111E-04	3.742E-03	6.199E-03	3.540E-04
Si	14	28	1.662E-03	1.999E-02	7.728E-02	4.412E-03
Cr	24	52	1.526E-02	1.835E-01	1.318E0	7.524E-02
Mn	25	55	1.699E-03	2.043E-02	1.552E-01	8.860E-03
Fe	26	56	5.467E-02	6.575E-01	5.084E0	2.903E-01
Ni	28	59	9.543E-03	1.148E-01	9.350E-01	5.339E-02
Total			8.315E-02	1.000	7.575E0	4.325E-01

Carbon Steel

Element	Z	A	At/b-cm	Atom Fraction	Density (g/cc)
C	6	12	3.925E-03	4.490E-02	7.821E-02
Fe	26	56	8.350E-02	9.551E-01	7.765E0
Total			8.742E-02	1.000	7.843E0

[8] VF = Void Fraction (0.9429)

Table 9.3-3. Large MPC Storage System Shield Compositions (cont'd.)

Stainless Steel

Element	Z	A	At/b-cm	Atom Fraction	Density (g/cc)
Fe	26	56	5.936E-02	6.883E-01	5.520E0
Cr	24	52	1.743E-02	2.021E-01	1.505E0
Mn	25	55	1.736E-03	2.013E-02	1.586E-01
Ni	28	59	7.721E-03	8.952E-02	7.565E-01
Total			8.625E-02	1.000	7.940E0

Concrete

Element	Z	A	At/b-cm	Atom Fraction	Density (g/cc)
H	1	1	1.439E-02	1.680E-01	2.389E-02
O	8	16	4.823E-02	5.632E-01	1.281E0
Na	11	23	1.829E-03	2.136E-02	6.986E-02
Al	13	27	1.827E-03	2.134E-02	8.192E-02
Si	14	28	1.740E-02	2.032E-01	8.090E-01
Ca	20	40	1.592E-03	1.859E-02	1.057E-01
Fe	26	56	3.635E-04	4.245E-03	3.380E-02
Total			8.563E-02	1.000	2.406

Table 9.3-3. Large MPC Storage System Shield Compositions (cont'd.)

Air

Element	Z	A	At/b-cm	Atom Fraction	Density (g/cc)
C	6	12	5.922E-09	1.177E-04	1.180E-07
N	7	14	4.047E-05	8.045E-01	9.409E-04
O	8	16	9.662E-06	1.920E-01	2.567E-04
Ar	18	40	1.695E-07	3.370E-03	1.126E-05
Total			5.031E-05	1.000	1.209E-03

NOTE: Internal MPC spaces were assumed to be voids; air shields were assumed on the exterior of the storage mode only.

9.3.3.3.3 Storage Area Configuration

For the purposes of the shielding analysis, the SNF stored in the storage area is assumed to be as follows.

- 150 casks per pad, 75 casks per row
- 20-foot center-to-center cask spacing
- Storage pads 60 feet wide and 1,540 feet long (consisting of a number of individual pads joined together)
- Approximately 1,000 MTU per pad
- Storage area containing 40,000 MTU arranged in 40 pads (two "columns" of 20 pads)
- 50 feet between rows; center aisle 50 feet wide.

All storage units are assumed to be large PWR MPCs. This storage area model is shown schematically in Figure 9.3-4, and a detailed view of the assumed cask/pad arrangement is shown in Figure 9.3-5.

9.3.3.3.4 Computer Programs

Four computer programs are used to perform the MPC shielding analysis: QAD-CGGP, MCNP, MicroSkyshine, and SKYSHINE III. QAD-CGGP is used to calculate radial and axial gamma fluxes and dose rates. MCNP is used to calculate radial and axial neutron fluxes and dose rates. MicroSkyshine is used to calculate the air-scattered gamma dose rate contribution from the storage area at on-site and off-site locations. SKYSHINE III is used to calculate the air-scattered neutron dose rate contribution from the storage area at on-site and off-site locations. Descriptions of these codes are presented below.

9.3.3.3.4.1 QAD-CGGP

QAD-CGGP (Ref. 9.3-4) is a code for calculating gamma ray penetrations through various shield configurations defined by combinatorial geometry specifications. QAD-CGGP uses a point kernel ray-tracing technique for gamma ray calculations. The GP version optionally makes use of the Geometric Progression (GP) fitting function for the gamma ray buildup factor.

9.3.3.3.4.2 MCNP

MCNP (Ref. 9.3-5) is a general purpose Monte Carlo N-Particle code that can be used for neutron, photon, electron, or coupled neutron/photon/electron transport. The code treats an arbitrary three-dimensional configuration of materials in geometric cells bounded by first- and second-degree surfaces and fourth-degree elliptical tori.

Pointwise cross-section data are used. For neutrons, all reactions in a particular cross-section evaluation (e.g., ENDF/B-IV) are accounted for. Thermal neutrons are described by both the free gas and $S(\alpha,\beta)$ models. For photons, the code takes account of incoherent and coherent scattering, the possibility of florescent emission after photoelectric absorption, absorption in pair production with local emission of annihilation radiation, and bremsstrahlung. A continuous slowing down model is used for electron transport that includes positrons, k x-rays and bremsstrahlung, but does not include external or self-induced fields.

9.3.3.3.4.3 MicroSkyshine

MicroSkyshine (Ref. 9.3-6) is a microcomputer-based program for calculating the dose rate due to air-scattering from gamma-emitting volume sources interacting with structures. The code is based on line-beam response functions, which were determined by empirical fits to Monte Carlo SKYSHINE calculations.

9.3.3.3.4.4 SKYSHINE III

SKYSHINE III (Ref. 9.3-7) is a code for the calculation of dose rates resulting from air scattering of gamma rays and neutrons emanating from plane or volume sources. The code includes interactions with structure walls. A Monte Carlo calculation technique is used.

9.3.3.3.5 Flux-to-Dose Conversion Factors

The shielding codes used in this analysis require the input of conversion factors to convert gamma and neutron fluxes to dose rates. The gamma and neutron conversion factors used are developed from American National Standards Institute/American Nuclear Society (ANSI/ANS) 6.1.1-1977 data (Ref. 9.3-8).

9.3.4 Ventilation

The transfer facility HVAC system is designed to provide personal comfort, personnel safety protection and equipment functional protection in the transfer facility. The transfer facility HVAC system design and operation are described in detail in Chapter 4.

From a radiation protection standpoint, the transfer facility HVAC system is designed to provide a slight negative pressure in the transfer facility so that all air leakage is into the building. Exterior roll-up doors are closed whenever possible to prevent bypass flow and release of air to the environment, other than through the monitored exhaust. The HVAC system is designed so that all effluents are released via a common exhaust vent, which is monitored for radionuclide releases. The system design includes in-line High-Efficiency Particulate Air (HEPA) filters for ALARA purposes and a damper for bypass operations. The normal operation of the system will be in a bypass mode, with the HEPA filters automatically being aligned upon an alarm from the effluent radiation monitoring system. When the HEPA filters are being used, exhaust air is filtered by the HEPA filters prior to discharge to the exhaust vent. Note that the HVAC system is not required to reduce releases below regulatory limits for normal operations or accident mitigation. The HVAC system also serves to vent atmospheric gases and gas samples from transportation cask interiors to ensure that any radionuclides are monitored and to reduce the chances for airborne radionuclides in the transfer facility atmosphere.

9.3.5 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

The CISF fixed radiation monitoring systems consist of the transfer facility area radiation monitoring system and the transfer facility radioactive airborne effluent monitoring system.

9.3.5.1 Area Radiation 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 are located in the vicinity of transfer stations and in the shipping/receiving area to define radiation fields around cask systems. The system consists of small silicon diode type detectors, approximately the size of a thermoluminescent dosimeter (TLD), with wireless remote output. The output is sent to a local computer for reference by Radiation Protection personnel. The detectors have a range of 0.03 to 1,000 mrem/hr. The system has adjustable local and remote alarms. The area radiation monitoring system is designed in accordance with the criteria of ANSI/ANS N13.1-1969 (Ref. 9.3-9).

9.3.5.2 Radioactive Airborne Effluent Monitoring System

The transfer facility radioactive airborne effluent monitoring system constantly samples the effluent from the transfer facility HVAC system. The system is capable of detecting particulate or aerosol (Co-60 and Cs-137), iodine (I-129), and gaseous (Kr-85) radionuclide species. The monitoring system covers normal and postulated accident conditions. See Table 9.3-4 for release assessment specifications. The system output is sent to a local computer for reference by Radiation Protection personnel. Each channel of the system has an adjustable alarm setting. An alarm signal from any channel signals the transfer facility HVAC system to align the exhaust air flow through the HEPA filters. The radioactive airborne effluent monitoring system is designed in accordance with the criteria of ANSI/ANS N13.1-1969 (Ref. 9.3-9).

In addition to permanent HVAC effluent monitors, portable continuous air monitors (CAMs) are used to monitor the transfer facility atmosphere during tasks that could generate airborne radioactivity, such as transportation cask interior sampling/venting. The CAMs are equipped with local audible alarms to warn of high airborne radioactivity concentrations.

Table 9.3-4. Transfer Facility Radioactive Effluent Monitoring and Sampling System Ranges

Type	**Principle Isotope(s)**	**Range (μCi/cc)**
Noble Gas	Kr-85	10^{-5} - 10^{0}
Iodine	I-129	10^{-10} - 10^{-5}
Aerosol/Particulate	Co-60,Cs-137	10^{-9} - 10^{-4}

9.4 ESTIMATED ON-SITE COLLECTIVE DOSE ASSESSMENT

9.4.1 Direct Radiation Dose Rate Within the Controlled Area

Using the calculational techniques described in Section 9.3.3.3, the dose rates due to direct and air-scattered radiation from 40,000 MTU of SNF stored in the storage area are calculated at various locations and distances from the storage cask array. The calculation includes the following constituents.

9.4.1.1 Direct Gamma Dose

The direct gamma dose rate is calculated by summing the contributions of all casks in the storage array at the selected dose points. The effect of the self-shielding of the storage array casks (i.e., contributions from casks behind the first row) is taken into account by modeling sections of the storage array in QAD, with the storage unit containing the source term modeled as described in Section 9.3.3.3, and casks in rows between the source and the dose point modeled as concrete cylinders of the same dimensions as a storage unit.

9.4.1.2 Direct Neutron Dose

Due to the low radial neutron dose rate at the surface of the MPC storage unit (<1 mrem/hr, versus 22.7 mrem/hr gamma), the contribution to direct dose from neutrons is neglected for the MPC.

9.4.1.3 Air-Scattered Dose

The air-scattered dose is modeled by summing the contributions from the entire cask array at the selected dose points. Scoping calculations determined that the air-scattered neutron dose rate is a factor of about 50 less than the gamma dose rate, even with the high neutron source term at the top vent of the MPC. Therefore, the neutron contribution from air scattering is neglected in the array calculations.

9.4.1.4 Dose Rate Results

Table 9.4-1 shows the dose rates totaled from direct and air-scattered radiation versus distance from the edge of the nearest storage unit. These results comply with the regulatory requirements described in Section 9.3.2 for the establishment of the minimum restricted area boundary distance (2 mrem/hr) at 50 meters (200 feet), the minimum unrestricted area setback distance (0.25 mrem/hr) at 200 meters (660 feet), and the controlled area (site) boundary (25 mrem/yr) at 700 meters (2,300 feet). As shown in Table 9.4-1, the air-scattered component of the dose for the MPC, while insignificant at close distances (10% of the total dose or less), increases to 45% of the total dose at 700 meters. This increase is due to the large axial streaming source term resulting from the MPC top vent, a feature not found in other storage system designs.

The maximum dose rates are calculated at the "mid-array" dose points shown in Figure 9.3-4. The variation in dose rates at different locations around the storage array perimeter is less than 50% of the maximum.

Table 9.4-1. Dose Rates from CISF Storage Array

Distance (m)	**Dose Rate**			
	Direct	**Air-Scattered**	**Total (mrem/hr)**	**Total (mrem/yr)**
20	6.26	2.46E-01	6.51	5.70E4
50	1.54	1.73E-01	1.71	1.50E4
100	5.32E-01	1.09E-01	6.41E-01	5.62E3
600	3.28E-03	2.22E-03	5.47E-03	4.79E1
700	1.35E-03	1.11E-03	2.46E-03	2.15E1

The above results are calculated for one representative storage system, the MPC. However, they can be extended to envelop the other storage systems that are accepted at the CISF. All of the other systems being stored, except the NUHOMS® HSM, are vertical cask systems of roughly similar dimensions, which will be stored in identical arrays on storage pads. Therefore, the contribution to the dose rates outside the storage area from these vertical systems should be similar to that of the MPC.

The NUHOMS® canister is stored in Horizontal Storage Modules (HSMs), which are placed together in two groups of 10 per pad, stored back-to-back with a six-inch air gap between modules. Pads can be adjacently joined at the ends to form a row, and each row end includes a two-foot-thick shield wall. The metric tons of uranium (MTU) stored per row is similar to that for the vertical storage systems. The close spacing of the HSMs results in almost complete self-shielding of the inner rows of a storage array. In addition, the end shield wall significantly reduces dose rates on the ends of the rows. Therefore, it is expected that, given similar dose rates on the module exterior surfaces, the contribution to dose rates outside the storage area from HSM arrays will be less per module than for vertical systems.

To ensure compliance with off-site dose criteria, the vendor systems are limited to the extent of direct radiation from each storage cask or module. See Section 3.3.7 for the specific radiation dose rate criteria; and Chapter 14 which specifies survey criteria to ensure compliance prior to placement in the storage yard.

9.4.2 Doses to Workers

The occupational radiation doses to CISF workers from normal operational activities are determined for each of the storage systems to be accepted at the CISF. All handling operations for each system are considered individually, using information from vendor and ISFSI SARs. The analysis produces realistic dose estimates based on vendor dose estimates, actual cask/canister performance and, if information is not available, engineering judgment by experienced personnel. Estimates of occupational exposure reduction are performed to ensure that exposures can be maintained ALARA during operations.

9.4.2.1 Analysis Methodology

The analysis is performed in two parts. A preliminary assessment is performed for each cask system based on common transport and storage cask handling as prescribed by the vendor for use at nuclear power plants. All operations with the potential for causing significant occupational exposure are estimated for receipt, handling, storing and maintaining transport and storage systems. The current systems are designed for manual handling techniques with limited use of remote or automated systems. In the final dose assessment, major dose contributors are evaluated and ALARA dose reductions are approximated using feasible remote and automated systems. Resulting design recommendations are incorporated in the CISF design. Occupational exposures are then re-estimated using these techniques.

The general method of this analysis is to use vendor data where available and create an occupational exposure estimate for each vendor system. The operations not included in the vendor SARs are estimated for their dose contributions using past studies and engineering judgment. The dose assessment is estimated for a single cask. Then the annual throughput for the system is evaluated including staffing estimates for the facility. With these data, an individual dose per person per year is estimated and compared to 10 CFR 20.1201 operating limits. In addition, a total facility population dose is estimated to determine the overall risk and benefits of alternatives.

The final assessment is similar to the preliminary assessment in that each operational step and dose is included. Improvements are estimated in order to lower the amount of dose both to individuals and to the exposed population. These improvements are incorporated in the transfer facility design of this TSAR. The analysis is then updated with the improvements, and the final dose assessment is performed.

9.4.2.2 Preliminary Assessment

Table 9.4-2 presents an example of the type of data collected for the dose assessment for each cask system, taking into consideration each of the operational steps, from receiving the cask at the gate to placing the cask into storage. The source of this data includes the vendors' SARs, reference data and operational experience. Table 9.4-3 provides a facility population dose estimate for all casks received in a year. Table 9.4-4 shows the calculated average individual doses for each occupation type for each cask system. Table 9.4-5 lists the total of other occupational doses associated with cask storage. It is assumed that 1,200 MTU (232 casks) is the maximum SNF annual receipt rate for the CISF. For receipt rates greater than this, the dose impact will increase proportionally. Dose assessments for similar systems and operations can be found in References 9.4-1 through 9.4-4.

Table 9.4-2. Example Dose Assessment for Receiving Cask

Ref.	Task Description	Occupation	Number of People	Total Time (min)	Exposure Time (min)	Dose Rate Field (mrem/hr)	Occupational Radiation Exposure (person-mrem)
C	Receive cask	Prime Mover	1	5	5	1	0.1
C	Transfer of paperwork	Security	1	10	0	0	0.0
C	Initial security inspection	Security	2	40	20	15	10.0
E	Wash road dirt	Security	2	60	30	2	2.0
C	Initial radiation survey	Radiation Protection	2	15	5	40	6.7
C	Transfer to site lag storage	Prime Mover	1	50	50	1	0.8
E	Periodic inspection	Security	1	60	5	40	3.3
Total				240	115		**23**

C= Calculated
E = Estimated

Table 9.4-3. Preliminary Dose Assessment Facility
Population Doses per Year for Receipt and Transfer Operations

Cask System		Receive Transport Cask	Off-Load Transport Cask	Transfer Canister to Storage Cask	Move Storage Cask to Storage Area	Totals
Holtec HI-STAR 100	person-mrem per cask	23	161	N/A	36	220
	person-rem for 232 casks	5	37	0	8	51
NAC STC	person-mrem per cask	23	161	N/A	63	247
	person-rem for 232 casks	5	37	0	15	57
TranStor™	person-mrem per cask	12	134	528	49	716
	person-rem for 232 casks	3	31	122	11	166
VECTRA MP187	person-mrem per cask	14	113	338	55	520
	person-rem for 232 casks	3	26	78	13	121
Westinghouse Large MPC	person-mrem per cask	26	226	432	106	790
	person-rem for 232 casks	6	52	100	25	183
Westinghouse Small MPC	person-mrem per cask	26	219	425	100	770
	person-rem for 232 casks	6	51	99	23	179

Table 9.4-4. Preliminary Dose Assessment Average Dose per Person per Occupation for Receipt and Transfer Operations (person rem/person-yr)

Cask System	Operator	Crane Operator	Radiation Protection	Prime Mover Operator	Operations Average[9]	Security
Holtec HI-STAR 100	5.9	0.6	1.5	3.6	4.1	1.2
NAC STC	6.8	0.6	1.5	4.0	4.6	1.2
TranStor™	12.9	1.3	1.0	0.3	7.8	0.3
VECTRA MP187	12.3	0.3	0.9	7.5	8.3	0.5
Westinghouse Large MPC	12.1	0.5	1.1	3.2	7.5	0.7
Westinghouse Small MPC	11.8	0.5	1.1	3.0	7.3	0.7

NOTE: Assumes 232 casks per year throughput

[9]Includes Operator, Crane Operator and Prime Mover Operator

Table 9.4-5. Preliminary Dose Assessment Summary of Doses Associated with the Storage Area Maintenance Activities (person-rem per year)

Storage Area Activity	HI-STAR 100	NAC STC	TranStor™	VECTRA MP187	Westinghouse Large MPC	Westinghouse Small MPC
Security Inspections	0.6	0.6	0.6	0.6	0.6	0.6
Visual Inspections	0	0	9	9	9	9
Temp/Press Monitoring	0	935	1876	936	936	936
TOTAL	1	936	1886	946	946	946

NOTE: Assessment assumed 20,000 MTU in storage yard for dose rate calculations.

9.4.2.3 ALARA Evaluation

At nuclear power plants, occupational exposures received for transfer operations to dry storage are typically a small fraction of the total station population exposure due to the small number of operations performed. That is, typically less than 10 transfers occur per year. The average occupational exposure for each loading is about 200 to 300 milli-person-rem, or about 2 to 3 person-rem per year, compared to the total station dose of about 200 to 300 person-rem per year. The average individual exposure for the work group performing the dry storage operations is also within the total station average of about 200 mrem per person. As a result, the occupational exposure due to current spent fuel transfer operations at power plants is acceptable and in compliance with the ALARA philosophy.

The situation for a facility capable of receiving hundreds of transportation casks per year is considerably different, as exhibited by the average exposures seen in the preliminary analysis. Therefore, alternative methods must be adopted for most cask operations to keep occupational exposures ALARA. Typical dose-reduction alternatives include increasing shielding to reduce dose rate fields in areas personnel must access to perform their functions, reducing the time in which personnel must access the radiation environment, and increasing the distance from the radiation source to the personnel work location.

For the CISF, facility modifications are emphasized to minimize the impact on vendor systems. That is, dose-reduction techniques will use augmented supplemental techniques, which are primarily designed to remove personnel from the radiation area with the use of remote and automated systems. It is also assumed that the vendor systems can accommodate these remote systems without significant design changes and with little or no impact on their safety-related designs.

9.4.2.3.1 Evaluation of Preliminary Dose Assessment Results

The results of the preliminary evaluation indicate that the doses received by CISF personnel during operations needed to off-load a transportation cask, transfer the canister to a storage cask, and place the cask into storage are very high from the standpoint of compliance with 10 CFR 20 exposure limits and the ALARA philosophy as defined in 10 CFR 72. The design of the facility should be capable of ensuring that the average dose received per person is less than the ALARA goal of 1 person-rem annually, and the total facility population exposure should also be ALARA.

Furthermore, as demonstrated in Section 9.4.2.2, the dose received in the storage area during inspections of the storage cask is high and requires additional dose-reduction techniques. The temperature and pressure inspections are to be performed either daily or twice a day. The dose per person associated with this activity on an annual basis is approximately 28 rem/yr, which is well above the 5-rem annual limit. The visual inspections are to be performed daily. The dose per person associated with this activity on an annual basis is approximately 0.8 rem/yr for 2,400 MTU in storage. Therefore, accommodations should be made to ensure compliance with ALARA goals in completing these inspections.

9.4.2.3.2 Dose Reduction Techniques Applied to the CISF

There are five ways to reduce personnel radiation exposures that have been considered for the CISF:

- Reduce the number of personnel needed to perform tasks in radiation areas, including redefining tasks and using alignment devices, fixtures and robotics.

- Reduce the amount of time needed to perform tasks in radiation areas, including redefining tasks, using alignment devices and bolting/unbolting fixtures.

- Increase the distance between workers and radiation sources, including placing operators in remote locations, using extensions tools and using video cameras to perform inspections.

- Provide permanent or temporary radiation shielding between radiation sources and workers.

- Increase the number of operations personnel available to perform tasks in radiation areas by cross-training personnel to perform multiple jobs (e.g., crane operator, transfer operator, prime mover operator).

The initial CISF personnel exposure estimates are reviewed and reductions are made using the above techniques, wherever possible. The radiation protection design features are described in Section 9.3. The results of the revised dose analysis are presented in Section 9.4.2.4.

9.4.2.4 Final Dose Assessment

9.4.2.4.1 Final Dose Assessment for the Receipt and Transfer Operations

After applying ALARA techniques to evaluate options for lowering the amount of dose received by personnel, a revised dose assessment is performed. Table 9.4-6 provides a summary of the estimated final dose assessment.

Table 9.4-6. Final Dose Assessment - Facility Population Doses per Year[10]

Cask System		**Receive Transport Cask**	**Off-Load Transport Cask**	**Transfer Canister to Storage Cask**	**Move Storage Cask to Storage Area**	**Totals**
Holtec HI-STAR 100	person-mrem per cask	5.0	11.0	N/A	6.0	22.0
	person-rem for 232 casks	1.2	2.6	0.0	1.4	5.2
NAC STC	person-mrem per cask	4.0	8.0	N/A	23.0	35.0
	person-rem for 232 casks	0.9	1.9	0.0	5.3	8.1
TranStor™	person-mrem per cask	4.0	14.0	78.0	14.0	110.0
	person-rem for 232 casks	0.9	3.2	18.1	3.2	25.5
VECTRA MP187	person-mrem per cask	4.0	8.0	6.0	172.0	190.0
	person-rem for 232 casks	0.9	1.9	1.4	39.9	44.1
Westing-house Large MPC	person-mrem per cask	4.0	26.0	21.0	17.0	68.0
	person-rem for 232 casks	0.9	6.0	4.9	4.9	16.7
Westing-house Small MPC	person-mrem per cask	4.0	25.0	21.0	16.0	66.0
	person-rem for 232 casks	0.9	5.8	4.9	4.9	16.5

[10]Based on 232 casks per year

The total dose per person per year per occupation can be estimated using the updated total dose per cask for each occupation and estimating the number of people working per shift, the number of shifts needed to take the cask through the operations, and the throughput per year. The total number of operators varies with the vendor system from 11 to 25 per year. Table 9.4-7 shows the average dose per person per year per occupation for each cask type. Note that when the operations tasks (crane operator, operator, and prime mover operator) are combined, as a result of cross-training, the average dose per person is reduced further.

Table 9.4-7. Final Dose Assessment Average Dose per Person per Occupation (rem/person/yr)

Cask System	**Operator**	**Crane Operator**	**Prime Mover Operator**	**Operations Average**[11]	**Radiation Protection**	**Security**
Holtec HI-STAR 100	0.5	0.0	0.2	0.3	0.7	0.2
NAC STC	0.7	0.0	1.4	0.6	1.1	0.2
TranStor™	2.3	0.0	0.6	1.4	1.0	0.1
VECTRA MP187	4.3	0.0	2.0	2.7	0.8	0.1
Westinghouse Large MPC	1.0	0.0	0.3	0.6	0.5	0.1
Westinghouse Small MPC	1.0	0.0	0.3	0.6	0.5	0.1

9.4.2.4.2 Final Dose Assessment for Storage Area Maintenance Operations

The additional dose received during day-to-day routines is reduced by using video monitors for visual inspections and remote sensors for temperature and pressure monitoring. Table 9.4-8 breaks down the operations in the storage area and the dose associated with the operations.

[11] Includes operators, crane operators and prime mover operators. Training shall be required for operators performing receipt, transfer and storage facility operations.

Table 9.4-8. Final Dose Assessment Summary of Doses Associated with the Storage Arca Maintenance Activities (person-rem per year)

Storage Area Activity	**HI-STAR 100**	**NAC STC**	**TranStor™**	**VECTRA MP187**	**Westinghouse Large MPC**	**Westinghouse Small MPC**
Security Inspections	0.6	0.6	0.6	0.6	0.6	0.6
Visual Inspections	0	0	0	0	0	0
Temp/Press Monitoring	0	0.4	0.4	0.4	0.4	0.4
TOTAL	1	1	1	1	1	1

NOTE: Assessment assumed 20,000 MTU in storage yard for dose rate calculations.

9.4.2.5 Summary

Table 9.4-9 shows a comparison between the preliminary and final assessments for receipt and transfer operations for each occupation category, in terms of average rem per person per year. The goal of the ALARA review is to reach an average dose of 1 person-rem per year or less. This goal is achieved for the Westinghouse Large and Small MPC System, the Holtec HI-STAR 100, and the NAC STC. The TranStor™ System averages 1.4 person-rem per year to Operations personnel. Considering the conservatisms in the analysis, such as the dose rates for casks and the number of casks, it is reasonable to expect that the actual dose will be half of the amount in this table. The NUHOMS® MP187 average doses are 2.7 person-rem per year to Operations personnel for the 1,200-MTU/yr (232 casks per year) receipt rate, assuming no modifications to the current vendor designs. Due to the transfer taking place at the storage area, the use of remote or automated systems for the NUHOMS® MP187 System is limited.

Table 9.4-9 Average Annual Individual Exposure Estimate Preliminary and Final Assessments (person-rem/person-year)

Cask System	**Preliminary**			**Final**		
	Operators[12]	**Rad. Prot.**	**Security**	**Operators**[12]	**Rad. Prot.**	**Security**
Holtec HI-STAR 100	4.1	1.5	1.2	0.3	0.7	0.2
NAC STC	4.6	1.5	1.2	0.6	1.1	0.2
TranStor™	7.8	1.0	0.3	1.4	1.0	0.1
VECTRA MP187	8.3	0.9	0.5	2.7	0.8	0.1
Westinghouse Large MPC	7.5	1.1	0.7	0.6	0.5	0.1
Westinghouse Small MPC	7.3	1.1	0.7	0.6	0.5	0.1

Another goal of the ALARA review is to reduce the total occupational doses. Table 9.4-10 shows a comparison between the preliminary and final dose assessment in terms of total person-rem per year. This table clearly shows that the dose reductions made in the final dose assessment are effective from an ALARA standpoint.

The doses to workers calculated in this section are based on a SNF receipt rate of 1,200 MTU/year (232 casks/year). Operation of the CISF at the maximum design rate of 3,000

[12]Crane operators and prime mover operators are included with general operations personnel.

MTU/year, while resulting in a proportional increase in the total personnel doses (person-rem), does not significantly affect the average exposure per worker, due to the additional staff required to process SNF at the higher rate.

Table 9.4-10. Total Annual Operations Dose Assessment Comparison (person-rem per year)

Cask System	Preliminary Dose Assessment			Final Dose Assessment			ALARA Dose Reduction
	Receipt[13]	Maint.[14]	Total	Receipt[13]	Maint.[14]	Total	
Holtec HI-STAR 100	51	1	52	5	1	6	46
NAC STC	57	936	993	8	1	9	984
TranStor™	166	1886	2052	26	1	27	2025
VECTRA MP 187	121	946	1067	44	1	45	1022
Westing-house Large MPC	183	946	1129	17	1	18	1111
Westing-house Small MPC	179	946	1125	17	1	18	1107

[13]Based on receipt of 232 casks per year.

[14]Based on 20,000 MTU in storage area.

9.5 RADIATION PROTECTION PROGRAM DURING OPERATION

The major radiation protection functions of the Radiation Protection program during operations of the transfer facility are described in this section. 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.

9.5.1 Organization and Functions

For occupational exposure control, radiation protection systems are provided to control personnel exposure to radiation. Administration of the Radiation Protection program is accomplished with a trained and qualified staff of Radiation Protection professionals. Tasks include radiation monitoring and communication to operations personnel.

Radiation survey information associated with transportation, transfer and storage of casks is provided. This information includes use of portable radiation monitoring equipment to measure direct gamma and neutron radiation levels in the vicinity of the casks. It also includes the measurement and control of radiation contamination. Permanent and temporary shielding is used to reduce exposure to personnel. Areas are surveyed for radiation, and job postings are provided to define the need for anti-contamination clothing, in order to reduce the potential for personnel contamination when accessing areas of potential contamination.

Radiological monitoring, sampling, maintenance and calibration are provided. General area monitoring equipment located in the shipping/receiving and transfer areas is sufficient for fixed monitoring requirements. Additionally, more detailed radiation surveys are provided by Radiation Protection personnel covering specific operations.

In the CISF Radiation Protection organization, the Radiation Protection Supervisor reports to the Technical Services Manager without operating pressures. Sufficient Radiation Protection personnel are available to perform routine functions and to respond to anticipated occurrences and accident conditions in a timely manner. Contract services are identified in the organization, and may include instrument calibration, contamination smear counting, dosimetry counting and radiation protection training.

9.5.2 Equipment, Instrumentation and Facilities

Facility requirements to support radiation protection functions are as follows.

- 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 to accommodate Radiation Protection staff
- Counting laboratory.

Equipment and instrumentation provided to support radiation protection functions are as follows.

- A proportional counter for contamination smears to define surface contamination and the need for decontamination
- Hand and foot contamination monitors stationed at building exits to prevent the spread of contamination
- A multi-channel analyzer used to define radionuclide concentrations in liquid or gas samples
- A beta scintillator counter for beta-only radionuclide measurements
- A whole-body counter to identify any internal dose commitment
- Portable monitoring equipment to augment fixed detector systems
- Fixed general area radiation monitors in the vicinity of transfer stations and in the transfer facility receiving area to define radiation fields around cask systems
- An airborne effluent vent monitor to detect particulate, iodine and gaseous releases
- Personnel protective equipment and clothing
- Personnel dosimetry instrumentation and equipment, including the following.
    - TLDs for permanent exposure records
    - Self-reading dosimeters for instantaneous readout and personnel exposure control
    - TLD reader

- Computer hardware/software to record and analyze radiological monitoring/sampling and personnel exposure data.

9.5.3 Procedures

Radiation Protection activities are performed in accordance with procedures. Radiation Protection staff utilize procedures to perform the following.

- Take contamination swipes of potentially contaminated areas
- Perform radiation surveys to define and maintain radiation dose rates in the radiation areas
- Post areas based on surveys
- Provide radiation work permits and perform pre-operational briefings
- Cover jobs to ensure radiation protection
- Evaluate personnel occupational radiation doses to determine if ALARA objectives are met
- Administer Personnel Dosimetry and Bioassay programs
- Perform instrument calibration and testing
- Perform sampling and radiological analysis of liquid and solid wastes
- Provide ALARA review of plant procedure and monitoring of operations
- Perform radiological safety training and refresher training
- Maintain 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
- Perform, monitor and record environmental monitoring of effluents and boundaries.

9.6 DOSE TO OFF-SITE PUBLIC

This section describes the calculated radiation dose to the public at the site boundary. In addition, the program and analytical approach to monitor the radioactive material content of the CISF effluent streams are described, along with the off-site collective dose (person-rem) resulting from CISF operations.

9.6.1 Site Boundary Dose

As calculated in Section 9.4.1 and shown in Table 9.4-1, the whole-body dose to a member of the public continually present at the CISF site boundary (700 meters) due to direct radiation from the storage of 40,000 MTU of SNF is 21.5 mrem/year. In addition, as discussed in Section 9.2.2, airborne releases due to external contamination of cask/canister surfaces in the storage area contribute less than 1 mrem/year to the site boundary dose. This meets the criteria of 10 CFR Part 72.104.

Radiation doses to the off-site public from postulated accidents are discussed in Chapter 12. All postulated accidents result in site boundary doses significantly less than the 5 rem criterion of 10 CFR Part 72.106.

9.6.2 Effluent and Environmental Monitoring Program

This section describes the program for monitoring and estimating the release of radioactive materials processed and stored at the CISF to the environment.

9.6.2.1 Gaseous Effluent Monitoring

Provisions for gaseous effluent monitoring at the CISF are described in Section 9.3.5.2.

9.6.2.2 Liquid Effluent Monitoring

As described in Section 6.3, potentially radioactive waste liquids resulting from transporter wash down and cask/equipment decontamination activities are collected in holdup tanks. The tanks are periodically sampled, and if established limits for radioactive content are exceeded, the contents are processed by a vendor.

9.6.2.3 Solid Waste Monitoring

As described in Section 6.4, two types of solid potentially radioactive wastes are generated at the CISF: waste from contamination surveillance, decontamination, and maintenance activities, consisting of paper or cloth swipes, paper towels, rubber gloves and boots, and other potentially contaminated job control wastes; and expended HEPA filters from the HVAC system. These wastes are packaged and may be temporarily stored at the facility until collected by a vendor for off-site disposal. Radiation Protection personnel periodically monitor dose rates in the solid waste storage area using portable instrumentation for ALARA purposes as part of the facility Radiation Protection program.

9.6.2.4 Environmental Monitoring

The Environmental Monitoring program consists of two parts: external radiation dose monitoring at the CISF site boundary; and monitoring of potential ingestion pathways via sampling of water, soil, vegetation, etc. in the vicinity of the site. External dose monitoring is accomplished by placing TLDs at selected site boundary locations, typically at the centerline of each of the 16 wind direction sectors. These TLDs are analyzed quarterly and compared to background measurements made prior to facility operation, to determine the whole-body dose from CISF operations.

The environmental monitoring of potential ingestion pathways is a site-specific activity, and therefore is beyond the scope of this TSAR.

In addition to the programs described above, the environmental monitoring program includes continuing collection and evaluation of meteorological data to supplement data collected prior to CISF operation.

9.6.3 Off-Site Collective Dose

Since this TSAR is for a non-site-specific CISF, no evaluation of off-site collective radiation dose (person-rem) can be made.

9.6.4 Liquid Releases

In general, releases of liquid effluents to the environment at the CISF are minimized. Specific provisions for release of liquid effluents from the facility after processing are part of the site-specific design, and therefore beyond the scope of this TSAR.

9.7 REFERENCES

Section 9.1

9.1-1 NRC Regulatory Guide 8.8. Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As is Reasonably Achievable. Rev. 3. U.S. NRC. June 1978.

9.1-2 NRC Regulatory Guide 8.10. Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As is Reasonably Achievable. Rev. 1. U.S. NRC. May 1977.

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10. CRITICALITY EVALUATION

Storage and transportation cask systems received at the CISF 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. This chapter presents criticality safety criteria and summarizes design features which ensure criticality safety at the CISF site. CISF site characteristics and design-basis events, including normal operation events, are evaluated to ensure applicability of vendor cask criticality safety design and licensing bases.

This TSAR seeks NRC concurrence that:

- The CISF design and proposed use of certified cask systems for the handling, transfer, storage and monitoring of SNF adequately ensure that the materials will remain subcritical and that, before a nuclear criticality accident is possible, at least two unlikely, independent, and concurrent or sequential changes must occur in the conditions essential to nuclear criticality safety.

- The proposed CISF design, operations and administrative features as described in the TSAR are sufficient to preclude degradation of the cask criticality control safety functions, and that no additional CISF site specific analyses are necessary.

- Certified cask system design and licensing bases are sufficient to address cask array neutronic interaction issues at the CISF without additional analysis.

10.1 CRITICALITY DESIGN CRITERIA AND FEATURES

This section presents the criticality design criteria for the CISF and summarizes criticality safety design and licensing bases applicable to CISF transportation and storage cask systems. CISF site design features and criticality safety evaluation assumptions are then presented to demonstrate consistency with vendor cask system design and licensing bases.

10.1.1 Criteria

Criticality safety is 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 brought together in an array. Criticality safety evaluations further assume limiting fuel characteristics, which are stipulated in the respective vendor SARs.

10.1.2 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 of basket geometry and supplemental neutron absorber materials. Neutron reflector effects of cask and/or canister walls are also evaluated in the calculation of final k_{eff}. Continued reliance on these design features is necessary following receipt of transportation casks at the CISF site, in order to ensure that the stored materials remain subcritical under normal, off-normal and accident-level conditions. These features must also remain functional for subsequent off-site transportation and SNF retrieval operations.

The CISF implements, as appropriate, array limitations as specified in the vendor SARs.

CISF design and operational control features preclude events or conditions which 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 systems received at the CISF site under all normal, off-normal and accident-level conditions.

Package confinement systems are likewise protected from damage and, in the case of mechanical closure confinement systems, are 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 at the CISF site. SNF cavity confinement features are summarized in Chapter 11. Other important-to-safety and defense-in-depth design and operational control features included in the CISF design which protect SNF basket structures or minimize the availability of hydrogenous materials in the vicinity SNF packages are summarized as follows.

- Seismic design of transfer facility crane and structure

- Seismic design requirements imposed on storage systems
- Tornado missile protection of transfer facility transfer operations area
- Crane design features which satisfy "single failure proof" criteria and reduce 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.

The CISF site further relies on the assumption that SNF characteristics comply with system design specifications to demonstrate criticality safety during site operations.

10.2 STORED MATERIAL SPECIFICATIONS

Spent nuclear fuel characteristics considered in cask system criticality safety evaluations are summarized in the respective vendor SARs. It is assumed that packages received at the CISF are loaded in accordance with vendor SAR and regulatory requirements.

10.3 CRITICALITY ASSESSMENT

No criticality safety analyses are performed beyond those presented in the vendor SARs. However, since the CISF may receive SNF in multiple transportation and storage system designs, array interaction between dissimilar systems must be addressed and comply with the criticality safety criterion demonstrated.

Although all SNF is handled and stored in a dry condition at the CISF site, transportation and storage cask systems are evaluated in the vendor SARs assuming infinite arrays of flooded packages to further demonstrate criticality safety. These calculations assume infinite arrays of similar systems. The effect of handling and storing multiple vendor cask system designs at the same site is considered to be bounded by the SAR analyses for similar units. This conclusion is based on a review of the vendor SARs and the following considerations.

- Due to the large capacity of individual reference storage system units, the impact of this "array assumption" 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 (i.e., relatively high enrichment fresh fuel characteristics are assumed for loaded SNF, uranium mass loadings are relatively equivalent between designs, and fuel basket design features are sufficient to maintain $k_{eff} \leq 0.95$ in all designs under all conditions).

- Worst-case array spacing and interspersed moderation density assumptions are consistently applied in transportation and storage cask system criticality safety calculations.

Thus, no additional criticality safety analyses are performed beyond those presented in the vendor SARs to address array interaction between dissimilar transportation or storage units at the CISF site.

10.4 APPLICANT CRITICALITY ANALYSIS

No criticality analyses were performed beyond those presented in the vendor SARs.

11. CONFINEMENT EVALUATION

Storage and transportation cask systems received at the CISF are designed to ensure confinement of stored materials under normal, off-normal and accident-level conditions during all operations, transfers and storage. This chapter summarizes the system design features which ensure that radiological releases are within limits and will remain as low as is reasonably achievable, and that spent fuel cladding and fuel assemblies are protected from degradation during storage. CISF site design basis events, including normal operation events, are evaluated to ensure applicability of cask confinement system design and licensing bases.

This TSAR seeks NRC concurrence that:

- The proposed CISF design and operation presented in the TSAR provide acceptable features to detect and reduce to the extent practicable radioactive releases.
- The design of the CISF acceptably provides for the continuous monitoring of the effectiveness of storage cask system confinement.
- The proposed CISF design, operations and administrative features as described in the TSAR are sufficient to preclude degradation of vendor cask confinement features, and no additional CISF site-specific analyses are necessary.

11.1 CONFINEMENT DESIGN CHARACTERISTICS

Storage and transportation cask systems received at the CISF are utilized as described in the vendor SAR. Confinement design features for welded closure systems include redundant closure welds and cask/canister walls. Mechanical closure systems consist of redundant metallic o-ring seals and require leakage monitoring. CISF operations will ensure that storage system confinement features are protected and monitored consistent with previous at-reactor applications. However, due to its independence, the CISF also requires that all transportation and storage cask receipt and handling operation design events be identified and reviewed to ensure that storage system confinement features are adequately protected, or that CISF mitigation design features are provided to ensure radiological releases are within limits and will remain ALARA.

Although the CISF receives SNF only in canisters or transportable storage systems (i.e., no bare SNF handling is required), the CISF design includes provisions to maintain radiological releases ALARA in the event that casks or canisters are received with significant contamination. Features incorporated to suitably control radiological releases from normal and off-normal events are listed as follows.

- Cask/canister surface contamination detection capabilities and procedures
- Sample counting laboratory facilities
- Cask decontamination wash-down facilities
- CISF transfer facility structure and heating, ventilation and air conditioning (HVAC) system which provides the capability for High-Efficiency Particulate Air (HEPA) filtration of ventilation system exhaust.

Accident-level design-basis events that may have an impact on confinement include transport cask, transfer cask and spent fuel canister drop events. These events are considered extremely unlikely due to the design and operations associated with transfer facility lift equipment. However, in accordance with the defense-in-depth design philosophy, drop events involving these components will be evaluated by cask vendors and shown to be acceptable. Other transfer facility features incorporated to prevent or suitably control radiological releases from accident level events are listed as follows.

- NUREG-0612 "single failure proof" cranes and lift fixtures
- CISF transfer facility structure (particulate retention).

Non-mechanistic drop events resulting in a small confinement boundary breach have also been evaluated for all proposed CISF transportation and storage cask systems to demonstrate defense-in-depth. The vendor SARs are required to demonstrate a capability to recover from postulated drop events assumed to occur from the maximum lift height anticipated for CISF operations.

11.2 CONFINEMENT MONITORING

In addition to confinement monitoring required for mechanical closure storage systems, the CISF includes monitoring systems to prevent events which could compromise confinement systems and to detect potential loss-of-confinement events. These confinement monitoring features are:

- Cask/canister interspace sampling prior to lid removal procedures
- General area airborne and HVAC exhaust monitors
- Sample counting laboratory facilities.

No important-to-safety function is performed by the radiation monitoring system since no plant system or operator action is needed to ensure releases are below regulatory limits.

11.3 POTENTIAL RELEASE SOURCE TERM

No repackaging of individual spent fuel assemblies is performed at the CISF. Because only certified or licensed cask systems are used at the CISF, source terms are limited by licensing commitments. Radionuclide inventory is provided by the vendor and represents the maximum expected inventory of the design-basis spent fuel characteristics.

11.4 CONFINEMENT ANALYSIS

A site-specific radiological effluent analysis of a loss-of-confinement accident will be necessary for each cask system used at the CISF. It remains to be demonstrated for specific transportation and storage systems that the consequences of a confinement breach at the CISF are at or below that previously analyzed. It will be necessary to confirm the applicability of vendor assumptions to specific site meteorological characteristics and site boundary distance when an actual site is selected. Dose consequences from design events shall be demonstrated to be within the acceptable regulatory limits.

Additional ALARA benefits are provided by the HEPA filter system which aligns upon radiation monitor signal. Although the HEPA filter system would be available to potentially mitigate the consequences of a loss-of-confinement event, no filter benefit will be assumed in the accident analysis.

11.5 ESTIMATED OFF-SITE COLLECTIVE DOSE ASSESSMENT

Due to the generic non-site-specific nature of the CISF, no population dose estimates are performed at this time.

11.6 PROTECTION OF STORED MATERIALS FROM DEGRADATION

Vendor specific requirements are defined in the respective vendor SARs.

12. ACCIDENT ANALYSES

The evaluation of the safety of the CISF is accomplished in part by analyzing the response to postulated design basis events (DBEs). The analyses of DBEs identified as being applicable to the CISF are presented in this chapter. In addition to identifying the significant DBEs, this chapter presents (1) a summary of the consequences of these events, (2) those design and administrative features which help to prevent the occurrence and/or mitigate the consequences of the event, and (3) the corrective actions taken to cope with each event.

In previous chapters of this TSAR, important-to-safety features have been identified and discussed. The purpose of this chapter is to identify and analyze a range of credible events, from minor occurrences to design-basis accidents. The identification and selection of DBEs (Section 5.2) is based on a hazards analysis which considers CISF operational steps and potential internal and external energy sources which could pose a hazard to the safe operation of the facility. Frequencies and consequences of each hazard are estimated, and those events identified as significant risk contributors are analyzed further. In addition, a review of vendor SARs and independent spent fuel storage installation (ISFSI) SARs was performed to identify events which have been considered for cask storage systems and similar facilities. From these sources, a list of DBEs was compiled. This list was narrowed to the events presented in this chapter, based on a screening process which considered applicability to CISF operations, site design criteria, and the estimated frequency of occurrence of the event.

The remaining events are categorized as off-normal events or accidents based on the four levels of design events described in American National Standards Institute/American Nuclear Society (ANSI/ANS) 57.9-1992. The categorization of DBEs is based on their expected frequency of occurrence. It provides a means of establishing design requirements to satisfy operational and safety criteria. Events expected to occur routinely as a part of normal operations are designated as Design Event I. Those events that may occur with a frequency of at least once per year are categorized as Design Event II. Events postulated to occur once during the operating lifetime of the facility are designated as Design Event III. Credible events of very low probability or those that are postulated because they result in bounding consequences representative of a number of potential accidents are categorized as Design Event IV.

Section 12.1 presents the analyses of the off-normal events. Section 12.2 presents the results of the accident analyses.

This TSAR seeks NRC concurrence that:

- The analyses of off-normal and accident events show that the design of the CISF is acceptable and meets regulatory requirements.
- The analyses of design-basis accidents and anticipated occurrences show that releases of radiation to the general environment will be below the exposure limits of 10 CFR part 72.

- The TSAR includes acceptable analyses of the design and performance of the SSCs important to safety under off-normal and accident scenarios.

- The identification of off-normal and accident events is thorough and comprehensive.

12.1 OFF-NORMAL EVENTS

Off-normal events include those events categorized as Design Event I or II as described in ANSI/ANS 57.9-1992 (Ref. 12.1-1). Type I events occur regularly or frequently in the normal course of operation of the CISF. These normal events are addressed in Chapters 4 and 5 of the TSAR. They include such operations as transportation package receipt, inspection and unloading. Type II design events are those that can be expected to occur with moderate frequency or on the order of once during a calendar year of CISF operation. In general, the consequences of such an off-normal event do not have a significant impact on important-to-safety criteria.

The events analyzed in this section are listed in Table 12.1-1. The table also provides an indication of whether these events are specifically applicable to the vendors' storage systems and/or CISF structures, systems and components. The level of description and analysis which follows is dependent on the uniqueness of the event to the CISF. For those events analyzed in the vendor SARs, only a brief summary is provided. More in-depth discussion of consequences and of CISF design and administrative features to prevent or mitigate consequences are provided for those events which are unique to the CISF or affect its design. Canister contamination is handled as a normal operation and discussed in Chapter 9.

Following the table, each event is presented by identifying its postulated cause, method(s) of detection, analysis of the effects and consequences. Corrective actions to recover from the event are given for each of the nine events.

Table 12.1-1. Off-Normal Events

Event	Design Event Type	Applicability
Partial blockage of air vents	II	Vendor storage systems
Canister misalignment	II	Vendor storage systems CISF facility
Failure of instrumentation	II	Vendor storage systems . CISF facility
Failure of secondary confinement boundary	II	Vendor storage systems CISF facility
Handling event	II	CISF facility
Lightning	II	Vendor storage systems CISF facility
Loss of external power	II	CISF facility
Off-normal ambient temp.	II	Vendor storage systems CISF facility
Vehicular impact	II	CISF facility

12.1.1 Partial Blockage of Air Vents

This event involves 50% blockage of a storage cask's air inlet vents while the cask is in the storage area. It is applicable only to storage casks which have air vents and is expected to last for the duration between successive inspections as determined in the full blockage of air inlets/outlets accident event. The partial blockage causes temperatures throughout a storage cask to initially increase, due to the partial loss of the natural circulation used to cool the canister containing the SNF, and to eventually reach a steady-state.

12.1.1.1 Postulated Cause of Event

This event may be initiated by blowing winds, a sand, snow or ice storm, an avalanche, a flood or a landslide. Each of these events may result in the build-up of foreign material debris near the bottom of a cask. Since air inlet vents 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.

12.1.1.2 Detection

This event is detected by an abnormal reading from a thermocouple measuring the temperature near the storage system exhaust vent.

12.1.1.3 Analysis of Effects and Consequences

Storage casks are designed for this event; therefore, there are no impacts to thermal safety criteria.

Facility Features

There are no implications to the CISF.

Storage System Features

Storage casks must be designed so that their steady-state temperature levels do not exceed those levels required to maintain fuel cladding integrity for this event.

12.1.1.4 Corrective Actions

Since there are no radiological releases or adverse consequences to the important-to-safety functions as a result of this event, no corrective actions are required. However, recovery from this event will take place by removing the obstructions to the air vents.

12.1.2 Canister Misalignment

This event involves the misalignment or interference of a cask/canister during insertion or removal from a transportation, transfer and/or storage container during both horizontal and vertical transfer operations. This event is applicable only to those cask/canisters subjected to on-site transfer operations that may result in a condition of misalignment. Canister transfer operations occur in either the transfer facility or the storage area. Therefore, this event may occur at either location.

12.1.2.1 Postulated Cause of Event

Misalignment may occur during canister transfer operations as a result of improper alignment and mating between the casks or storage module surfaces, and as a result of interference caused by foreign material present, or a combination of such conditions.

12.1.2.2 Detection

These events are noted by observing excessive jamming forces and/or unusual audible noises during the horizontal pushing or pulling of a cask/canister. Ram pressures during horizontal transfer operations also provide an indication of canister misalignment and interferences. Remote video and audio capabilities are provided to help monitor operations during vertical canister transfer. (See facility features below.) Unusual audible noises (denoting potential interference) or slackening of the crane wire slings supporting the cask/canister load during vertical canister loading will be detected. Crane load sensors provide an indication of excessive forces during vertical canister transfer operations.

12.1.2.3 Analysis of Effects and Consequences

The extent of jamming depends on the initial misalignment, and the composition and quantity of foreign material causing interference on transfer surfaces. The consequence of this jammed condition and subsequent disengagement has the potential for damage to the outer basket assembly, cask/or canister shell during movement.

The consequences of this event, as described below for both the storage systems and the facility, have no impact on the confinement safety function.

Facility Features

Transfer operations in the transfer facility are to be performed remotely with the assistance of closed-circuit television (CCTV) monitors, robotics equipment and alignment fixtures. Cameras with audio capability are provided on the cranes and throughout the canister transfer area in the transfer facility to assist the crane operators in the alignment of the casks during transfer operations. Operators in the crane operating room may also be able to visually observe the canister transfer through a viewing window; however, their primary aids during transfer are the CCTV monitors and an alignment system. Load indicators will be provided with the cranes to alert the operator to significant load changes during canister transfer operations, which may be a sign of cask misalignment. For storage systems which utilize a hydraulic ram, vendor-supplied systems will monitor the pressure applied to the ram during canister transfer so that excessive pressure is avoided. In addition, operations personnel will be available on the floor of the canister transfer area if needed. Extensive crane operator training will also be provided for each of the applicable vendors' systems prior to actual operations. Operating procedures will require that empty storage casks be checked for the presence of foreign material prior to initiating canister transfer.

For the VECTRA NUHOMS® System, an alignment system will also be provided to aid in the proper alignment of the transportation cask and skid with the concrete storage module. The load on the hydraulic ram will be closely monitored during canister transfer to avoid excessive pressures which may indicate canister misalignment. Prior to actual operations, extensive training will be provided to personnel who will be controlling the horizontal canister transfer operations in the storage area. In addition, operating procedures will require the verification of the absence of foreign material in the applicable Horizontal Storage Module prior to loading a canister.

Storage System Features

The evaluation of this event is unique for each of the canister-based storage systems. This off-normal event is evaluated in SAR submittals for all canister-based storage systems to which this event is applicable. An evaluation of canister misalignment during transfer for the Sierra TranStor™ System is presented in Portland General Electric's ISFSI SAR for Trojan Nuclear Power Plant (Ref. 5.2-17). The design features and resulting consequences in the storage system SARs are sufficient to satisfy the required confinement safety function.

12.1.2.4 Corrective Actions

Recovery from this event takes place immediately once the misalignment and/or interference violations are detected. Specific recovery actions vary among the various vendor designs due to the differences in canister transfer operations. In general, immediate recovery actions include reversing the canister insertion, or withdrawal operations to lessen the load on the canister or cask. The operator would then visually inspect the alignment, make necessary adjustments, and try to complete the transfer. If unable to satisfactorily correct the alignment, the operator would return the canister and casks to their initial positions and visually inspect the affected casks for foreign objects.

12.1.3 Failure of Instrumentation

A failure of instrumentation event is postulated to occur when an instrument either is not operational or yields a false reading. None of the instrumentation failure events identified for the CISF itself results in any radioactive release or otherwise impairs the ability of any SSC to perform an important-to-safety function. However, an instrument failure may contribute to or delay detection of another event covered in this section.

For the purpose of this event, CISF instrument and control systems are grouped into the following categories: (1) transfer facility process instrumentation and control components, (2) storage system monitoring equipment, and (3) 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 and RTD, or thermocouples, with their 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.

12.1.3.1 Postulated Cause of Event

Failure of instruments used in any of these systems could be caused by a loss of power, faulty instrument sensor/component, sensor/component malfunction or wiring discontinuity that would fail to convey the intended signal to the applicable instrument. Failures can also be anticipated due to component aging or exposure to extreme environmental conditions, such as humidity-induced fogging of camera lenses.

12.1.3.2 Detection

Instrumentation or control system failures can usually be directly observed and detected by equipment operators. In addition, instrumentation failures or calibration problems will be detected as a result of periodic required inspection, calibration and testing.

Monitoring instrumentation will generally fail in one of two failure modes.

- System fails at some indication, which appears reasonable for normal conditions. Operators can detect this failure mode by comparing trends with other monitors or with changes in environmental conditions, or through required surveillance testing.

- The system fails to zero or full scale. This failure mode would be immediately obvious.

Using process control equipment, such as the remote cameras and robotic system controllers, the failure of the system is immediately detectable by the crane operator through visual observation of the remote operations being performed. In addition, abnormally high or low forces required to lift casks or transfer canisters are indicative of faulty ram pressure or crane load sensor instrumentation.

12.1.3.3 Analysis of Effects and Consequences

Instrumentation and control system failures which are immediately obvious to facility operators are expected to result in operator action to discontinue operations or take appropriate actions to maintain the facility in a safe configuration. However, failures which result in erroneous indications of monitored parameters not immediately obvious to operators can be postulated. Such instrument failure events are anticipated and accommodated by the facility design to assure safe facility operations should they occur.

Facility Features

Transfer facility instrumentation is tested and maintained on a regular frequency so that the probability of a failure is greatly decreased. All instrumentation and control system failures are backed up by manual means or fail-safe important-to-safety facility design features, so that no impacts on safety functions result.

The functions of the remote and robotic systems are to support transportation cask unloading and canister transfer operations. Operations of these systems are controlled by a qualified operator with remote CCTV visual capability. All operations are low-speed with low impact potential against the massive cask and canister systems. The equipment is demonstrated and qualified for use at the CISF prior to facility start-up, as described in Chapter 13. Transfer facility remote and robotic instrumentation, including crane load sensors and hydraulic ram pressure indicators, are also tested and calibrated on a regular basis. Crane and robotic operations remain under the direct control of facility operators. Any instrumentation or control system malfunction resulting in an inadvertent motion or an improper/incomplete action will be immediately observed by the operator and corrective actions taken. Effects and consequences of inadvertent motions by a robot or crane are covered under the handling event in Section 12.1.5.

Failures of control systems resulting in the inability to limit lift height are mitigated by important-to-safety crane design features which prevent two-blocking or cable failures. A fail-safe automatic cable brake feature prevents uncontrolled load drop events. Erroneous indications from crane hook load sensors indicating an abnormal condition would be immediately noticed by the operator, and appropriate actions would be taken to ensure that no misalignment has occurred and that loads are handled and canisters transferred in a safe manner. Should the load sensor fail to indicate an abnormal load change (i.e., canister misalignment event), visual observation of crane transfer operations, including monitoring of lifting slings, load and rigging orientations and lift height, serves as an independent monitoring capability for detection of misalignment events during vertical canister transfer operations. Erroneous indications of hydraulic ram forces will result in similar operator actions during horizontal canister transfer operations. Abnormal pressure indications or abnormal transfer rate will be observed by the operator and corrective actions taken prior to proceeding with transfer operations.

Area radiation monitoring system provides general area radiation monitoring and can alert personnel to changes in radiation dose rate levels. Failure of radiation monitoring instrumentation can result in a temporary misunderstanding of the local radiation field. Due to the inherent protection provided by the shielded transportation and storage casks, radiation fields are not expected to be very high or significantly variable, and radiation monitoring instrumentation is not relied upon to perform any process control function. Area monitors are also backed up by portable survey equipment. Radiation surveys are performed at various stages of SNF receipt and handling operations. Failure of the radiation monitoring instrumentation, therefore, will not result in significant occupational radiation exposure or impact on important-to-safety functions.

The radiation monitoring system also includes a facility heating, ventilation and air conditioning (HVAC) discharge vent monitoring system. This system includes a monitor, is sensitive to noble gases and collects iodine and particulate samples for release assessment purposes. The discharge vent monitor can align HVAC High-Efficiency Particulate Air (HEPA) filtration upon detection of release rates significantly above background levels for ALARA purposes. However, the system provides no important-to-safety process control and is not required for accident mitigation. The system is regularly maintained and calibrated.

Although its failure impacts the ability to collect data necessary for reporting purposes, it does not affect any important-to-safety facility function.

Radiation monitors are placed at the site boundary for verification of site boundary dose compliance. Thermoluminescent detectors (TLDs) are replaced and read frequently to characterize the radiation dose received at site boundary locations for dose assessment and reporting purposes. Failure of any of these monitors will have no impact on important-to-safety functions.

Storage System Features

Instrumentation used to facilitate canister transfers includes alignment systems. Although operations occurring within the transfer facility will generally be performed remotely, this equipment will be used as described by storage system suppliers. Consequences of misalignment events and recovery procedures for each storage system are presented in Section 12.1.2.

Failure of storage pressure and temperature monitoring equipment or instrumentation will require the restoration of manual inspection capability. Failure of these instrumentation systems will not result in reduced performance of any important-to-safety SSCs. Once the failure is detected by the operator or through the routine surveillance program, the instrumentation is repaired and returned to service.

12.1.3.4 Corrective Actions

Failure of the storage monitoring instrumentation (both temperature and pressure) is investigated within the time frame specified in the applicable vendor's SAR. Failure of a signal requires manual inspection capability and replacement of the faulty equipment. The failed pressure or temperature devices must be replaced at the CISF in accordance with approved maintenance procedures.

Many transfer facility monitoring instrumentation or control features are backed up with independent manual methods. Failure of the remote and robotic systems are corrected or manual operations can be performed. Many of the robotic system functions such as impact limiter unbolting, contamination swipes and cask decontamination are intended to reduce dose to facility workers for routine tasks that can be automated. Backup manual means to perform these operations is generally available. In cases where manual methods are not available, the facility is maintained in a safe configuration while repairs are performed and systems tested prior to reinitiating normal facility process operations. In the case of instrumentation failures indicating potential misalignment events, vendor SAR procedures are followed to confirm alignment and proper functioning of important-to-safety hydraulic system pressure limiting devices prior to continuing with transfer operations.

Likewise, recovery action for failure of the fixed area radiation monitoring instrumentation consists of repair or replacement of the faulty instrumentation and backup with portable radiation monitors. Portable radiation monitors and alarms will be provided until the fixed area radiation monitors can be returned to service. If coverage of the affected area by radiation monitors cannot be re-established, operations involving radioactive materials will be discontinued. In the case of a discharge vent monitoring system failure, cask and canister handling operations are discontinued until the system is repaired and back in service, or until temporary instrumentation can be put into place to perform the necessary routine release assessment function.

12.1.4 Failure of Secondary Confinement Boundary

This event is postulated to occur for bolted cask closure systems (e.g., NAC STC System) in the storage area or transfer facility when the single seal (metallic o-ring) associated with the outer lid fails. This event does not apply to welded cask/canister storage systems because of the structural integrity of the confinement barriers. The NAC STC System has a dual lid design that provides a redundant cask closure system and protection of the vent and drain ports incorporated into the inner lid. The primary confinement boundary for the NAC STC System is the inner lid and its penetrations, which are protected by mechanical means through the use of two metallic o-rings. The outer lid and single o-ring provide the secondary confinement boundary.

12.1.4.1 Postulated Cause of Event

The failure of one of the o-ring seals may be caused by mishandling during transfer, transport and/or storage operations, resulting in possible material fracture of the mechanical seal for the outer lid.

12.1.4.2 Detection

Leakage of the single metallic o-ring associated with the outer lid during storage will be detected by monitoring the pressure in the region between the inner and outer lids. The pressure in this region will be set at levels higher than the cask fuel cavity and the surrounding environment, such that any leakage will be from the interlid region to the environment. An alarm signal will be sent to a computer data monitor in the cask monitoring room once the pressure in the interlid region drops to a preset level. This alarm set point will make allowance for normal variations in pressure due to seasonal temperature differences, diurnal variations, and normal radioactive decay processes.

12.1.4.3 Analysis of Effects and Consequences

No leakage of radioactive gases takes place since the primary confinement barrier is still intact. There are no radiological releases or adverse consequences to the important-to-safety functions associated with this off-normal event.

12.1.4.4 Corrective Actions

Although there are no radiological consequences associated with this event, 10 CFR Part 72.236(e) requires redundant sealing of the confinement systems. Therefore, recovery action must be initiated within the time frame specified in the vendor SAR to replace the outer seal and restore the secondary confinement boundary. Recovery actions will be initiated once an alarm indication is detected. CISF personnel will investigate the cause of the low pressure alarm. If the pressure transmitter is determined to be functioning properly, then the cask is brought back into the transfer facility from the storage area and the source of the leakage is investigated. If the leakage is determined to be a result of a failure of the secondary confinement boundary (i.e., the outer lid o-ring seal), then the outer lid is removed and the o-ring seal is replaced. After installing the outer lid, the interlid region is again repressurized and tested, and the cask is returned to the storage area. Additional details on recovery operations from a cask seal failure which confirm the ability of the storage casks and the facility to respond to this event are presented in Section 12.2.9.

12.1.5 Handling Event

A handling event is postulated to occur when a storage, transfer or transportation cask collides with part of the transfer facility or with equipment found in the transfer facility as a result of crane operator error, equipment failure or a natural event.

12.1.5.1 Postulated Cause of Event

A handling event may occur during any process in which storage, transfer or transportation casks are moved by transfer facility cranes, or as equipment in the facility is moved toward one of these casks. Causes include operator error, improper usage of vendor equipment (i.e., the mixing of vendor equipment), failure of equipment, or a natural event. Each of these postulated mechanisms may result in a storage, transfer or transportation cask impact on the transfer facility walls, the transfer facility floor, or the equipment found in the transfer facility. This equipment includes robotics and other storage, transfer and transportation casks.

12.1.5.2 Detection

This event should be readily detectable through visual inspection by CISF personnel. The transfer facility crane operator may either visually or audibly detect this event when it occurs.

12.1.5.3 Analysis of Effects and Consequences

All credible handling events are mitigated by the design of the transfer facility, the transfer facility crane, and the design of the cask/canister systems. The rigid design of the casks used at the CISF prevents damage to them due to credible handling events.

If a cask is damaged due to this event, the damage is expected to be superficial (i.e., chipping or spalling) due to the low-speed operations and the robustness of the system. There are no criticality, confinement, thermal or retrievability implications due to this event. A partial loss of shielding is possible. The radiological implications due to this event are bounded by those due to the tornado missile event.

Facility Features

The design of the transfer facility prevents a cask hooked to a transfer facility crane from impacting any of the walls inside the facility, except for the tornado missile protection partitions, due to any credible event. To prevent damage to these partitions and other areas where equipment may normally be stored, the transfer facility cranes will move the cask along defined travel paths. The transfer facility cranes are also designed to be single failure proof, and their configuration precludes any potential interaction between the loads of these two cranes. In addition, to prevent handling events caused by the mixing of vendor equipment, the equipment is clearly labeled and easily identifiable to the crane operator.

The transfer facility robotics are designed to be lightweight and to move at slow speeds. Hence, a handling event caused by a transfer facility robot impacting into a cask will not impact any important-to-safety functions. In addition, operating controls coordinate equipment movements in the transfer facility preventing interaction between a cask hooked to a crane and the gantry-mounted robotics.

A handling event may, however, still occur between a cask hooked to the crane and equipment found in the cask travel paths, due to equipment malfunction or crane operator error. This equipment includes other storage, transfer or transportation casks, the gantry, transfer trailers, transfer skids, carriages, and cask transporters. To minimize the damage caused to this cask and equipment, the transfer facility crane speeds and the height at which a cask is moved are limited.

Storage System Features

Damage to a cask involved in a handling event is superficial, due to the design of the cask/canister systems. Tipover of the cask will not occur due to the low height at which a cask is moved by the crane, and the limited speed of the crane. In addition, casks not attached to a crane are seismically restrained or designed not to tip over.

12.1.5.4 Corrective Actions

A storage, transfer or transportation cask which has undergone a handling event must be inspected after the event has taken place. Casks not suffering from external damage or elevated dose rates do not require any further action.

Those casks containing transferable canisters may require the transfer of the canister to another unit and the damaged unit either sent off-site for repair or decommissioned. For systems without a transferable canister, the damage produced by this event may cause a loss of shielding. Therefore, these casks require temporary shielding until the external shield can be permanently replaced, and may require transfer to the off-normal cask holding area to be repaired by a contractor.

12.1.6 Lightning

This is a natural event associated with thunderstorms in which one or more cloud-to-ground lightning strikes impact upon CISF SSCs exposed to the environment. Lightning is a large-scale high-tension natural electrical discharge in the atmosphere.

12.1.6.1 Postulated Cause of Event

This event is a natural phenomenon which is expected to occur once per year in the course of normal operations. Its frequency is based on the frequency of occurrence of thunderstorms. This has been determined to be a function of several variables, including the time of day, geographic location and elevation. The period of greatest thunderstorm activity typically occurs during the late afternoon and evening during the summer. Certain areas of the country are also prone to greater occurrences of thunderstorms, particularly the warmer, more humid locations.

12.1.6.2 Detection

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 event may be observed by individuals at the time of the event, or it may not be observed until a later time during routine surveillance inspections.

12.1.6.3 Analysis of Effects and Consequences

The analysis of this event is generally site-specific and will be addressed again once a site has been selected. The general effects of a lightning strike event depend on the structures impacted and the number of lightning strikes. Specific effects may include a localized temperature increase, a loss of power, and/or a short circuit of electrical components.

To prevent the occurrence of damage resulting from a lightning event, all CISF buildings and structures will be designed in accordance with National Fire Protection Association (NFPA) 780 (Ref. 12.1-2). The fundamental principle which forms the basis for the requirements given in NFPA 780 is to provide a means by which a lightning strike can enter the earth without resulting damage. This is done by providing a low-impedance path which the electrical discharge current follows, in preference to alternative high-impedance paths offered by building materials such as concrete. When lightning follows high-impedance paths, damage may result from the heat and mechanical forces generated by the electrical discharge. Metal conductors, which form the basis of the lightning protection systems, are virtually unaffected by thermal and mechanical forces if they are sized sufficiently to carry the current. In a lightning protection system, a continuous path is provided from air terminals or similar devices to the ground.

Facility Features

All CISF buildings and structures will be designed in accordance with NFPA 780. Air terminals or other lightning protection devices (as specified by NFPA 780) will intercept the lightning discharge and provide a low-impedance path to ground terminals. Therefore, no significant damage to the facility and no impacts on the important-to-safety design functions will result.

Storage System Features

The accident consequences are no different than those analyzed in the SARs for the storage systems which are being considered for the CISF. The arrangement of storage casks in the storage area and any required structures will be considered in the design of the site so that the requirements of NFPA 780 are met with regard to lightning protection. No impairment of thermal or other important-to-safety functions of the storage systems will result from a lightning event.

12.1.6.4 Corrective Actions

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

12.1.7 Loss of External Power

This event involves a total loss of external AC power, short term or long term, to the CISF. The duration of the power loss depends largely on the initiating event and the time required to restore the power supply circuit.

12.1.7.1 Postulated Cause of Event

The loss of external power could result from either an open or a short-to-ground circuit (or any other mechanism) which produces a disruption in the electrical circuits supplying power to the CISF. This event is postulated to occur as a result of an external event (e.g., lightning or extreme wind) or an internal event (e.g., fire). There are many possible causes of a loss of external power, including the off-site failure of the transmission system supplying the power to the CISF, as well as failures due to local on-site conditions.

12.1.7.2 Detection

A loss of power event in the transfer facility would be detected immediately by facility workers due to the loss of interior lighting, HVAC system shutdown, and the loss of crane and robotics operations. A loss of power in the storage area would be detected by the momentary loss of security lighting and the start-up of the backup security diesel generator.

12.1.7.3 Analysis of Effects and Consequences

Facility Features

The loss of electrical power impacts operations in the transfer facility. The primary impact is the inoperability of the two bridge cranes used to maneuver the transportation and storage casks and their associated equipment. A loss of power in the transfer facility temporarily halts the receiving of casks and transferring of canisters. To prevent the occurrence of a cask drop, the cranes are designed to be fail-safe in the event of loss of power, so that the load cannot be dropped or moved inadvertently.

Loss of external power also causes the area radiation monitoring instrumentation and the transfer facility unit vent monitor to become inoperable. The loss or failure of the radiation monitoring instrumentation, as described in Section 12.1.3, does not result in significant occupational radiation exposure or significantly impact important-to-safety functions. Administrative procedures require that further canister transfer operations or other operations involving radioactive materials be halted until power is restored.

Loss of external power will result in HVAC system shutdown. However, the loss of HVAC does not impact any important-to-safety functions.

Although having no impact on safety functions, the CISF design includes electrical power backup for the security and fire protection systems.

This event has no radiological safety implications. It simply results in a delay in transportation cask unloading and canister transfer operations in the transfer facility. The loss of external power during canister transfer operations does not result in any radioactive release or loss of critical safety functions.

Storage System Features

Since the various storage casks or modules are designed for passive interim dry storage without electrical power, there are no radiological consequences or impacts on other important-to-safety functions from this event.

However, to provide added assurance of the continued functioning of the SNF confinement and heat removal systems for the storage casks, the design of the storage cask monitoring system has considered the loss-of-power event. As described in Chapter 4, the storage cask monitoring system is backed up by an Uninterruptible Power Supply (UPS) system upon loss of off-site power, to provide for an orderly shutdown of the computer and ensure that computer data containing storage cask pressure and temperature records are not lost. If the expected duration of the loss-of-power event is to exceed 24 hours, an off-site contractor is contacted to bring in a portable diesel generator to power the storage cask monitoring system and other CISF requirements. The loss of pressure and temperature indications until the portable diesel is activated is not expected to exceed 24 hours, which is comparable to the surveillance intervals for the cask monitoring system.

12.1.7.4 Corrective Actions

Upon a loss of external power, CISF personnel will trace the source of the loss of external power and initiate corrective actions to restore power. If the damage to the power grid is determined to be outside the site boundary, the local utility is contacted to determine the expected time that power is expected to be restored. If the duration of the power loss is expected to exceed 24 hours, then an off-site contractor will be contacted to supply a portable diesel generator to connect to the 5 kV electrical switchgear. This will provide power to the cask monitoring system and to other required systems.

12.1.8 Off-Normal Ambient Temperature

This event consists of two scenarios, each expected to occur less than once per year and result in either extremely low ambient temperatures combined with no solar insolation, or extremely high ambient temperatures combined with full solar insolation. Values for the extreme low and high temperatures and the solar insolation are site-specific. For the CISF, values for these parameters have been established to encompass most of the potential CISF sites in the contiguous United States. This event affects only external SSCs at the CISF.

12.1.8.1 Postulated Cause of Event

This event is a natural phenomenon expected to occur less than once per year. The duration of this event is 12 hours, which is the duration of the application of the solar insolation. Although it is unlikely that these loadings would be sustained for more than a couple of hours, the 12-hour duration provides for a conservative analysis (i.e., a steady-state analysis as opposed to a transient analysis).

12.1.8.2 Detection

Observation of regional meteorological data should indicate when this event has occurred.

12.1.8.3 Analysis of Effects and Consequences

The effects produced by this event involve either a temperature increase or decrease to external SSCs at the CISF.

Facility Features

No facility features are required. However, the transfer facility is equipped with HVAC for personnel comfort.

Storage System Features

Each storage cask system used in the CISF storage area must be able to operate under these extreme ambient temperatures without impacting important-to-safety functions.

12.1.8.4 Corrective Actions

Since there are no radiological releases or adverse consequences to the important-to-safety functions as a result of this event, no corrective actions are required.

12.1.9 Vehicular Impact

Vehicular impact is postulated to occur either in the transfer facility or in the storage area. It is 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. It is caused by equipment failure, operator error or a natural event.

In the transfer facility, vehicular impacts are limited to those vehicles which enter the facility: site locomotives, site cask transporters, site tractors, flatbed trailers, site transfer trailers and flatbed rail cars. The site locomotives, site tractors, flatbed trailers, site transfer trailers and flatbed rail cars enter and exit only through the receiving bay of the transfer facility. The site cask transporters enter and exit through either the receiving bay or the transporter bay. In the storage area, potential vehicular impacts are limited to site cask transporters, site tractors, site transfer trailers, and vehicles used by site personnel (e.g., security vehicles).

12.1.9.1 Postulated Cause of Event

Vehicular impact is postulated to occur either in the transfer facility or in the storage area due to operator error, mechanical failure (runaway), or a natural event (e.g., an earthquake). It results in 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 site cask transporter, or a vehicle used by site personnel.

12.1.9.2 Detection

This event is visually detected by CISF site personnel. In addition, easily identifiable visual evidence, such as dents or scratches on casks, on-site vehicles, and other CISF SSCs would indicate that a vehicular impact has taken place.

12.1.9.3 Analysis of Effects and Consequences

Protective barriers and administrative procedures are in place to minimize the consequences of a vehicular impact event and, in many cases, prevent this event from occurring. In addition, the limited stretches of straight roads or paths at the CISF minimize the potential for acceleration beyond posted speed limits.

Facility Features

CISF facilities are designed to sustain the impact of a large tornado generated missile. Therefore, a site speed limit is conservatively established from the speed and weight of this missile and the weight of the heaviest on-site vehicle, so that any damage caused by a vehicular impact at the CISF is conservatively bounded by the damage caused by the large tornado missile.

To prevent potential interactions between the site locomotive and a flatbed rail car or a flatbed trailer in an active receiving bay, a physical/retractable barrier is placed on both ends of the track leading into and out of the active bay, and administrative procedures prevent any activities along that track. Administrative procedures and physical barriers prevent operations from occurring in adjacent receiving bays in the transfer facility when a cask must pass through that bay either on the crane, a site cask transporter, or a site transfer trailer. In addition, the conservatively low speed limit for site locomotives and other site vehicles prevents most vehicular impacts and minimizes the damage produced by any accidents which may occur in the adjacent receiving bays.

If the flatbed trailer or the transfer trailer is misaligned as it is pulled into the transfer facility, it may impact the transfer facility. Impact of either of these trailers on the transfer facility produces minimal damage and is quickly recognized, preventing further damage from occurring. Since the casks on these trailers do not hang over the trailer sides, an impact with the transfer facility does not cause any damage to a cask.

Storage System Features

With the above procedures and barriers in place, vehicle impacts cannot cause significant damage. The damage produced by an impact is bounded by the damage produced by the impact of a large tornado generated missile (e.g., loss of shielding). No loss of confinement or significant dose is expected as a result of this event.

12.1.9.4 Corrective Actions

A cask impacted by an on-site vehicle must be externally inspected after the event. Casks not suffering from structural damage or elevated dose rates do not require any further action. Damage which may occur is expected to be to the external shield or to the outer cask surface. These casks may require temporary shielding until the external shield can be permanently replaced or repaired, and they may be required to be moved to the off-normal cask holding area for repair by a contractor. In some cases, casks containing transferable canisters may be required to be transferred to another unit (preferably a storage unit), and the damaged unit either sent off-site for repair, or decommissioned.

12.2 ACCIDENTS

This section provides the results of analyses of events categorized as Design Events III and IV from American National Standards Institute/American Nuclear Society (ANSI/ANS) 57.9-1992 (Ref. 12.1-1). Type III design events occur infrequently, but could reasonably be expected to occur once during the lifetime of the CISF. Type IV events include those low probability design-basis accidents which are hypothesized because they may result in maximum potential impact to the surrounding environment. These events establish a conservative design basis for SSCs important to safety and confinement. They include such credible bounding natural phenomena as earthquakes, tornados and hurricanes.

The consequences of these events have a potential impact on important-to-safety functions. The radiological effects on both personnel within the controlled area boundary and the general public located at the boundary are also noted. The accident events analyzed in this section are listed in Table 12.2-1. The table also provides an indication of whether these events are specifically applicable to the vendor storage systems and/or the CISF SSCs. The level of description and analysis of each DBE which follows is dependent on the uniqueness of the event to the CISF.

In the following sections, a description of the accident event, its postulated cause, analysis of its effects and consequences including design and administrative procedures which help to prevent its occurrence or mitigate its consequences, and corrective actions to recover from the event are given for each of the 13 events.

Table 12.2-1. Accident Events

Event	**Design Event Type**	**Applicability**
Full blockage of air inlets/ outlets	III	Vendor storage systems CISF facility
Drop accident	III	Vendor storage systems CISF facility
Earthquake	IV	Vendor storage systems CISF facility
Explosion	IV	Vendor storage systems CISF facility
Extreme/tornado winds	III & IV	Vendor storage systems CISF facility
Failure of primary confinement boundary	III	Vendor storage systems CISF facility
Fire	III	Vendor storage systems CISF facility
Flood	III	Vendor storage systems CISF facility
Loss of confinement	IV	Vendor storage systems
Loss of shielding	IV	Vendor storage systems CISF facility
Pressurization	IV	Vendor storage systems
Tipover/overturning	IV	Vendor storage systems CISF facility
Tornado missiles	IV	Vendor storage systems CISF facility

12.2.1 Full Blockage of Air Inlets/Outlets

This event involves complete blockage of storage cask or storage module air inlets and outlets while the cask or module is in the storage area. This event is considered a design basis accident for cask systems which have inlets and outlets for natural air circulation. It is expected to last for the duration between successive monitoring intervals, which is dependent on the expected temperature characteristics of each cask system.

12.2.1.1 Cause of Accident

This event may be initiated by strong blowing winds; a very large sand, snow or ice storm; an avalanche; a flood; or a landslide. Each of these conditions may produce a buildup of debris, including several large pieces of blowing paper or plastic, a large sand drift or a significant accumulation of other debris around and over the storage cask or storage module, potentially blocking the air inlets and outlets. The 100% vent blockage event is considered a highly unlikely situation due to the great distance between the inlet and outlet vents.

12.2.1.2 Accident Analysis

Cask systems with air vents must be designed for a complete blockage of these vents.

Facility Features

Temperature readings are monitored as required for each cask system. In addition, regular visual inspections are made to verify that the cask air vents are clear from any obstructions. Administrative procedures will be written to ensure that materials that could become a problem are kept out of the storage area.

Storage System Features

The principal effects and consequences from this event are dependent on the type of cask system. In general, once the vents have been blocked, the temperatures throughout a storage system are expected to increase due to the complete loss of the natural circulation used to cool the canister containing the spent fuel. Each cask vendor with air inlets and outlets must analyze for this accident event, and from their analysis determine the time intervals required to clear any blockage.

12.2.1.3 Accident Dose Calculations

There are no radiological releases or adverse consequences to the important-to-safety functions as a result of this event. See the vendor SARs for additional information. Recovery operations include manual inspection of the blocked vent or vents, and removal of the blockage. This requires personnel to access the area around the cask or module for a short period of time. The occupational exposure associated with this activity should be small, given the expected frequency of the event, the relatively short period of time to remove the blockage, and the radiation fields to be expected. Those cask systems where exposures are expected to be greater will require more extensive ALARA techniques, including use of long-handled tools and temporary shielding.

12.2.2 Drop Accident

This event involves the dropping of 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.

12.2.2.1 Cause of Accident

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's equipment may also lead to a cask, canister or lid drop event.

The probability of a cask or lid drop has been minimized by the design of the crane and the rigging which meet the safety margins suggested in NUREG-0612. Other non-crane lifting equipment is also designed by the vendors to minimize the potential of a drop by providing straps or other devices to secure casks, both during and after lifting or lowering operations.

12.2.2.2 Accident Analysis

Each cask/canister lifted or lowered at the CISF must be designed for a drop from its maximum credible height which is specific to the cask system type. The only cask lid drops which can produce damage to a canister occur during vertical canister transfer, when the lid is removed from the loaded transportation cask and when the lid is replaced on the loaded storage cask.

Facility Features

The transfer facility cranes and non-vendor supplied rigging are designed and operated in such a manner that the probability of a drop event has been significantly reduced. The cranes and rigging are designed to meet the guidelines of ANSI N14.6 (Ref. 12.2-1) and NUREG-0612 (Ref. 12.2-2) for the lifting of heavy loads. In addition, since many of the lifting devices are unique to each vendor system, the equipment is clearly labeled and easily identifiable to the crane operator. Operational controls are also used to restrict and monitor lift heights and verify clearance and load paths.

For vertical canister transfers, damage due to lid drops is minimized by raising a lid a maximum of six inches above a cask and moving it laterally. In addition to controlling the lift heights, the crane is equipped with a load sensor. This sensor alerts crane operators to significant load changes caused by canister "hang-up" during vertical transfer or by raising a canister to a height that causes the transfer cask to become slightly lifted during vertical transfer.

To recover a dropped cask, the transfer facility robotics and video system can be used to remotely inspect the casks. Temporary shielding can be provided for cases resulting in some loss of shielding. In addition, for all canistered systems, canisters can be transferred out of dropped casks.

Storage System Features

Each of the cask systems used at the CISF is designed to withstand a drop from the maximum credible drop height specified in Chapter 3 of this TSAR. For this event, "designed to withstand" is defined as no impact on important-to-safety functions except the following: A partial loss of shielding and confinement system deformation is allowed to the extent evaluated in the reference vendor SARs.

In addition, the site transporters, site transfer trailers, upender/downenders, intermediate lifting devices, and yokes/rigging (all vendor-supplied equipment) must be designed to minimize the probability of a drop event and restrict lift heights to analyzed conditions.

12.2.2.3 Accident Dose Calculations

Due to the cask system designs, the consequences of this event are bounded by the loss of shielding, tornado missile, and loss-of-confinement events presented in this TSAR. Thus, no additional calculations are provided here.

Recovery of a dropped cask in the transfer facility can be performed mostly with the robotics, crane and video system of the transfer facility. Transfer facility personnel may accumulate some additional dose beyond what is normally received while making simple repairs to a dropped cask. The occupational exposure associated with this activity should be small given the expected frequency of the event, the relatively short period of time required to repair the cask, and the radiation fields to be expected. Exposures expected to be greater will require more extensive ALARA techniques, including use of long-handled tools and temporary shielding.

12.2.3 Earthquake

The CISF must be able to endure the consequences of a design-basis earthquake which has a design response spectra anchored at a horizontal acceleration of 0.75 g. This earthquake is applied at the structure foundation.

12.2.3.1 Cause of Accident

An earthquake is a natural event that can occur at any time at the CISF and during any stage of a transfer or storage operation involving a cask or a canister.

12.2.3.2 Accident Analysis

All QA 1, QA 3, and QA 5 SSCs are designed for the ground motions caused by this earthquake. The effect of a seismic event on all other SSCs has no impact on important-to-safety SSCs.

Facility Features

The transfer facility superstructure is designed to withstand the effects of the design-basis earthquake. The cranes in the transfer facility are designed to accommodate seismic loadings while loaded with the heaviest cask. In addition, assurance is made that the cranes remain on their rails throughout a CISF earthquake event. Thus, the transfer facility cranes have been designed to sustain the design earthquake without any increase to the probability of a drop event.

Since there are no surface faults assumed at the CISF, lift and settlement of the soil are unlikely to be significant and, hence, significant tilting of a storage pad is unlikely. The large size of the pad for vertical storage casks reduces the probability of a cask sliding off of the edge of the pad and the probability of a cask sliding into another cask.

Storage System Features

Storage, transportation and transfer casks found in the transfer facility loaded with SNF must either be designed not to tip over due to the design-basis earthquake or be restrained to seismically designed equipment at all times. In the transfer facility, this equipment includes transfer skids (vendor designed), upender/downenders (vendor designed), vertical transfer platforms (vendor designed) and transfer facility cranes. In addition, the vendor designed upender/downenders and transfer skids used for horizontal canister transfers must be designed not to collapse or significantly move during a seismic event. This seismic design prevents damage to a canister which is being horizontally transferred during a seismic event.

Site transporters and site transfer trailers used to transport casks from the transfer facility to the storage area must be designed by the cask vendors not to overturn due to the CISF design earthquake.

Storage casks and storage modules in the storage area must be designed not to tip over due to a seismic event.

12.2.3.3 Accident Dose Calculations

There are no radiological releases or adverse consequences to the important-to-safety functions as a result of this event. In addition, cask systems undergoing transfer operations when an earthquake strikes are not adversely affected by this event, as vendor transfer equipment is designed for this event. Nevertheless, prior to the initiation of any canister transfer operations, the alignment of a cask system must be reverified after a seismic event.

12.2.4 Explosion

This event involves an off-site or an on-site explosion which may damage important-to-safety SSCs at the CISF. Each explosion type can be caused by several different postulated scenarios. The effects produced by an explosion may be an incident or reflected pressure (overpressure), dynamic (drag) pressure, blast-induced ground motion, and blast-generated missiles.

12.2.4.1 Cause of Accident

The potential scenarios which 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 which 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, and 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.

12.2.4.2 Accident Analysis

Guidance provided in Regulatory Guide 1.91 (Ref. 12.2-3) is used to limit the proximity of a potential explosion to QA 1 SSCs. Satisfying these guidelines ensures that an accidental explosion does not produce an overpressure of greater than 1 psi.

The consequences of an explosion may include an incident or reflected pressure (overpressure), dynamic (drag) pressure, blast-induced ground motion, and blast-generated missiles. For explosions of the magnitude considered in Regulatory Guide 1.91, the NRC judges overpressure effects to be controlling. For smaller explosions, the pressure effects are bounded by the tornado wind criteria, the blast-induced ground motions are bounded by the earthquake criteria, and the blast-generated missiles are bounded by the tornado missile criteria established for the CISF site.

To prevent an explosion from causing an overpressure of greater than 1 psi, Regulatory Guide 1.91 recommends maintaining a specified distance from an explosion source. This distance can be determined from the TNT equivalent weight of a potential explosive material and the following formula:

$$R \geq k\ W^{1/3}$$

R is the distance (in feet) from an exploding charge of W pounds of TNT and k (an experimentally measured coefficient) has been determined to equal 45. Results from this expression for accidents involving hazardous solid and vapor loads are shown in Figure 12.2-1.

Figure 12.2-1 is used to determine the minimum distance required between a potential explosion source and the transfer facility or the storage area. Off-site transportation, industrial and pipeline accidents will be considered when a specific site has been identified. The proximity of on-site tanker trucks and fuel tank(s) to the transfer facility and storage area depends on the mass of fuel contained in these tanks and the TNT equivalent of the fuel. Note that the vapor phase of some materials is a more explosive agent than their solid or liquid phase (e.g., diesel fuel) and, hence the appropriate line in Figure 12.2-1 must be selected.

At the CISF, there are four areas where a potentially explosive agent can be found: the backup security power generator diesel fuel tank and day tank; the backup fire pump power generator day tank; the on-site vehicle refueling area; and the areas containing on-site welding gas. The small size of the two day tanks precludes them from causing a significant explosion. In addition, only a limited amount of welding gas is allowed on-site, precluding it from being a serious explosion threat. However, the backup security fuel tank holds 1,000 gallons of diesel and the on-site vehicle refueling area is serviced by a 2,000-gallon tanker truck provided by off-site suppliers.

Facility Features

From Figure 12.2-2, the minimum distances required between diesel fuel and the CISF transfer facility and storage area at room temperature, and the maximum and minimum temperatures allowed at the CISF are shown. The 1,000-gallon diesel fuel tank is located a minimum of 150 feet from the transfer facility and a minimum of 700 feet from the storage area. These distances satisfy the minimum distances specified by Regulatory Guide 1.91, as shown in Figure 12.2-2. Similarly, to satisfy Regulatory Guide 1.91, the on-site refueling area serviced by the 2,000-gallon tanker truck is located a minimum of 200 feet from both the transfer facility and the storage area.

By satisfying Regulatory Guide 1.91, the proximity of on-site and off-site explosions cannot cause an overpressure of greater than 1 psi. The transfer facility is designed for this event, as it allows the roll-up doors to blow out in order to limit building internal pressure to 1 psi.

Storage System Features

By satisfying Regulatory Guide 1.91, the proximity of on-site and off-site explosions cannot cause an overpressure of greater than 1 psi. 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 event of 1 psi.

12.2.4.3 Accident Dose Calculations

There are no radiological releases or adverse consequences to the important-to-safety functions as a result of this event.

12.2.5 Extreme/Tornado Winds

A tornado wind and an extreme wind are postulated to occur during a tornado, hurricane, sandstorm or intense thunderstorm. This event is associated only with the effects produced by these winds (i.e., the pressure drop and the wind load). Tornado missiles are evaluated in Section 12.2.13. The characteristics of the design basis tornado and extreme wind are described in detail in Chapter 3.

12.2.5.1 Cause of Accident

The winds and pressure differentials are associated with natural meteorological events such as tornados, hurricanes and sandstorms.

12.2.5.2 Accident Analysis

All important-to-safety SSCs exposed to tornado and extreme winds are designed for the pressure drop and wind loads associated with these events.

Facility Features

The wind load of the design-basis tornado and extreme wind is not capable of overturning the CISF transfer facility. Calculations of the overturning moments for the transfer facility due to wind load are examined in Section 7.4. The roll-up doors of the transfer facility are designed to blow out in order to limit building internal pressure to 1 psi. Section 7.4 shows how the pressure drop is handled by the transfer facility.

Storage System Features

The wind load of the design-basis tornado and extreme wind is not capable of overturning any of the storage casks at the CISF. The analysis of the ability of the vendors' storage systems to mitigate the impact of a design-basis tornado and extreme wind is documented in their respective safety analysis reports. The pressure drop associated with the passing of a tornado does not adversely affect any of the storage casks used at the CISF.

After being subjected to an extreme wind or tornado wind load, all storage cask and module air vents must be inspected and cleared of any debris. In addition, a functional verification of the operability of the containment monitoring system (pressure transducer monitoring of the interlid pressure) and alarm board panel will be performed. Repair of any damage to the pressure transducers or the alarm board indication will be performed as necessary.

12.2.5.3 Accident Dose Calculations

Since the transfer facility and vendors' storage systems are designed for this event, there are no radioactive releases or other adverse consequences to the important-to-safety functions.

12.2.6 Failure of Primary Confinement Boundary

This event is postulated to occur for bolted cask closure systems (e.g., the NAC STC System) in the storage area of the transfer facility, when leakage of radioactive gases from the fuel basket occurs past failed primary confinement boundary seals through a single outer-lid seal to the environment. The NAC STC System has a dual-lid design providing a redundant cask closure system and protection of the vent and drain ports incorporated into the inner lid. The primary confinement boundary for the NAC STC System 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 both dual metallic o-ring seals on one of the primary confinement barriers (inner lid, vent/drain port or pressure port) and failure of the storage cask confinement monitoring system are necessary in order for this event to take place. See the NAC STC System TSAR (Ref. 12.2-4) for more details on the lid arrangement and confinement boundaries.

12.2.6.1 Cause of Accident

The failure of both redundant metallic o-ring seals associated with one of the primary confinement barriers may be caused by mishandling during handling, transfer, transport and/or storage operations and by other severe accident events (cask drop, earthquake, etc.). This is a low probability event because it requires failure of two redundant metallic o-ring seals associated with the primary confinement boundary and the failure of the cask confinement monitoring (pressure transducer in the interlid cavity) system.

12.2.6.2 Accident Analysis

The effects and consequences of this accident event are bounded by the hypothetical loss-of-confinement accident. The consequences of the failure of the primary confinement boundary are no different than presented in the NAC STC System TSAR. The failure of the primary confinement boundary assumes the release of helium cover gas and gaseous radionuclides from 10% failed spent fuel rods in the cask cavity past a single o-ring seal in the outer lid. The radioactive gases are assumed to leak at the maximum permissible cask seal leakage rate. For the NAC STC, the design criterion for each seal is a leakage rate not to exceed 2.2×10^{-5} std-cm^3/sec, the basis for which is the allowed leakage during normal conditions of transport under 10 CFR Part 71. It should be noted that any leakage through or by the remaining cask seal is at a very slow rate, so no immediate hazard is present. The radiological consequences are defined by the leakage rate, and the quantity and characteristics of the enclosed fuel in the cask cavity.

Facility Features

During storage, the monitoring of the pressure in the region between the inner and outer lids is done on a regular frequency, as specified in the vendor SAR and summarized in Chapter 14.

Storage System Features

The design features of the NAC STC confinement system help to prevent the occurrence of this event. To ensure that radioactive fission gases from the cask cavity do not escape to the outside environment during storage, the interlid region is prepressurized to 7.7 psig and a pressure transducer in the interlid region monitors the pressure and alarms if it drops below the setpoint. In addition, the design of the primary confinement boundary includes dual metallic o-rings to prevent releases of radionuclides and to provide the capability to test the seal effectiveness of the inner lid.

12.2.6.3 Accident Dose Calculations

The dose resulting from this event was analyzed by the vendor in its TSAR submittal (Ref. 12.1-2). The important-to-safety functions which may be affected by this event are the limited loss of SNF confinement, radiation protection and SNF retrievability. The dose from krypton-85 and the dose from tritium was combined in the NAC STC System TSAR to obtain the total dose rate from gaseous release from the postulated leaking cask. The total dose resulting from this postulated 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. Because of the low rate of leakage and resulting small dose, the impact on the radiation protection function is also insignificant. However, corrective action at the CISF facility must be undertaken to replace the damaged seals or otherwise restore the SNF confinement.

Recovery action must be initiated within the time frame specified in the vendor TSAR. Upon detection of an alarm indicating seal leakage, site personnel will assess the functionality of the interlid pressure monitoring system. If the pressure monitoring system is functioning correctly, then failure of either the inner lid or outer lid seals has occurred. The suspect NAC STC cask is moved from the storage area to the transfer facility for leakage assessment. If the inner lid seals are determined to have failed, then several options exist for recovery, depending on the severity of the leak. If the leak is small, it may be possible to simply repressurize the interlid region. For larger leaks involving a 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. Recovery actions ensure that SNF confinement is restored.

12.2.7 Fire

A credible fire accident exposing SSCs important to safety, either during handling at the CISF transfer facility or during cask transporting, is possible but not probable. Typical fires that may occur include trash fires, vehicle fires, diesel fuel fires and electrical fires. Other fires that may be considered as site-specific, such as forest fires, accidents occurring on nearby highways, or accidents at nearby highly-flammable industrial complexes with potential long-term thermal radiation effects, will be analyzed after site selection. Since all flammable and combustible materials are controlled and limited within the CISF transfer facility and on-site, and since the cask systems important to safety for SNF storage are constructed of non-combustible materials, only minor fires of short duration are expected.

12.2.7.1 Cause of Accident

A credible fire accident within the CISF transfer facility or on-site may be initiated by the ignition of oil leaking from the diesel fuel storage tank, trash, hydraulic fluid, solid radwaste vehicle diesel fuel and/or electrical insulation/equipment.

12.2.7.2 Accident Analysis

A fire at the CISF is limited in magnitude and duration since the amount of fuel is limited. In addition, the CISF has appropriate equipment and trained personnel to effectively handle any fire event.

Facility Features

Portable fire extinguishers or, in the transfer facility, fire hoses are provided to extinguish any credible CISF fire. In addition, the building fire detection system has a dedicated UPS sized for 24-hour service, and the fire protection system has a diesel-driven backup pump in case of a power loss.

A fire involving slightly contaminated solid radwaste in waste containers in the transfer facility will result in radioactive releases which never exceed the releases evaluated for normal operations in Chapter 9. The small volumes and low concentrations of radwaste stored in steel containers at the CISF prevent excessive releases due to a fire. In addition, the steel waste containers are covered when not in use, preventing exposure to fire initiators.

Storage System Features

The effects of a credible CISF fire accident on a storage or transportation cask would be negligible since the casks are designed and constructed of non-combustible heavy-section concrete and high-temperature metal sections. These heavy section structures would afford high heat capacity and dissipate heat rather quickly, minimizing significant localized temperature rises. No consequences would be expected from such a credible fire event although, as a matter of site practice, subsequent radiological surveys followed by visual inspections and instrumentation testing would ensure that no damage to the structures nor radiological release had occurred. The necessary reporting of the accident would be implemented in accordance with 10 CFR 72.75 requirements.

12.2.7.3 Accident Dose Calculations

There are no radiological releases or adverse impacts on important-to-safety functions due to a credible CISF fire event not involving slightly contaminated solid radwaste. Fires involving site-generated waste will not result in releases greater than those expected during normal operations.

12.2.8 Flood

Sources of water from both the facility itself (e.g., from the decontamination tank and from the fire protection system) and from natural hazards may affect operations at the CISF and present a hazard to personnel. As identified in Chapters 2 and 3, all CISF QA 1 SSCs are located above the probable maximum flood level: hence, natural flood effects are not considered in this analysis.

12.2.8.1 Cause of Accident

Floods may be caused by a variety of sources external to the CISF, including a dam break upstream of a nearby river or lake, a seiche, a tsunami, a hurricane, a high river stage, a high lake level, a high tide, a landslide, an avalanche, a snow melt, intense precipitation, or a storm surge. However, for the CISF generic site, all QA 1 SSCs are located above the maximum probable flood level.

Several sources of on-site water could cause an uncontrolled release of water onto and possibly inside CISF SSCs. A puncture or breach of the fire protection system piping or the decontamination tank (inside the transfer facility) could cause a localized flood. An internal flooding event could be caused by an earthquake or an impact into pipes or tanks by a transporter vehicle, or by a piece of cask handling equipment moved by an overhead crane.

12.2.8.2 Accident Analysis

Since the CISF design is based on locating QA 1 SSCs at an elevation above a postulated design-basis flood plane, there is no need to consider the external sources of flooding.

The CISF design does not preclude floods produced by internal events. However, the volume of water available from on-site sources is not sufficient to cause concern with regard to radiological safety.

Facility Features

All QA 1 SSCs are at an elevation above a postulated design-basis flood plane. In addition, the transfer facility has a waste water system which collects and drains water from an internal flood event. This collected water is sampled and tested before it is released to a vendor for disposal.

Storage System Features

Each of the cask vendors has analyzed its casks for tipover/overturning and hydrostatic pressurization due to a flood event. All casks are able to withstand the maximum static pressures exerted on the cask when completely submerged in water. At the CISF, there is an insufficient volume of water available to cause tipover or overturning and submersion of the entire cask on the flat site.

12.2.8.3 Accident Dose Calculations

There are no radiological releases or other impacts on important-to-safety functions associated with this postulated accident.

12.2.9 Loss of Confinement

The loss-of-confinement event is postulated to occur when redundant seals or welds on one canister/basket containing SNF fail and release radioactive fission products. Only gaseous fission products are considered to be released from the facility, since solid fission product particles either would not escape in significant quantities or would be deposited in the immediate vicinity of the release point. To create a bounding design-basis accident, a non-mechanistic failure of all the fuel rods in a cask/canister is assumed, coupled with a subsequent release of the free (non-entrained) fission product gases. It should be noted that this is not a credible event. It is analyzed because the consequences calculated for this analysis will result in the maximum radiological impact to the immediate environment.

12.2.9.1 Cause of Accident

There is no credible mechanism which would result in the complete failure of all fuel rod cladding and the failure of the confinement boundary. Failure of the confinement boundary could be caused by a cask drop accident. There are no other credible personnel-caused hazards or natural phenomena which can cause a complete failure of the confinement boundary of the storage canisters and casks. This event is postulated in order to establish a conservative design basis for the CISF.

12.2.9.2 Accident Analysis

The analysis of the loss-of-confinement accident is specific to each of the vendor storage systems. Upon a complete failure of the confinement boundary with 100% failure of the fuel rods, all free fission product gases are assumed to be released to the environment. Not all fission product gases are available for release from the fuel; only those which have migrated to the fuel-cladding gap are assumed to be released upon cladding failure. The remainder of the fission product gases are entrained in the fuel pellet matrix.

Facility Features

No CISF effluent mitigation features are required to ensure that releases are less than the accident criteria of 10 CFR 72.106.

However, for personnel protection, air samples are drawn from the cask through a particulate filter, sampled and analyzed prior to removal of the cask lid. The continuation of the canister transfer process is based on the findings from the analyzed filter.

Storage System Features

All storage system vendors consider this event to be non-credible because of the robust design of the storage and transportation casks. They must survive hypothetical accident conditions with no significant loss in confinement capability.

12.2.9.3 Accident Dose Calculations

The consequences resulting from a loss-of-confinement event have been analyzed by each of the storage system vendors in their respective SARs. The consequences depend on the type of fuel assemblies (PWR or BWR), the quantity of fuel which is contained in the cask/canister, its burnup characteristics, and the amount of time elapsed since the fuel assemblies have been removed from the reactor core. The six storage and transportation systems being considered for the CISF assumed conservative design-basis fuel assembly characteristics in order to provide a design that would envelop all expected fuel contents.

The consequences of a loss-of-confinement design-basis accident for all of the storage systems are below the radiological dose acceptance criterion of 5 rem to the whole body or any organ received by any member of the public at the controlled area boundary.

The impact of this event on the CISF design is limited to verification that the closest distance from the storage area to the controlled area boundary at the CISF is greater than or equal to that analyzed by the vendors in their analysis of this event. Since all vendors of storage systems considered for the CISF found that the radiological consequences were acceptable at distances less than that proposed for the CISF, there is no further impact on the design of the CISF facility.

Since this is not a credible event, no corrective actions need to be specified. However, for defense in depth the following recovery actions show that the facility satisfies recovery criteria.

Canister-Based System Recovery

For vendor cask systems that store SNF in sealed canisters, recovery of a suspect canister is accomplished by retreiving the suspect canister from the storage area and taking it into the transfer facility for corrective action. Systems provided within the transfer facility for normal SNF canister transfer operations are also used for recovery operations. Once the suspect canister is in the transfer facility, the canister is transfered from its storage or transfer cask to a transportation cask or other storage overpack approved for storage confinement system recovery. This procedure applies to all of the cask/canister vendor systems. Once the suspect canister has been transfered to an approved confinement recovery overpack, it can be returned to storage subject to the monitoring requirements of the recovery system. Another alternative which may be available is to transfer suspect canisters to an approved transportation cask for subsequent shipment to a facility capable of further recovery operations. These operations may involve repairing the suspect canister or transferring the individual SNF assemblies into another canister.

Cask-Based Storage System Recovery

Recovery operations for systems which do not contain a canister involve transferring the suspect cask from storage to the transfer facility for corrective action. Individual SNF assemblies are directly confined within the cask, and SNF confinement is provided by a redundant seal-welded or mechanical closure system.

Seal-welded systems are inspected to determine the source of leakage and are repared using approved procedures. Repairs are performed to re-establish original system design features, such as redundant seal welds, and are performed consistent with original manufacture fabrication standards.

Mechanical closure systems, such as the NAC-STC, are inspected to identify and repair faulted seals. If an NAC STD lid seak is leaking, the cask monitoring system detects the leak and initiates an alarm in the cask monitoring room of the transfer personnel building. In response to the alarm, workers enter the storage area to assess and verify the functionality of the interlid pressure monitoring system. If the interlid pressure monitoring system is functioning properly, then corrective action is necessary to further assess leakage sources and possibly to repair cask closure system seals. The suspect NAC STC is taken into the transfer facility for further evaluation and recovery. If elakage from the interlid region to the environment is confirmed, the following recovery activities are performed.

- Replace faulty seal
- Re-establish closure
- Repressurize interlid region with helium
- Retest interlid region for leakage.

When an outer lid closure system leak is corrected, no further recovery operations are necessary. The cask is returned to the storage area for normal storage operations. The interlid monitoring system is reconnected to the cask, tested and placed into operation.

In cases where leakage through secondary outer-lid closure systems cannot be confirmed, the outer lid is removed and primary closure systems associated with the inter lid are tested. This condition is characterized by interlid region as migrating into the cask interior. The leakage rate into the cask cavity may be sufficiently low to allow an appreciable amount of storage time before the interlid region pressure is equalized with the cavity pressure. In this case, the following recovery operations are performed.

- Reinstall outer lid of the cask.

- Re-establish the interlid region design pressure to the normal operating range by filling the interlid region with more helium.

- Calculate the leakage rate into the cask by performing periodic measurements of the interlid cavity pressure.

- Verify that the leak rate is sufficiently low to allow continued storage and monitoring of the cask before additional recovery actions are necessary.

If the leak rate is determined to be sufficiently large to preclude return to a normal storage condition with enhanced monitoring and maintenance, the condition of the cask is evaluated to determine if the leakage rate is sufficiently low to allow time to acquire facilities necessary to replace the inner lid seals, possibly through adaptation of transfer facility equipment. If so, appropriate preparations are made, and the inner lid seals are replaced. If sufficient time is not available to adapt transfer facility equipment or otherwise provide facilities at the CISF site to replace the seals, then the following recovery operations are performed.

- Seal-weld inner lid.
- Perform helium leak tests of seal welds using the seal test ports.
- Upon successful testing, reinstall outer lid.
- Fill interlid region with helium.
- Retest itnerlid region for leakage.

The cask is returned to the storage area for normal storage operations. The interlid monitoring system is reconnected to the cask, tested and placed into operation.

12.2.10 Loss of Shielding

Design basis events identified in this chapter may have a potential impact on the radiation shielding properties of the transport, transfer and storage casks. The impact on the casks is a partial loss of the cask's shielding capability. This loss is limited to the non-structural shield on the outside of the cask, or a small surface loss or cracking of the concrete shield.

12.2.10.1 Cause of Accident

Partial loss of shielding could be caused by vehicular impact, a cask drop, or a tornado missile. Additional operational events that could reduce the shielding effectiveness (without damaging the cask systems) are failures to properly align the transfer, transport, or storage casks for a canister transfer.

12.2.10.2 Accident Analysis

The cask vendors have analyzed the potential for the removal or loss of partial shielding from their systems. The only impact on important to safety criteria is the impact on radiation protection due to an increase in dose rates.

A radiation monitor alarm may indicate a possible loss-of-shielding; CISF personnel will follow emergency procedures associated with the monitor alarm. This includes immediate evacuation from the affected area to a safe location. Radiation Protection personnel are trained to respond to this emergency, with additional support from Operations working to emergency procedures. In general, the recovery process includes immediate recovery actions to put the cask into a safe position to prevent any additional impacts. The next step would be to define the extent of the impact by taking radiation field measurements with remote monitoring by fixed and movable detectors, and visual observation with CCTV cameras located in the transfer facility. Emergency recovery operations are then planned that include minimizing occupational radiation exposure. Corrective actions will include either repairing/replacing the damaged shield, or transferring the canister (for canister-based systems) to an undamaged cask.

Facility Features

Upon an event which results in loss-of-shielding, area radiation monitors will alarm locally and in the remote operations room indicating high dose rates. Operations personnel will be instructed to follow emergency procedures associated with the radiation monitor alarm. All personnel, except those involved in recovery operations, will be instructed to evacuate the area around the damaged cask to a safe location. As a part of recovery operations, facility equipment will be available on-site to provide alternative shielding capabilities.

Storage System Features

Only the Holtec HI-STAR 100 and the NAC STC storage systems have a separate neutron shielding outer layer on their transportable storage casks. The transportation casks for the Sierra TranStor™, VECTRA NUHOMS®, and Westinghouse Large/Small MPC Systems also have a separate outer layer of neutron shielding which could be damaged during unloading operations in the transfer facility or during transport to the storage area (VECTRA NUHOMS® MP187 only). In addition, the transfer cask for the Sierra TranStor™ System also has an outer layer of neutron shielding. The design features for the vendor transportable storage casks and transportation casks which help to prevent the occurrence of this design-basis accident are provided in their respective SARs for 10 CFR Part 71 and 10 CFR Part 72 compliance.

12.2.10.3 Accident Dose Calculations

No additional shielding analysis is performed for the loss of shielding events. Potential loss of shielding event consequences are limited as defined in the vendor SARs. The vendor analyses indicate that the consequences are limited to a small increase in dose rates. At the CISF, these small increases will not significanly impact occupational radiation exposures due to the use of temporary shielding and remote facilities.

No off-site dose consequences have been estimated for the CISF pertaining to this event, because of the limited duration of the event and the distance to the controlled area boundary.

12.2.11 Pressurization

This event is postulated to occur to SNF storage systems when 100% of the fuel rod cladding ruptures, releasing all of the fuel rod fill gases (primarily helium [He]), and 30% of the fission product gases. The fission product gases, in combination with the fuel rod fill gases, will then exert an internal pressure on the cask/canister. This could cause a potential breach of the canister or cask confinement system if the structural integrity of the cask/canister is compromised.

12.2.11.1 Cause of Accident

There is no known mechanism which would result in the complete failure of all fuel rod cladding. This non-mechanistic event is postulated in order to establish a conservative design basis and to establish the maximum internal pressures which might result from this highly improbable event. This event is only applicable to the storage systems.

12.2.11.2 Accident Analysis

There are no adverse thermal or criticality consequences from the pressurization design basis accident. The structural consequences are evaluated in the storage vendor SARs; they depend on whether the resulting internal pressures inside the cask or canister exceed the design limits for the shell of the canister/cask. The stresses in the canister/cask body and all closure components (lids, etc.), produced by the increased internal pressure resulting from an assumed failure of all the fuel rod cladding, are evaluated and compared with the stress design limits for these components. If the stress from combined pressure, temperature and mechanical loads from all sources produces stresses in the canister/cask and closures that are less than the design limits, then no radiological consequences are associated with this event. If the calculated stresses are greater than the design limits, then leakage and possible gross failure of the confinement vessel components are possible, with a resulting release of radioactive fission gases and particulates from the spent fuel directly to the environment.

12.2.11.3 Accident Dose Calculations

The effects of a pressurization event are unique to each of the different storage systems and have been analyzed in their respective SARs. The structural consequences of a pressurization design-basis accident were evaluated by all of the storage system vendors except for the Holtec HI-STAR 100 cask, and determined to be well within the stress design limits of the canister/cask. All vendors are required to demonstrate this. Therefore, there are no adverse consequences from this event for these storage systems.

12.2.12 Tipover/Overturning

This event involves the tipover of a transportation cask or storage cask/module from a vertical to a horizontal orientation, and the overturning of a transportation cask in the horizontal position on a transfer skid in the transfer facility, storage area, and path from the transfer facility to the storage area.

12.2.12.1 Cause of Accident

CISF and cask design features preclude a tipover event from occurring. In the absence of these features, a tipover is postulated to be caused by an earthquake, a tornado missile impact, a cask-to-cask impact due to crane motion, a rigging or crane failure, a flood or a vehicle impact. An overturning event is postulated to be caused by the failure of a site transfer trailer or a transfer skid to support its load, usually as a result of another initiating event (e.g., seismic event or tornado missile impact).

12.2.12.2 Accident Analysis

Tipovers and overturning events at the CISF are mitigated by cask design, facility design, and operating procedures. See the vendor SARs for a specific tipover analysis.

Facility Features

The limited speed of a crane and the low height at which a cask is moved by a crane in the transfer facility prevents cask-to-cask impact resulting in a cask tipover. Similarly, the limited speed of the on-site vehicles prevents vehicle impact from resulting in a tipover. Tipovers caused by a partial failure of the rigging or of the crane in the transfer facility are unlikely events, based on the design of the crane, the design of the rigging, administrative procedures which prevent mixing of vendor equipment, and training of personnel ensuring the proper rigging setup.

Storage System Features

Storage casks/modules used to store SNF on storage pads are designed not to tip over due to any credible event at the CISF. Hence, for casks/modules on storage pads in the storage area, there are no consequences associated with this event.

Storage casks requiring restraining mechanisms to prevent tipovers, and transportation and transfer casks which may tip over during credible CISF events, must be secured at all times to seismically designed equipment when loaded with SNF. This requires that the transfer skids, upender/downenders, site transfer trailers, vertical transfer platforms and site transporters (all vendor supplied equipment) be seismically designed.

12.2.12.3 Accident Dose Calculations

There are no radiological releases or adverse consequences to the important-to-safety functions, as each cask system shall be designed to prevent tipover or overturn due to credible CISF events.

12.2.13 Tornado Missiles

This event is associated with the consequences of impacts of tornado-generated missiles on CISF QA 1 SSCs. This tornado missile accident evaluation explicitly evaluates the impact of a potential design-basis tornado missile on each cask/canister technology, and also on CISF QA 1 SSCs. Site operating personnel are presumed to have no prior warning before CISF QA 1 SSCs are impacted by a potential design-basis tornado missile. Characteristics of the design-basis tornado missiles can be found in Chapter 3.

12.2.13.1 Cause of Accident

Different size objects are postulated to be picked up and transported by the winds of a design-basis tornado, which is defined in the extreme/tornado wind accident event. These objects impact on the CISF buildings, structures, storage casks and other SSCs exposed to the environment.

12.2.13.2 Accident Analysis

The important-to-safety SSCs vulnerable to tornado missile impact must either be protected from the missiles or designed to withstand a missile impact.

Facility Features

For the transfer facility, tornado missile protection is provided by the reinforced concrete walls and roof that encompass the entire transfer facility. Tornado missiles which could enter the facility through the exterior doors are prevented from entering the canister transfer area by a labyrinth of missile protection walls. In addition, openings in the roof and walls are provided with missile protection barriers where necessary.

Storage System Features

As stated in Chapter 3, each cask system vulnerable to tornado missiles must be designed so that a design-basis tornado missile cannot impact any important-to-safety functions, with the exception of a partial loss of shielding. This may result in higher local dose rates. However, as shown in the vendor SARs, radiation dose rates resulting from a tornado missile impact do not exceed 10 CFR 72.106(b) limits.

In addition, the impact of a design-basis tornado must not cause the site transfer trailers or the site transporters (vendor supplied equipment) to tip over or overturn when hauling a cask loaded with SNF.

After the impact of tornado missile(s), radiological surveys and visual inspections are performed in the storage area to identify potentially damaged storage units. If high local dose rates and/or substantially damaged storage containers are discovered, the damages would be repaired in accordance with approved procedures. These site procedures are based on the repair procedures identified in the vendors SARs.

In addition, after being subjected to tornado missiles, a functional verification of the operability of the containment monitoring system (pressure transducer monitoring of the interlid pressure) and alarm board panels will be performed. Repair of any damage to the pressure transducers or the alarm board indication is performed as necessary.

12.2.13.3 Accident Dose Calculations

There are no radiological releases or adverse impacts on important-to-safety functions of cask systems in the transfer facility. However, in the storage area, a tornado missile impact can locally penetrate or crush the gamma-neutron shielding overpack or locally reduce the concrete cask structural thickness. By design, the consequences of this event are limited to an increase in local dose rate. Inspections after the tornado event identify these losses of shielding, and emergency recovery operations are then implemented to include minimizing occupational radiation exposure and potential for off-site releases. Temporary and alternative shielding can be provided (if needed) without significant occupational exposures.

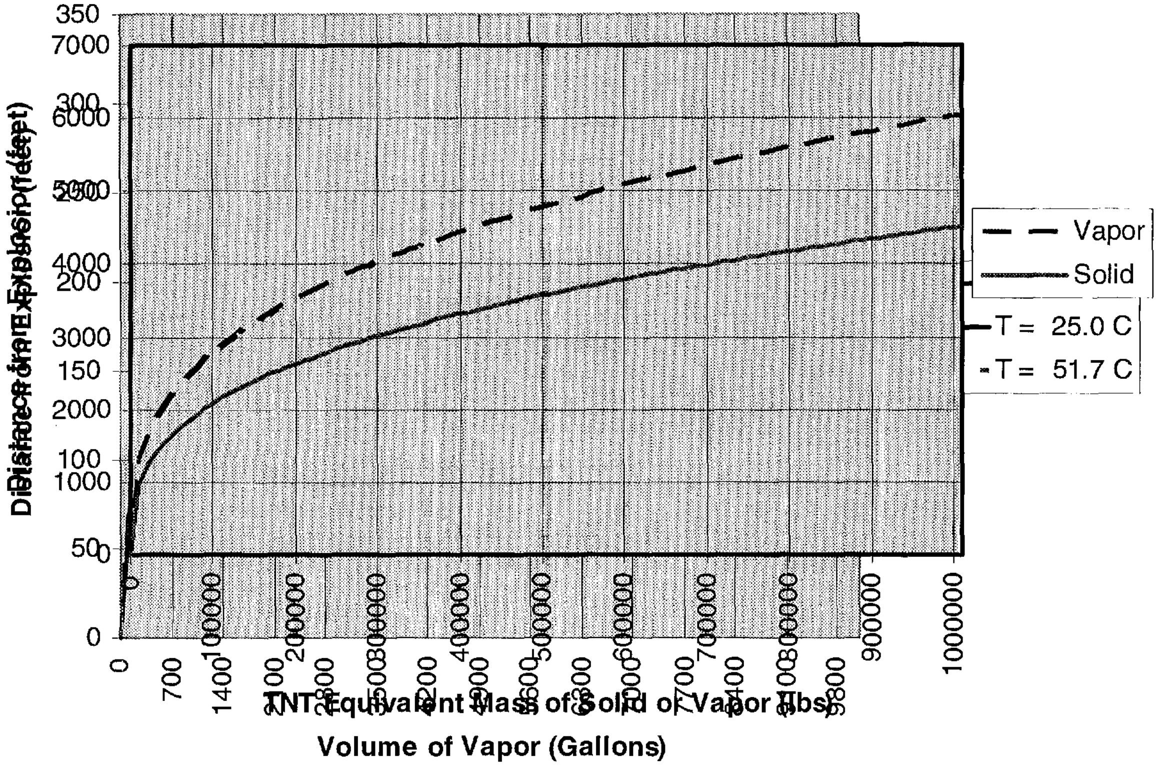

Figure 12.2-1. Bounding Radius to Peak Incident Pressure of 1 psi

Figure 12.2-2. Bounding Radius to Peak Incident Pressure of 1 psi for Diesel Fuel Tanks

12.3 REFERENCES

Section 12.1

12.1-1 ANSI/ANS 57.9-1992. *Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type).* American National Standards Institute and American Nuclear Society. 1992.

12.1-2. NFPA No. 780. *Lightning Protection Code.* National Fire Protection Association. 1992.

Section 12.2

12.2-1. ANSI N 14.6-1986. *American National Standard for Radioactive Materials - Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More.* American National Standards Institute. 1986.

12.2-2. NUREG-0612. *Control of Heavy Loads at Nuclear Power Plants.* U.S. NRC. July 1980.

12.2-3 Regulatory Guide 1.91. *Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants.* Rev. 1. U.S. NRC. February 1978.

12.2-4 NAC-T-90002. *Topical Safety Analysis Report for the NAC Storable Transport Cask for Use at an Independent Spent-Fuel Storage Installation.* Rev. 3. NAC Services Inc. July 1994.

13. CONDUCT OF OPERATIONS

This chapter describes a proposed infrastructure and plan for the management, test and operation of the Civilian Radioactive Waste Management System (CRWMS) CISF. Proposed training and emergency plans are also described. A level of detail typically found in a facility license application has been provided. The intent of this chapter is to provide sufficient information to enable the NRC Staff to make a determination that the proposed DOE and contractor organizations, plans and procedures will satisfy the regulatory requirements related to the facility's conduct of operations.

A subsequent CISF license application could reference the TSAR and the NRC Staff's Safety Evaluation Report (SER) as the bases for the facility's conduct of operations. Any significant revision or change to the facility's conduct of operations from that described in the TSAR or SER would be identified and justified in the license application.

This TSAR seeks NRC concurrence that:

- The TSAR provides an acceptable plan for the conduct of operations. Commitment to this plan in a subsequent license application will satisfy the requirements of 10 CFR 72.24(h).

- The TSAR provides an acceptable description of the program covering pre-operational testing and initial operations. Commitment to this program in a subsequent license application will satisfy the requirements of 10 CFR 72.24(p).

- The TSAR provides an acceptable description of the proposed technical qualifications, including training and expeience, for the DOE to engage in the proposed activities. Commitment to these minimum qualifications in a subsequent license application will satisfy the requirements of 10 CFR 72.28(a).

- The TSAR provides an acceptable description of a personnel training program. Commitment to this program in a subsequent license application will satisfy the requirements of 10 CFR 72, Subpart I.

- The TSAR provides an acceptable description of a proposed CISF operating contractor organization, delegations of responsibility and authority, and the minimum skills and experience qualifications. Commitment to this proposed contractor organization structure and minimum technical qualifications in a subsequent license application will satisfy the requirements of 10 CFR 72.28(c).

- The TSAR provides an acceptable emergency plan for the CISF. Commitment to this plan in a subsequent license application will satisfy the requirements of 10 CFR 72.32(b).

13.1 ORGANIZATIONAL STRUCTURE

13.1.1 Corporate Organization

The Office of Civilian Radioactive Waste Management (OCRWM) was established within DOE to manage the centralized interim storage and ultimate disposal of civilian spent nuclear fuel and high-level radioactive waste. The corporate organization of OCRWM is illustrated in Figure 13.1-1. It consists of two major projects: (1) the Yucca Mountain Site Characterization Project and (2) the Waste Acceptance, Storage and Transportation Project. The Office of Waste Acceptance, Storage and Transportation is the organization responsible for the CISF. The Office of Program Management and Integration provides support to the two projects and to the Civilian Radioactive Waste Management Program Director. The Office of Quality Assurance also reports directly to the Director of OCRWM.

As a federal agency, the DOE is not required to demonstrate the financial capabilities for the construction, operation and decommissioning of the CISF. Adequate funding will be obtained when necessary from the Nuclear Waste Fund, as authorized by Congress.

13.1.1.1 Corporate Functions, Responsibilities, and Authorities

The Director of OCRWM is responsible for carrying out the functions of the Secretary of Energy with regard to the provisions of the Nuclear Waste Policy Act of 1982 and the Nuclear Waste Policy Amendments Act of 1987. Responsibility for the interim storage facility is delegated to the Director of the Office of Waste Acceptance, Storage and Transportation. This position has signature authority for all licensing activities associated with the CISF.

Figure 13.1-2 illustrates the organizational structure of the Office of Waste Acceptance, Storage and Transportation, which is responsible for the design, quality assurance, construction, testing, start-up and operation of the CISF. The Director of the Office of Waste Acceptance, Storage and Transportation reports to the Director of OCRWM.

Reporting directly to the Director of Waste Acceptance, Storage and Transportation is the Director of the Storage and Engineering Technology Division, who has direct responsibility for the non-site-specific CISF design activities and the CISF topical safety analysis report (TSAR). Preparation of the non-site-specific design documents and development of the TSAR are contracted to qualified contractors. TRW Environmental Safety Services Inc. (TESS) is the current Managing and Operating (M&O) contractor for DOE's Civilian Radioactive Waste Management System (CRWMS).

Also reporting directly to the Director of Waste Acceptance, Storage and Transportation is the CISF Project Manager, who will be the senior DOE official at the CISF site. The on-site DOE organization will be established following designation of the CISF site. At that time, responsibility for the design and licensing activities will transition from the Director of Storage and Engineering Technology to the CISF Project Manager. The CISF will be staffed at sufficient levels prior to operation to allow for training, procedure development and other pre-operational activities.

13.1.1.2 Applicant's In-House Organization

Figure 13.1-3 illustrates a proposed DOE CISF site organization. The positions shown are functional and may not correspond to actual titles or positions.

13.1.1.2.1 CISF Project Manager

The CISF Project Manager has ultimate responsibility for the final design, construction, testing, operation and decommissioning of the CISF, and for the operation of the facility in a safe, reliable and effective manner to ensure the protection of the public health and safety and the environment. The CISF Project Manager is responsible for proper selection of CISF staff for all key DOE positions, including representation on the Facility Safety Review Committee. Responsibilities of this position also include compliance with the facility license. The CISF Project Manager is responsible for ensuring adequate interfaces with other elements of the DOE high-level waste program. The CISF Project Manager or designee(s) has the authority to approve and issue DOE site directives and procedures.

13.1.1.2.2 Quality Assurance Manager

The Quality Assurance Manager (QA) reports directly to the CISF Project Manager and is responsible for providing guidance and direction related to the implementation of the OCRWM QA program, and for providing oversight of the M&O contractor's QA program for the facility. Responsibility for the oversight of all quality affecting work at the facility includes the verification of quality achievement by the on-site line organization through audits, surveillance or other means of verification, as appropriate. This position is independent from other DOE management positions at the facility to ensure that the QA Manager has access to the CISF Project Manager regarding matters affecting quality. In addition, the QA Manager has the authority and responsibility to contact OCRWM QA Director or the Director of OCRWM directly with any QA concerns.

13.1.1.2.3 Chief Counsel

The Chief Counsel is responsible for all DOE legal services provided to the project. The Chief Counsel reports directly to the CISF Project Manager and serves as the CISF liaison with the DOE's Office of General Counsel and other organizations on all legal matters. The Chief Counsel is responsible for ensuring that the project's legal activities are consistent with the policies established by the DOE General Counsel.

13.1.1.2.4 Assistant Manager, Office of Institutional Affairs

The Assistant Manager of the Office of Institutional Affairs is responsible for the coordination and direction of CISF institutional activities, which includes providing information to the public regarding the project's activities. The Office of Institutional Affairs provides liaison and coordination between national, state and local governments, public and private sector organizations, educational institutions, special interest organizations and the media.

13.1.1.2.5 Chief Financial Officer

The Chief Financial Officer reports directly to the CISF Project Manager. The Chief Financial Officer manages and establishes policies for procurement, property, information management, safeguards and security, human relations and general administrative support.

13.1.1.2.6 Chief Safety Officer

The Chief Safety Officer reports directly to the CISF Project Manager. The Chief Safety Officer is responsible for providing oversight and management of all CISF contractor activities associated with facility operations, maintenance and technical project support with the exception of safeguards and security.

13.1.1.2.7 Facility Safety Review Committee

A Facility Safety Review Committee (FSRC) assists with the safe operation of the facility. The FSRC reports to the CISF Project Manager and provides technical and administrative review and audit of operations which could impact plant worker and public safety. The scope of activities reviewed and audited by the FSRC, as a minimum, includes the following.

- Radiation protection
- Nuclear safety
- Industrial safety including fire protection
- Environmental protection
- ALARA policy implementation
- Changes in facility design or operations.

The FSRC will conduct at least one facility audit per year for the above areas.

The FSRC is composed of at least five members, including a Director. FSRC members may be from on-site or off-site DOE offices or from the CISF contractor staff. The five members include experts on operations and all safety disciplines (criticality, radiological and industrial). The Director, members and alternate members of the FSRC are formally appointed by the CISF Project Manager. Each has an academic degree in an engineering or physical science field and a minimum of five years of technical experience, of which a minimum of three years relates directly to one or more of the safety disciplines (criticality, radiological or industrial).

The Facility Safety Review Committee will meet at least three times per calendar year with a maximum interval of 180 days between any two consecutive meetings.

Review meetings are to be held within 60 days of any incident reportable to the NRC. These meetings may be combined with regular meetings. Following a reportable incident, the FSRC shall review the incident's causes, the responses, and both specific and generic corrective actions to ensure resolution of the problem.

A written report of each FSRC meeting and audit is to be forwarded to the CISF Project Manager within 30 days and retained for at least three years.

13.1.1.3 Interrelationships with Contractors and Suppliers

As facility owner and licensee, DOE will retain ultimate responsibility for the safe operation of the facility and for compliance with all license conditions. The authority for the management and operation of the facility will be contractually delegated to the CISF contractor. To exercise its ultimate responsibility, DOE will: (1) retain responsibility for and perform independent audits of the CISF contractor's QA Program (both the achievement of quality by the CISF contractor management and the verification of quality by CISF contractor QA personnel), (2) provide qualified on-site staff to manage and oversee CISF contractor CISF activities, (3) retain the responsibility to budget necessary and sufficient funds to safely operate and maintain the facility, and (4) retain the authority through the establishment of initial CISF contract provisions, and as necessary through revision of the contract, to correct deficiencies in the operation of the facility relative to its design and licensing basis.

The on-site DOE organization will be modified as necessary to ensure an appropriate interface with the CISF operating contractor organization to perform the management and oversight functions discussed above.

13.1.1.4 Applicant's Technical Staff

The minimum qualification requirements for key DOE positions responsible for management and oversight of the safe operation of the facility shall be as outlined below. The actual qualifications, training and experience of the DOE staff providing oversight to the design, construction, and operation of the CISF will be maintained on file to demonstrate compliance with the minimum requirements.

13.1.1.4.1 CISF Project Manager and Deputy Manager

The CISF Project Manager and Deputy Manager shall be appointed by the OCRWM Director as the overall manager/deputy manager of the CISF site. Requirements for these positions include knowledge of spent nuclear fuel handling and storage equipment and processes, criticality safety control, industrial safety and radiation protection program concepts as they apply to the overall safety of a nuclear facility. The CISF Project Manager and Deputy Manager shall have, as a minimum, a bachelor's degree in engineering or a scientific field and 10 years of responsible nuclear experience.

13.1.1.4.2 Quality Assurance Manager

The QA Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field, five years of responsible nuclear experience in the implementation of a Quality Assurance program, and at least two years of experience in a QA organization at a nuclear facility.

13.1.1.4.3 Chief Safety Officer

The Chief Safety Officer shall have, as a minimum, a bachelor's degree in nuclear engineering and 15 years of responsible nuclear experience, and shall be a Registered Professional Engineer in the state where the CISF is to be located.

13.1.1.4.4 Chief Financial Officer

The Chief Financial Officer shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field, and five years of relevant experience.

13.1.2 Operating Organization, Management, and Administrative Control System

13.1.2.1 On-site Organization

A proposed CISF operating contractor organization for the CISF is shown in Figure 13.1-4. The positions shown are functional and may not correspond to actual titles or positions. Prior to operation, the CISF will be staffed at sufficient levels to allow for training, procedure development and other pre-operational activities. The operating organizations are composed of two groups of employees: (1) those who work only during the standard eight-hour work day, and (2) those who work shifts to provide 24-hour coverage for essential services. The specific number of personnel assigned to each organizational unit will be presented in the CISF license application.

The day group provides standard administrative and logistical support, and is staffed such that the absence of any given employee can be absorbed within the organization with little loss in effectiveness. No adjustments are needed to account for absences such as vacations, holidays or sick time.

The rotating shift group provides essential services for facility operations, operations support and security functions. A minimum staff is maintained at all times to ensure essential operations can be performed. Each rotating shift crew is staffed with sufficient personnel to account for routine absences due to vacation, holidays, or sickness. During unusual situations in which an unexpected number of employees is absent, on-site employees are held over until additional resources are called in to ensure minimum required staffing. Minimum staffing requirements include those resources needed to respond to off-normal or emergency situations. The emergency on-site response organization is discussed in Section 13.5.

13.1.2.2 Personnel Functions, Responsibilities, and Authorities

The functions and responsibilities of the facility management and supervisory staff are described in the following paragraphs. Where applicable, the succession of responsibility for the various positions is indicated. (The discussion of position functions and responsibilities during emergencies, and the succession of those responsibilities, are discussed in Section 13.5, Emergency Planning.)

13.1.2.2.1 Centralized Interim Storage Facility Site Manager

The CISF Site Manager has direct responsibility for all activities at the site. The CISF Site Manager is authorized by DOE to act as agent for the Office of Waste Acceptance, Storage and Transportation, and has exclusive responsibility and control over the physical construction, operation, and maintenance of the CISF. The CISF Site Manager is accountable for operation of the facility in a safe, reliable and efficient manner. The CISF Site Manager is responsible for proper selection of key CISF staff, including contractor representation on the Facility Safety Review Committee. The CISF Site Manager is responsible for the protection of the facility staff and the general public from radiation exposure or any other consequence of an accident at the facility. The CISF Site Manager also bears the responsibility for compliance with the facility license. The CISF Site Manager or designee(s) has the authority to approve and issue site directives and procedures.

13.1.2.2.2 Quality Assurance Manager

The QA Manager reports to the CISF Site Manager. The QA Manager is responsible for implementing the QA program for the facility. This responsibility includes ensuring that all activities affecting quality at the facility are performed in accordance with appropriate regulations, codes and standards. The QA Manager has no other duties. This position is independent from other management positions at the facility to ensure that the QA Manager has access to the CISF Site Manager regarding matters affecting quality. In addition, the QA Manager has the authority and responsibility to contact the DOE QA Manager or the DOE CISF Project Manager directly with any QA concerns.

13.1.2.2.3 Operations Manager

The Operations Manager reports to the CISF Site Manager, and is responsible for directing day-to-day operation of the facility. This includes such activities as ensuring the correct and safe receipt, transfer and storage of spent nuclear fuel in casks or canisters; operation of facility support systems; and performance of periodic tests or surveillance. The Operations Manager is also responsible for any radioactive waste collection activities. In the event of the absence of the CISF Site Manager, the Operations Manager may assume the responsibilities and authorities of that position.

13.1.2.2.4 Maintenance Manager

The Maintenance Manager reports to the CISF Site Manager, and is responsible for directing and scheduling maintenance activities to ensure proper operation of the facility. These activities include repair and preventive maintenance of facility equipment. In the absence of the CISF Site Manager, the Maintenance Manager may assume the responsibilities and authorities of that position.

13.1.2.2.5 Technical Services Manager

The Technical Services Manager reports to the CISF Site Manager, and provides technical support to the facility. This includes activities associated with radiation protection, licensing and regulatory compliance, engineering and computer support. Before changes are made to the facility or to operations involving radiation or criticality considerations, those changes are reviewed and approved in writing by the Technical Services Manager or designee. In the event of the absence of the CISF Site Manager, the Technical Services Manager may assume the responsibilities and authorities of that position.

13.1.2.2.6 Site Services Manager

The Site Services Manager reports to the CISF Site Manager, and is responsible for a variety of site support functions including safeguards and security, training, health and safety, and administration support. In the absence of the CISF Site Manager, the Site Services Manager may assume the responsibilities and authorities of that position.

13.1.2.2.7 Community Relations Coordinator

The Community Relations Coordinator is an optional position, depending upon the CISF location selected. If a remote location, the functions of the Community Relations Coordinator may be performed by another member of the CISF staff. The Community Relations Coordinator reports to the CISF Site Manager, and is responsible for providing information about the CISF to the public and the media. During an emergency event at the facility, the Community Relations Coordinator ensures that the public and the media receive accurate and up-to-date information.

13.1.2.2.8 Regulatory and Licensing Manager

The Regulatory and Licensing Manager reports to the Technical Services Manager, and is responsible for coordinating facility activities to ensure compliance with Nuclear Regulatory Commission (NRC) requirements. The Regulatory and Licensing Manager is also responsible for ensuring abnormal events are reported to the NRC in accordance with NRC regulations, and for coordinating facility activities to ensure all local, state and federal environmental regulations are met. This includes submission of periodic reports to appropriate regulatory organizations of effluents from the CISF.

13.1.2.2.9 Emergency Preparedness Coordinator

The Emergency Preparedness Coordinator reports to the Regulatory and Licensing Manager and is responsible for ensuring that the facility remains prepared to react and respond to any emergency situation that may arise. This includes emergency preparedness training of facility personnel and facility support personnel, training of and coordination with off-site emergency response organizations, and conducting periodic drills to ensure facility personnel training and off-site response organization personnel training is up-to-date.

13.1.2.2.10 Engineering Supervisor

The Engineering Supervisor reports to the Technical Services Manager and is responsible for the implementation of facility modifications and for providing engineering services to support facility operation and maintenance. This support includes performance testing of systems and equipment.

13.1.2.2.11 Industrial Safety Coordinator

The Industrial Safety Coordinator reports to the Technical Services Manager and implements CISF industrial safety programs and procedures. This includes safety training and maintaining the performance of the facility fire protection systems.

13.1.2.2.12 Radiation Protection Supervisor

The Radiation Protection Supervisor reports to the Technical Services Manager and is responsible for implementing the radiation protection program. These duties include the training of personnel in the use of equipment, control of radiation exposure of personnel, continuous determination of the radiological status of the facility, and conducting the radiological environmental monitoring program.

During emergency conditions the Radiation Protection Supervisor's duties shall also include: providing Emergency Operations Center personnel information and recommendations concerning radiation levels at the facility, gathering and compiling on-site and off-site radiological monitoring data, recommending actions (at the facility and off-site) deemed necessary for limiting exposures to facility personnel and members of the general public, and taking prime responsibility for decontamination activities.

In matters involving radiological protection, the Radiation Protection Supervisor has direct access to the CISF Site Manager.

13.1.2.2.13 Security Manager

The Security Manager reports to the Site Services Manager and is responsible for directing the activities of security personnel to ensure the physical protection of the facility. The Security Manager is also responsible for the protection of safeguards information at the facility and obtaining the proper security clearances for facility and support personnel.

13.1.2.2.14 Safeguards Manager

The Safeguards Manager reports to the Site Services Manager and is responsible for ensuring the proper implementation of the Material Control and Accounting Plan. This position is separate from and independent of the operations, maintenance and technical services departments to ensure a definite division between the safeguards group and other departments. In matters involving safeguards, the Safeguards Manager has direct access to the CISF Site Manager.

13.1.2.2.15 Administrative Supervisor

The Administrative Manager reports to the Site Services Manager and is responsible for ensuring that support functions such as accounting, word processing and document control are provided for the CISF.

13.1.2.2.16 Transfer Facility Shift Supervisor

The Transfer Facility Shift Supervisor reports to the Operations Manager and is responsible for actual receipt, transfer and storage operations during his or her assigned shift. The Transfer Facility Shift Supervisor directs the activities of the technicians described below and shown in Figure 13.1-4 (page 2 of 3).

- Transfer Facility Crane Operator (TFCO) - This person performs remote crane operations from inside the shielded crane operator room overlooking the shipping/receiving area. The TFCO operates the overhead bridge crane from a remote shielded room, and also operates the gantry-mounted robot.

- Transfer Facility Operator (TFO) - This person performs most of the close-up, hands-on operation and maintenance activities around the casks. The TFO performs transportation cask shipping and receiving tasks, radiological surveys, cask decontamination, canister transfer preparation, canister transfer, and storage cask preparation. The TFO provides assistance to all operational personnel and performs most of the day-to-day maintenance activities in the transfer facility.

- Transfer Facility Remote Operator (TFRO) - This person performs most of the robotic operations during canister transfer operations in the canister transfer area. The TFRO performs remote operations during canister transfer using remote operator consoles located in shielded rooms at one end of the canister transfer area along the elevated walkways.

- Radiation Protection Technician (RP) - This person supervises all radiological surveys and cask decontamination activities. The RP, along with TFOs, performs cask radiological surveys and decontamination with the aid of the shipping/receiving area gantry-mounted robot and transfer area robotic devices during operations involving transportation cask shipping and receiving, canister transfer, and storage cask preparation. The RP provides assistance to operational personnel involving all radiological concerns of day-to-day operations and maintenance.

- Site Operator - This person performs most of the hands-on operations involving transportation cask receipt and dispatch outside the transfer facility.

- Storage Operator - This person performs most of the hands-on operations for placing loaded storage casks and TSCs into storage and for performing retrieval operations. The storage operator also performs canister transfer operations that take place in the storage area.

13.1.2.2.17 Security Shift Supervisor

The Security Shift Supervisor reports to the Security Manager, and is responsible for facility security during his or her assigned shift. The Security Shift Supervisor directs the activities of security force personnel illustrated in Figure 13.1-4 (page 3 of 3).

13.1.3 Personnel Qualification Requirements

13.1.3.1 Minimum Qualification Requirements

The minimum qualification requirements for the CISF operating contractor positions described in Section 13.1.2.2 are outlined below. The physical condition and general health of personnel certified for the operation of equipment and controls important to safety shall not be a potential cause of operational errors that could endanger other in-plant personnel or the public health and safety.

13.1.3.1.1 CISF Site Manager

The CISF Site Manager's qualifications include knowledge of spent nuclear fuel handling and storage equipment and processes, criticality safety control, industrial safety and radiation protection program concepts as they apply to the overall safety of a nuclear facility. A bachelor's degree (or equivalent) in an engineering or scientific field and 10 years of responsible nuclear experience are required as a minimum.

13.1.3.1.2 Quality Assurance Manager

The QA Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and at least five years of responsible nuclear experience in the implementation of a QA program. The QA Manager shall have at least two years of experience in a QA organization at a nuclear facility.

13.1.3.1.3 Operations Manager

The Operations Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and 10 years of responsible nuclear experience.

13.1.3.1.4 Maintenance Manager

The Maintenance Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and 10 years of responsible nuclear experience.

13.1.3.1.5 Technical Services Manager

The Technical Services Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and 10 years of responsible nuclear experience.

13.1.3.1.6 Site Services Manager

The Site Services Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and 10 years of responsible nuclear experience.

13.1.3.1.7 Community Relations Coordinator

The Community Relations Coordinator shall have a minimum of three years of appropriate, responsible experience in implementing and supervising a community relations program.

13.1.3.1.8 Regulatory and Licensing Manager

The Regulatory and Licensing Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and a minimum of five years of appropriate, responsible experience in implementing and supervising a nuclear licensing and regulatory compliance program.

13.1.3.1.9 Emergency Preparedness Coordinator

The Emergency Preparedness Coordinator shall have a minimum of two of years experience in the implementation of emergency plans and procedures at a nuclear facility. Academic training may not be credited toward this experience requirement.

13.1.3.1.10 Engineering Supervisor

The Engineering Supervisor shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and 10 years of responsible nuclear experience. The Engineering Supervisor shall also be a Registered Professional Engineer in the state designated to host the CISF.

13.1.3.1.11 Industrial Safety Coordinator

The Industrial Safety Coordinator shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and three years of appropriate, responsible nuclear experience associated with the implementation of a facility safety program.

13.1.3.1.12 Radiation Protection Supervisor

The Radiation Protection Supervisor shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and three years of responsible nuclear experience associated with implementation of a radiation protection program. At least two years of experience shall be in a radiation protection organization at a nuclear facility.

13.1.3.1.13 Security Manager

The Security Manager shall have a minimum of five years of experience in the responsible management of physical security similar to that required for the CISF. Academic training may not be credited toward fulfilling this experience requirement.

13.1.3.1.14 Safeguards Manager

The Safeguards Manager shall have a minimum of five years of experience in the management of a safeguards program for special nuclear material, including responsibility for material control, material accountability and physical security. Academic training may not be credited toward this experience requirement.

13.1.3.1.15 Administrative Supervisor

The Administrative Supervisor shall have a minimum of three years of appropriate, responsible experience in implementing and supervising administrative responsibilities at an industrial facility.

13.1.3.1.16 Transfer Facility Shift Supervisor

Transfer Facility Shift Supervisors shall have a high school diploma or equivalent and at least two years of nuclear power plant experience. Prior to appointment, the Shift Supervisor shall be trained and certified on CISF equipment and controls important to safety, per the CISF Training Program.

13.1.3.1.17 Security Shift Supervisor

Security Shift Supervisors shall have a high school diploma or equivalent and at least two years of applicable experience at an industrial facility. Prior to appointment, the Shift Supervisor shall have satisfied CISF security force training and qualification requirements.

13.1.3.2 Qualification of Personnel

The qualifications, training and experience of the CISF operating contractor staff occupying the key positions described in Section 13.1.2.2 will be kept on file to demonstrate compliance with the minimum requirements set forth in Section 13.1.3.1.

13.1.4 Liaison With Outside Organizations

The CISF will interface with a number of off-site organizations and agencies. The centralized interim storage of spent nuclear fuel is only one element of OCRWM's overall high-level waste program. DOE's Office of Waste Acceptance, Storage and Transportation will facilitate DOE's acceptance of spent nuclear fuel and its delivery to the CISF. Eventually, the spent nuclear fuel stored at the CISF will be transported to a permanent repository. The CISF will interface with applicable DOE offices or projects as necessary to ensure the safe shipment of spent nuclear fuel to and from the CISF.

Formal arrangements will be established with various federal, state and local governments relative to the construction and operation of the CISF. These arrangements will be presented in the site-specific CISF license application following designation of the CISF site. Similarly, any arrangements made with off-site organizations as part of a site-specific emergency plan will be presented in the license application.

Figure 13.1-1 Office of Civilian Radioactive Waste Management

Figure 13.1-2 Office of Waste Acceptance, Storage and Transportation

Figure 13.1-3 Proposed DOE CISF Site Organization

Figure 13.1-4 Proposed CISF Operating Contractor Site Organization
(Page 1 of 3)

Figure 13.1-4 Operations Shift Organization

Figure 13.1-4 Security Shift Organization

13.2 PRE-OPERATIONAL TESTING AND OPERATION

This section describes the CISF Pre-operational and Operational Test program. Included is a description of the administrative procedures for conducting the program and a general program description.

The testing program consists of pre-operational testing, which occurs prior to fuel receipt, and operational or start-up testing, which occurs after fuel receipt. The objectives of both are to ensure that plant structures, systems and components (SSCs):

- Have been adequately designed and constructed
- Meet regulatory and licensing requirements
- Do not adversely affect worker safety or the health and safety of the public
- Can be operated in a dependable manner so as to perform their intended function.

Additionally, the testing programs ensure that operating and emergency procedures are correct and that personnel have acquired the correct level of technical expertise.

A pre-operational test report will be submitted to the NRC at least 30 days prior to receipt of spent fuel in accordance with 10 CFR 72.82(e). The report will provide a detailed description of the test program, specify pre-operational test acceptance criteria and results, and identify the start-up test acceptance criteria. Since start-up testing occurs after fuel receipt, the results of these tests will be provided after completion of the program.

13.2.1 Administrative Procedures for Conducting Test Program

All testing is performed using written test procedures, which are sufficiently detailed for qualified personnel to perform the required functions without direct supervision. Facility testing is performed by the CISF operating contractor. The CISF operating contractor shall develop an overall testing program that establishes appropriate administrative controls to ensure that the following activities are performed in a consistent manner by qualified personnel.

- Development, review and approval of test procedures

- Performance of tests

- Evaluation of test results

- Incorporation of needed system modifications or procedure changes based upon test results.

The CISF Site Manager has overall responsibility for the test program. Responsibilities include ensuring that personnel are qualified to conduct the test program, and that the test program is conducted without endangering the health and safety of CISF personnel or the public. The CISF Site Manager is also responsible for approval of the overall program results.

The Operations Manager is responsible for the development and conduct of the test program. Responsibilities include ensuring, prior to the performance of any test, that the tests are appropriate and can be conducted without endangering the health and safety of CISF personnel or the public. During a test, the Operations Manager is responsible for approving any necessary changes and, following the test, for approval of test results, which is required before proceeding to the next test.

Test Engineers are responsible for development, conduct, documentation and necessary modifications of all CISF test procedures. Test Engineers are also responsible for evaluating and approving test results. During a test, CISF Test Engineers are responsible for:

- Ensuring that testing procedures are followed
- Verification of system testing prerequisites
- Observance of limits and precautions
- Compliance with the requirements of the facility license and facility directives regarding procedure changes and documentation
- Identifying and taking corrective actions necessary to resolve system deficiencies or observed discrepancies
- Verification of proper data acquisition, evaluation of results and compliance with stated acceptance criteria
- Ensuring that adequate personnel safety precautions are observed during a test
- Coordinating and observing additional manpower and support required from other groups or organizations.

The Facility Safety Review Committee (FSRC) is responsible for reviewing the testing program prior to implementation to ensure that the program can be conducted safely and efficiently without endangering the health and safety of workers or the public. The FSRC is responsible for reviewing and approving the results of the test programs prior to receiving fuel and beginning normal operations. The FSRC is also responsible for reviewing and approving major changes to test procedures.

Cask system vendors and fabricators are responsible for developing test procedures, performing tests, ensuring test acceptance criteria are met, and documenting test results for all SSCs prior to delivery to the CISF. Prior to acceptance of the SSCs at the CISF, the CISF Test Engineers, the Operations Manager, the CISF Site Manager and the FSRC review and approve the constructor test program, the tests and results.

Changes to test procedures are governed by procedure in accordance with 10 CFR 72.48, and are made by the Test Engineer. Minor changes are reviewed and approved by the Operations Manager, while major changes require Operations Manager, CISF Site Manager and FSRC review and approval. Any change that results in a change to the license, conditions of the license, an unreviewed safety question, a significant increase in occupation exposure, or a significant unreviewed environmental impact requires NRC approval.

Table 13.2-1 provides a summary of test program responsibilities. The minimum qualifications for key CISF personnel involved in the test program are provided in Section 13.1.

Table 13.2-1. Test Program Responsibilities

Task	Test Engineer	Operations Manager	CISF Site Manager	FSRC[1]
Review Constructor Test Program	✔	✔	✔	✔
Develop Test Procedures	✔			
Approve Test Procedures		✔	✔	✔
Conduct Tests	✔			
Approve Test Results	✔	✔	✔	✔
Modify Procedures	✔			
Approve Minor Test Procedure Changes		✔		
Approve Major Test Procedure Changes		✔	✔	✔

[1]Facility Safety Review Committee

13.2.2 Test Program Description

The test program is divided into two parts, pre-operational testing and operational testing. Pre-operational testing occurs prior to fuel receipt and includes tests conducted by the CISF facility constructor, the cask system vendor and cask system fabricator, and CISF personnel. Operational testing occurs after fuel receipt and is conducted by CISF operating contractor personnel.

13.2.2.1 Pre-operational Testing

The facility constructor is responsible for completion of all as-built drawing verification, purging/flushing, cleaning, hydrostatic or pneumatic testing, system turnover and initial calibration of instrumentation, in accordance with design and installation specifications provided by the architect engineers and cask system vendors. Pre-operational testing begins as systems or portions of systems are turned over to the Department of Energy (DOE). The Operations Manager is responsible for coordination of the Pre-operational Testing program.

The Pre-operational Test Plan, including test summaries for all systems, is made available to the NRC at least 90 days prior to the start of testing. Subsequent changes to the Pre-operational Test Plan are also made available to the NRC.

Pre-operational testing is performed for all SSCs important to safety and associated interfaces, to ensure that all SSCs important to safety are built and function as designed. Pre-operational tests (dry runs or cold tests) are also performed for all operations involving spent nuclear fuel (SNF), to demonstrate that operations are efficiently performed in a safe manner, and to provide verification that operating procedures are acceptable prior to receipt of SNF.

Pre-operational testing on SSCs important to safety is completed prior to the on-site receipt of SNF. On systems that are not important to safety and which are not required prior to on-site receipt of SNF, pre-operational testing may be completed after SNF receipt (for example, building ventilation tests). Those systems are identified in the Pre-operational Test Plan.

For systems and components that are not QA Level 1, acceptance criteria are established only to ensure worker safety and the reliable and efficient operation of the system, and to demonstrate the performance of intended functions.

An operational readiness review will be conducted as part of the pre-operational test program, to verify that the CISF is ready to receive and store SNF. The operational readiness review addresses the following areas at a minimum.

- Radiological controls
- Nuclear safety
- Operations training and procedures
- Construction
- Engineering/design control
- Fire protection
- Maintenance
- Quality assurance
- Emergency preparedness
- Safeguards and security.

Results of pre-operational tests are evaluated, and changes to SSCs and operating procedures are made as necessary. In accordance with 10 CFR 72.82(e), results of pre-operational tests will be submitted to the NRC at least 30 days prior to fuel receipt.

13.2.2.2 Operational Testing

Operational testing is performed for all SSCs important to safety, and associated interfaces. These tests ensure that the SSCs function as designed when loaded with fuel, and that measured parameters are bounded by the safety analysis. Operational tests are also performed for all operations involving SNF. These test demonstrate that operations are efficiently performed in a safe manner, and provide verification that operating procedures are acceptable prior to normal operations.

Operational testing associated with a particular cask system design is performed the first time the cask system is used at the CISF. Testing is performed in accordance with the cask safety analysis report (SAR) and license conditions imposed on the particular cask system.

After start-up testing is complete, inspections and tests of all SSCs important to safety will continue on a routine basis to verify that SSCs continue to function as designed. This includes full load tests of the cranes which carry spent fuel casks and canisters.

Results of operational tests will be submitted to the NRC upon program completion.

13.2.3 Test Discussion

Specific tests will be conducted on all SSCs important to safety and operations involving SNF. A complete listing of all tests, test prerequisites, the test method and test acceptance criteria will be provided with the Pre-operational Test Plan.

13.3 TRAINING PROGRAM

This section describes the Centralized Interim Storage Facility (CISF) Training program. Included are descriptions of the General Training program, the Continuing Training program, and the Administrative and Records Retention program.

The principal objective of the CISF Training program is to ensure the proficiency of all facility personnel through effective training and qualification. The Training program is designed to accommodate future growth and comply with applicable established regulations and standards. The Training program satisfies the requirements of 10 CFR 72, Subpart I.

Qualification is indicated by successful completion of prescribed training, demonstration of the ability to perform assigned tasks and, where required by regulation, maintenance of current and valid operator certification.

Training is designed, developed and implemented according to a systematic approach. Employees are provided with formal training to establish a knowledge foundation and on-the-job training to develop work performance skills. Continuing training is provided, as required, to maintain proficiency and provide further employee development. All training is documented and records are maintained to provide evidence that the training program has been properly implemented.

13.3.1 Program Description

The Training program is designed to prepare personnel for the safe, reliable and efficient operation of the facility. The program ensures that personnel are adequately trained, tested, and certified when necessary, and that only certified personnel will operate equipment important to safety. It also identifies the minimum physical requirements and health conditions necessary for certification.

Appropriate training is provided for personnel of various ability and experience backgrounds. The level at which an employee initially enters the training program is determined by an evaluation of his or her past experience, level of ability, and qualifications.

Training of CISF personnel is provided to develop and maintain the minimum qualifications outlined in Section 13.1. Training requirements are applicable to, but not necessarily restricted to, those personnel within the plant organization who have a direct relationship to the operation, maintenance or other technical aspect of the CISF. Training courses are updated to reflect plant modifications and changes to procedures. Training sessions are conducted on a regular basis to accommodate new employees or those requiring retraining.

The training program consists of General Employee Training and Technical Training. Continuing or periodic retraining courses shall be established to ensure that personnel remain proficient. Periodic retraining to ensure retention of knowledge and skills important to facility operations may consist of exercises, instruction and/or review of subjects as appropriate.

13.3.1.1 General Employee Training

General Employee Training (GET) encompasses those Quality Assurance, radiation protection, safety, emergency and administrative procedures established by CISF management and applicable regulations. All persons under the supervision of facility management participate in GET; however, certain facility support personnel, depending on their normal work assignments, may not participate in all topics. Temporary maintenance and service personnel receive GET to the extent necessary to ensure safe execution of their duties. Certain portions of GET may be included in a New Employee Orientation program.

GET topics include:

- New employee orientation/indoctrination
- General administrative controls and procedure use
- Quality Assurance policies and procedures
- Facility systems and equipment
- Industrial safety, health and first aid
- Emergency plan and implementing procedures
- Facility security program
- Fitness for duty
- Nuclear safety training (See Section 13.3.1.1.1)
- Fire protection and fire brigade (See Section 13.3.1.1.2).

13.3.1.1.1 Nuclear Safety Training

A high level of importance is placed on the radiological safety of plant personnel and the public, and all CISF personnel receive some level of Nuclear Safety Training. The Nuclear Safety Training program is established for the various types of job functions (e.g., transfer facility operator, radiation protection technician, contractor personnel) having radiation safety responsibilities. Visitors to the Controlled Access Area (CAA) receive formal Nuclear Safety Training or are escorted by trained personnel while inside the CAA. Individuals requiring unescorted access to the CAA receive annual retraining, which is scheduled and reported by use of a computerized tracking system.

The Nuclear Safety Training program is reviewed and updated as required at least every two years by the Operations Manager, the Technical Services Manager and the Site Services Manager, to ensure that the program is current and adequate.

Operational personnel are further instructed in the specific safety requirements of their work assignments by their immediate supervisors (or designees) during on-the-job training. Employees must demonstrate understanding of safety requirements, based on observations by their immediate supervisors (or designees), before working without direct supervision.

Changes to work procedures, including safety requirements, are reviewed with operational personnel by their immediate supervisors (or designees).

Nuclear safety topics are discussed and reviewed with employees at least annually in round-table safety meetings held by supervisors or delegates, and at other meetings held by managers.

Training sessions covering radiation protection and emergency procedures are conducted on a regular basis to accommodate new employees or those requiring retraining. Topics covered in the training program include:

- Notices, reports and instructions to workers
- Plant access and visitor control
- Practices designed to keep radiation exposures ALARA
- Methods of controlling radiation exposures
- Contamination control methods
- Use of monitoring equipment
- Emergency procedures and actions
- Nature and sources of radiation
- Biological effects of radiation
- Use of personnel monitoring devices
- Principles of nuclear criticality safety
- Risk to pregnant females.

Individuals attending these sessions must pass an examination to ensure their understanding of the training contents. Training effectiveness is also evaluated by audits of personnel responsible for criticality safety and radiation protection.

All personnel requiring unescorted access into the CAA will complete Nuclear Safety Training covering at a minimum the following topics.

- Radiation protection practices
- Exposure monitoring devices
- Protective clothing
- Respiratory protection
- Personnel surveys
- Emergency actions
- Radiation Work Permits.

These training programs are conducted by instructors certified by the managers responsible for criticality safety and radiation protection.

13.3.1.1.2 Fire Brigade Training

The purpose of the Fire Brigade Training program is to develop a group of facility employees skilled in fire prevention, fire fighting techniques, first aid procedures and emergency response. They are trained and equipped to function as a fire fighting team.

The Fire Brigade Training program provides initial training of all new fire brigade members, semi-annual classroom training and drills, annual practical training and leadership training.

13.3.1.2 Technical Training

Technical Training is designed, developed and implemented to assist facility employees in gaining an understanding of applicable fundamentals, procedures and practices common to a nuclear facility. Technical Training is also used to develop the necessary manipulative skills to perform assigned work in a competent manner. Technical Training consists of the following segments.

- Initial Training
- On-the-Job Training and Qualifications
- Continuing Training
- Special Training.

13.3.1.2.1 Initial Training

Initial Training provides an understanding of the fundamentals, basic principles and procedures related to an employee's assigned work. This training may consist of, but is not limited to, live, taped and filmed lectures, self-guided study, demonstrations, laboratories, workshops and on-the-job training.

New employees or those transferred from other sections within the facility may be partially qualified due to previous training or experience. The extent of further training for these employees is determined by applicable regulations, performance in review sessions, comprehensive examinations or other techniques designed to identify the employee's level of ability.

Initial job training and qualification programs are developed for operations, maintenance and technical services classifications. Training for each program is grouped into logical blocks or modules and presented to accomplish specific behavioral objectives. Trainee progress is evaluated through written examinations, oral examinations or practical tests. Depending upon regulatory requirements, the individual's needs and plant operating conditions, allowances are made to suit specific situations. Modules that may be included in initial training programs include:

- Operations Initial Training
    - CISF fundamentals
    - General spent fuel handling systems
    - Specific spent fuel handling systems
    - Radiological safety
    - Equipment design and operating characteristics
    - Instrumentation and controls
    - On-site SNF cask transport systems
    - Procedures.
- Mechanical Maintenance Initial Training

- CISF fundamentals
- Fundamental shop skills
- Facility and cask system familiarization.

• Instrumentation, Electrical and Performance Initial Training

  - CISF fundamentals
  - Basic instrument and electrical
  - Basic performance
  - Facility and cask system familiarization.

• Radiation Protection Initial Training

  - CISF fundamentals
  - Fundamental radiation protection
  - Facility and cask system familiarization.

• Engineer/Professional/Supervisory Training

  - CISF fundamentals
  - Facility orientation
  - Spent nuclear fuel handling and cask system training.

• Quality Assurance

  - Basic requirements
  - General criteria
  - Applicable codes, standards and implementing documents
  - Problem identification
  - Dispute resolution.

13.3.1.2.2 On-the Job Training and Qualifications

On-the-Job Training (OJT) is a systematic method of providing the required job related skills and knowledge for a position. This training is conducted in the work environment. Tasks and related procedures for each technical area supplement and complement formal classroom, laboratory and/or simulator training. The program objective is to ensure the trainee's ability to perform job tasks as described in the task descriptions and Training and Qualification Guides.

13.3.1.2.3 Continuing Training

Continuing Training maintains and improves job-related knowledge and skills, such as:

- Facility systems and component changes
- OJT/qualifications program changes
- Procedure and directive changes
- Operating experience program document review, including industry and in-house operating experiences
- Continuing training required by regulation (e.g., Emergency Preparedness)
- General employee, special administrative, vendor and/or advanced training topics supporting elective tasks
- Training to resolve deficiencies or to reinforce seldom-used knowledge and skills
- Pre-job instruction, mock-up training and structured walk-throughs
- Quality awareness.

Continuing Training and Requalification training may overlap to some degree in definition. Requalification or Retraining refers to specific training designed for proficiency maintenance. Continuing Training consists of formal and informal components performed as needed to maintain proficiency on the job. Each organization's continuing training program is developed with a systematic approach, using information from job performance and safe operation information as a basis for determining training content. Continuing Training may be offered, as needed, on any of the topics or programs listed above.

Once the objectives for Continuing Training have been established, training methods may vary. A selected method must provide clear evidence of objective accomplishment and consistency in delivery.

13.3.1.2.4 Special Training

Special Training involves those subjects of a unique nature (i.e., QA, Fire Protection, Emergency Preparedness) required for a particular area of work. Special training is usually given to selected personnel based on specific needs not directly related to disciplinary lines.

13.3.1.3 Personnel Certification Requirements

Operation of equipment and controls important to safety is performed by trained and certified personnel. Certification training includes at a minimum the following topics:

- GET Training
- Nuclear Safety Training
- Technical Training
- Specific On-the-Job Training.

Training is specific to the task to be performed, and personnel must pass specific written and practical tests to become certified to perform that task. Refresher training and testing are conducted at least every two years or as required by codes and standards to maintain proficiency and adapt to changes in technology, methods or job responsibilities.

13.3.1.4 Training Program Evaluations

Training and qualification activities are monitored by designated facility personnel. The Quality Assurance department audits the facility Training program. In addition, trainees and vendors may provide input concerning Training program effectiveness. Methods utilized to obtain this information include surveys, questionnaires, performance appraisals, staff evaluation and overall Training program evaluation instruments. Frequently conducted classes are routinely evaluated at a frequency sufficient to determine program effectiveness. Evaluation information may be collected through the following methods.

- Verification of program objectives as related to job duties for which intended
- Periodic working group program evaluations
- Testing to determine student accomplishment of objectives
- Student evaluation of instruction
- Supervisor's evaluation of trainee's performance after OJT
- Supervisor's evaluation of instruction.

Unacceptable individual performance is reported to the appropriate group Manager.

13.3.2 Retraining Program

See Section 13.3.1.2.3.

13.3.3 Administration and Records

The CISF Training program is the responsibility of the Site Services Manager. Accurate records are maintained on each employee's qualifications, experience, training and retraining. The employee training file shall include records of all general employee, technical, and employee development training conducted at the CISF. The employee training file shall also contain records of special facility-sponsored training conducted by others. Accurate and retrievable training records are maintained for each individual. Training records are retained for two years after an individual's employment is terminated.

13.4 FACILITY OPERATIONS

This section describes the Centralized Interim Storage Facility (CISF) programs for conducting normal facility operations. Included are descriptions of procedure and record management programs and the facility review and audit, facility modification management and employee concerns programs.

13.4.1 Facility Procedures

All facility operations important to safety are conducted using detailed written and approved procedures. The development, review, approval, use, distribution and changes to all procedures are governed by facility administrative procedures, all of which will be made available to the NRC prior to their use. As noted throughout the Topical Safety Analysis Report (TSAR), procedures are used to ensure that activities are carried out in a safe manner. These activities typically include procedures for the following.

- All cask operations including receipt, on-site transport, transfer and storage operations
- Transfer facility workstations
- All facility operations
- Material control and accounting activities
- Emergency Plan implementation
- Security and Safeguards Plan implementation
- Design changes to the facility
- Maintenance of facility structures, systems and components (SSCs)
- Construction and testing of facility SSCs
- Quality Assurance (QA) program implementation
- Training.

General Procedure categories are as follows.

- Administrative Procedures: Provide rules and instructions to provide all CISF personnel with a clear understanding of operating philosophy and management policies.

- Design Control Procedures: Establish measures for the identification and control of design interfaces and for coordination among participating design organizations.

- Radiation Protection Procedures: Implement the radiation control program to ensure exposures are kept as low as is reasonably achievable (ALARA). Included are procedures controlling the release of effluents. Chapter 9 provides a detailed description of the Radiation Protection program and procedures.

- Operating Procedures: Provide instructions for all CISF operations, including receiving, handling and storing of SNF, to ensure all operations are performed consistently, efficiently and safely. Special processes and SNF material control and accounting procedures are also governed by operating procedures.

- Maintenance Procedures: Provide instructions for performing preventive and corrective maintenance to ensure that maintenance is performed consistently, efficiently and safely.

- Surveillance Test Procedures: Ensure that all CISF SSCs are tested on a routine basis to verify operability, to ensure that they continue to meet design requirements, and to ensure that they meet quality standards commensurate with their importance to safety.

- Quality Assurance Procedures: Ensure that all CISF activities are performed in accordance with the CISF QA program.

13.4.1.1 Preparation of Procedures

The development of all procedures, including operating, abnormal, maintenance, instrument, periodic test, radioactive waste management, radiation protection and emergency preparedness, is performed by qualified members of the facility staff. Procedures addressing receipt and handling of incoming casks are provided by the vendors and integrated into facility procedures. All procedures are sufficiently detailed so that qualified individuals can perform the required functions without direct supervision.

Initial procedure drafts are reviewed by other qualified staff members and by vendor personnel as appropriate. Initial drafts also receive a cross-disciplinary review by the appropriate organizations including the Technical Services Department and QA. Reviewers, designated to approve procedures, determine the necessity for additional cross-disciplinary reviews. The CISF Site Manager or designee shall approve all procedures. In addition, important-to-safety procedures are subject to an independent safety review by the Facility Safety Review Committee. If the procedure directly involves QA, the QA Manager must also approve it.

13.4.1.2 Changes to Procedures

Changes to procedures shall be processed as described below.

1. The preparer documents the proposed change as well as the reason for the change.

2. A safety evaluation performed by a qualified reviewer includes a screening and an unreviewed safety question evaluation, in accordance with 10 CFR 72.48. If the safety evaluation reveals that a license change is needed to implement the proposed changes, NRC approval is needed prior to implementation.

3. The procedure, with proposed changes, is reviewed and approved by a qualified reviewer.

4. The CISF Site Manager or designee also reviews the procedure change and is responsible for final approval, and for determining whether cross-disciplinary review is necessary and by which groups. The need for cross-disciplinary reviews shall be considered, as a minimum, for the following.

   - For proposed changes having a potential impact on radiation safety, a review shall be performed for radiation hazards. Changes shall be approved in writing by the Technical Services Manager or designee.

   - A criticality safety review shall be performed for proposed changes having a potential impact on criticality safety. Changes shall be approved in writing by the Technical Services Manager or designee.

   - A QA review shall be performed for proposed changes that directly involve QA. Changes shall be approved in writing by the QA Manager.

   - A material control review shall be performed for proposed changes potentially affecting material control and accountability.

5. Records of completed cross-disciplinary reviews shall be maintained in accordance with Section 13.4.2 for all changes to procedures important to safety.

13.4.1.3 Distribution of Procedures

Approved original procedures and approved procedure revisions are distributed in a controlled manner.

The CISF shall establish and maintain a distribution index for facility procedures and manuals. Revisions are controlled and distributed in accordance with this index. Old revisions are collected and removed from circulation. Indexes are reviewed and updated on a periodic basis or as required.

Managers, or their designees, are responsible for ensuring that all personnel whose work requires the use of the procedures have ready access to controlled copies.

13.4.2 Facility Records

Records management is controlled in a systematic manner in order to provide identifiable and retrievable documentation.

The CISF maintains a Master File. Access to and use of the CISF Master File is controlled. Documents in the Master File shall be legible and identifiable as to subject. Original or reproduced copies of documents shall be stamped, initialed, signed or otherwise authenticated and dated by authorized personnel. Computer storage of data may be used.

In order to preclude deterioration of records in the Master File, the following requirements apply.

- Records are not stored loosely, but firmly attached in binders or placed in folders or envelopes. Records are stored in steel file cabinets.

- Special processed records (e.g., radiographs, photographs, negatives, microfilm) which are light-sensitive, pressure-sensitive and/or temperature-sensitive, are packaged and stored as recommended by the manufacturers of those materials.

- Computer storage of records is performed in a manner to preclude inadvertent loss and to ensure accurate and timely retrieval of data.

The Master File storage system provides for the accurate retrieval of information without undue delay. Written instructions regarding the storage of records in a Master File include, but are not limited to, the following.

- A description of the Master File location(s) and identification of the location(s) of the various record types within the Master File

- The filing system to be used

- A method for verifying that records received are in agreement with any applicable transmittal documents and are in good condition. This is not required for documents generated within a section for use and storage in the same section's satellite files.

- A method for maintaining a record of the records received

- The criteria governing access to and control of the Master File

- A method for maintaining control of and accountability for records removed from the Master File

- A method for filing supplemental information and for disposing of superseded records.

A qualified fire protection engineer will evaluate record storage areas, including satellite files, to ensure that records are adequately protected from damage.

Records related to health and safety shall be maintained in accordance with the requirements of Title 10, Code of Federal Regulations, as described below. A CISF administrative procedure shall provide a list of all applicable records and retention periods. The following records shall be retained for at least three years.

- Records of instrument calibrations
- Records of audits and inspections
- ALARA findings
- Changes to physical security records, in accordance with 10 CFR 72.180, 72.182 and 72.184.

Records of spent fuel inventory are retained for as long as the material is stored at the CISF and for five years after the SNF is transferred out of the CISF. These records are maintained in duplicate at separate locations in accordance with 10 CFR 72.72.

At a minimum, the following records are retained for the duration of the facility license.

- Records important to decommissioning
- Records of spills or other unusual occurrences involving the spread of contamination in and around the facility
- As-built drawings and modifications of structures and equipment in restricted areas where radioactive materials are used or stored, and of locations of possible inaccessible contamination
- A list of areas designated or formerly designated as restricted areas, or areas where a documented spill has occurred. This list is kept in a single document and updated at least every two years.
- Records of any changes to the CISF, changes to procedures pursuant to 10 CFR 72.48, test records, the safety analysis report (SAR) and SAR updates
- Records of safety evaluations described in the CISF license conditions
- Records of SNF shipment receipts, inventory, location, disposal and transfer

- Records of current SNF inventory based on a physical inspection that occurs at least once annually
- Records of written material control and inventory procedures
- Records of QA activities required by the QA program in accordance with 10 CFR 72.174
- Records of training, qualification and re-qualification as required by the CISF license conditions for current and past CISF staff
- Operating records, including maintenance and modifications
- Records of Facility Safety Review Committee activities
- Records of radiation exposure for all individuals entering radiation control areas
- Records of analyses required by the Radiological Environmental Monitoring program that would permit accuracy evaluation of the analyses at a later date
- Records of plant radiation surveys
- Records of environmental surveys
- Physical security records in accordance with 10 CFR 72.180, 72.182 and 72.184.

Retention periods are specified for other facility records as necessary to meet applicable regulatory requirements. Records with no specified retention periods are kept for the duration of the facility license. All retention times are indicated within specific facility procedures.

13.4.3 Facility Review and Audit Program

A review and audit program for operational Quality Assurance of the CISF is established and periodically reviewed by management to:

- Verify that facility operation is consistent with approved procedures and license provisions
- Review important proposed facility modifications, tests and procedures
- Verify that reportable occurrences are investigated and corrected in a manner which reduces the probability of recurrence of such events
- Detect trends which may not be apparent to a day-to-day observer.

The intent of this program is to verify that the facility is constructed and operated safely and in accordance with license conditions.

The organizational structure for conducting the operational Quality Assurance review and audit program includes:

- Internal audits conducted by the responsible organization
- Regular audits conducted by the QA department
- Safety audits conducted by the FSRC.

Each of the above organizations has the authority to discharge its responsibilities. Implicit in this authority is access to facility records and personnel in order to properly perform reviews and audits.

Audited organizations shall respond to deficiencies in a timely manner by correcting deficiencies and documenting the changes in writing.

Facility Management periodically reviews the audit program to ensure it is functioning properly. Additional QA program details are provided in Chapter 15.

13.4.4 Modifications to Facilities and Equipment

13.4.4.1 Facility Initiated Modifications

To provide for the continued safe and reliable operation of CISF SSCs, measures are implemented to ensure that quality is not compromised by planned modifications. The CISF Site Manager is responsible for the design and implementation of SSC modifications. The design and implementation of modifications is performed in a manner to maintain quality commensurate with the remainder of the system being modified, or as dictated by applicable regulations.

Administrative procedures and instructions for modifications are contained in the CISF Facility Modification Manual which is approved, including revisions, by the CISF Site Manager with the concurrence of the QA Manager. The manual contains the requirements for initiating, approving, monitoring, designing, verifying, documenting and implementing modifications. The CISF Facility Modification Manual shall be written to ensure that policies are formulated and maintained to satisfy the QA standards specified in 10 CFR 72 Subpart G, as applicable.

Each change to the facility shall require a safety evaluation in accordance with 10 CFR 72.48. Each modification shall also be evaluated for required changes or additions to the facility's procedures, personnel training, testing program or regulatory documents.

Each modification is also evaluated and documented for radiation exposure, in keeping with the facility ALARA program, criticality, and worker safety requirements and/or restrictions. The evaluation of modifications may also include, but is not limited to, the review of:

- Modification cost
- Similar completed modifications
- QA aspects
- Potential operability or maintainability concerns
- Constructibility concerns
- Post-modification testing requirements
- Environmental considerations
- Human factors.

After completion of a modification to an SSC, the CISF Engineering Supervisor shall ensure that all applicable testing has been completed for correct operation of the systems affected by the modification, and that documentation regarding the modification is complete. In order to ensure operators' ability to operate a modified system safely, all necessary documents are made available to operations and maintenance personnel the moment the modified system becomes operational. Formal notice of a modification completion is distributed to all site Managers within five working days. For modifications to SSCs important to safety, as-built drawings incorporating the modifications are completed within six months. These records shall be identifiable and shall be retained as specified in Section 13.4.2.

13.4.4.2 Vendor-Initiated Modifications

Prior to receipt of any cask system for which the CISF is licensed, any modifications to the cask systems performed under a vendor's or utility's 10 CFR 72.48 program shall be evaluated by facility personnel, to verify that the modified system satisfies the CISF's design and licensing bases.

13.4.5 Employee Concerns Program

The Department of Energy and its CISF operating contractor shall establish and maintain a safety-conscious work environment in which employees feel free to raise concerns, both to their management and the NRC, without fear of retaliation. This program will be documented in an appropriate CISF procedure. All CISF personnel will receive formal training on the employee concerns program.

In addition to the Employee Concerns Program, the following actions will be taken.

- Copies of NRC Form 3, "Notice to Employees," will be posted in locations frequented by employees.

- Space will be made available on-site to NRC personnel with sufficient privacy that CISF personnel may feel comfortable discussing safety or other concerns with NRC personnel.

13.5 EMERGENCY PLANNING

This section of the Topical Safety Analysis Report (TSAR) describes the emergency planning that has been developed for the Centralized Interim Storage Facility (CISF). The outline and content of the Emergency Plan has been developed in accordance with 10 CFR 72.32(b). The Emergency Plan also conforms to the guidance presented in Regulatory Guide 3.67, *Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities,* and Appendix C to Draft NUREG-1567, *Standard Review Plan for Spent Fuel Dry Storage Facilities,* to the extent practical for a non-site-specific facility design. Portions of the Emergency Plan that cannot be developed at this time have been annotated to indicate that they will be included in the site-specific license application for the CISF.

13.5.1 Facility Description

13.5.1.1 Description of Licensed Activities

The Department of Energy (DOE) is the owner of the CISF, and uses contractors to manage and operate the facility.

The CISF provides for temporary storage of spent nuclear fuel (SNF) while awaiting eventual disposal in the Mined Geologic Disposal System (MGDS). The CISF has been designed to receive, handle, transfer, store and ship commercial SNF contained in transportable storage casks (TSCs) or dual purpose cask/canister systems which have been licensed by the Nuclear Regulatory Commission (NRC). The facility has the capability to receive and store 40,000 metric tons of uranium (MTU).

13.5.1.2 Description of Facility and Site

The CISF is located on approximately 1225 acres. The storage area accommodates 40,000 MTU of canistered SNF, as illustrated in Figure 13.5-1. Storage is provided for both vertical cask and horizontal storage module modes of storage. A 200-foot minimum buffer is provided between the unrestricted area and the closest cask in storage, and a 2300-foot minimum distance is provided to the site boundary from stored SNF. These distances minimize the radiation impact of operations upon CISF employees and the public.

The Emergency Operations Centers (EOCs) are located as shown in Figure 13.5-2. The primary EOC is located in the security complex. The alternate EOC is located in the Temporary Administration Building across from the security complex in the area labeled "Temporary Site Support Facilities."

The emergency assembly areas are specified by the emergency coordinator based on the location of the incident and existing meteorological conditions. Two assembly areas have been designated at this time: the temporary site support facilities area and the employee canteen area adjacent to the CISF transfer facility. The two assembly areas are noted in Figure 13.5-2.

The emergency assessment areas (i.e., laboratories for sample analysis) are located in the temporary site support facilities area. This area is noted in Figure 13.5-2.

First aid supplies are located throughout the facility. The first aid room is located in the Temporary Administration Building. The ambulance staging area is located just outside the security complex in close proximity to the first aid room.

Airborne activity releases postulated to occur during normal or accident conditions are most likely to occur in the transfer facility. The transfer facility ventilation system is designed to control airborne emissions so that all effluents are released via a common facility vent which is monitored for radionuclide releases. In-leakage to the transfer facility is minimized in order to minimize exhaust flow rates and maintain positive air effluent control. To ensure positive air effluent control, the exhaust flow rate is greater than the supply rate. Therefore, all leakage is into the building. Roll-up doors are closed whenever possible to prevent bypass flow and the escape of air to the environment, other than through the monitored vent.

Although no significant airborne radiological releases are expected, a transfer facility ventilation discharge monitoring system is provided to monitor and sample vent-air effluent on a continuous basis for environmental discharge assessment purposes. It is capable of detecting particulate, iodine and gaseous radionuclide emissions.

The transfer facility ventilation system includes in-line High-Efficiency Particulate Air (HEPA) filters (for ALARA purposes only) and a damper for bypass operation. The normal operation of the system will bypass the HEPA filters. The HEPA filters can be manually aligned by facility operators for ALARA purposes. The HEPA filters flow path will also be automatically aligned, should noble gas acitivity be detected in transfer facility effluent by the ventilation discharge monitoring system. When the HEPA filters are being used, exhaust air is filtered prior to discharge to the exhaust vent. The exhaust air is monitored by the radiation monitoring subsystem to ensure that no radiological contamination is spread to the environment.

The major structures and areas of the CISF are described below. General arrangements and additional information are provided in Section 4.1.

13.5.1.2.1 Transfer Facility

The transfer facility is the focal point for handling SNF transportation and storage casks at the CISF, and provides for the eventual retrieval of SNF from storage for shipment off-site.

13.5.1.2.2 Storage Area and Concrete Storage Pads

The storage area provides temporary storage space for SNF received at the CISF. It is designed to handle, transfer, store and retrieve commercial SNF contained in Transportable Storage Casks (TSCs), Horizontal Storage Modules (HSMs) and vertical concrete cask systems. In addition, the storage area provides for storage system monitoring, protective services (radiological protection) and the eventual retrieval of SNF from storage for shipment off-site.

The storage area will be constructed in stages, as needed, to support operational throughput requirements. Only SNF assemblies loaded inside sealed canisters or TSCs will be received and handled in the storage area.

Figure 13.5-1 shows the storage area site plan. The figure shows the concrete pads of modular construction which will store up to 40,000 MTU of SNF. The figure denotes a configuration at the beginning of operations (the first stage of construction), representing storage for approximately the first four years.

In the figure, vertical concrete storage casks and TSCs are arranged in double rows, with sufficient spacing to provide access for placement and retrieval of each cask using a dedicated transporter supplied by the vendor. Horizontal Storage Modules are arranged back-to-back in rows, with sufficient spacing to provide access for placement and retrieval of each canister using a dedicated transfer system and horizontal transfer trailer supplied by the vendor.

13.5.1.2.3 Shipping Cask Queuing Areas

The shipping cask queuing areas are provided between the transporter wash-down station and the transfer facility. Queuing spaces are provided for a minimum of 10 rail casks and 10 heavy-haul transporters simultaneously. Rail SNF deliveries will simply await entrance to the transfer facility on the tracks. Heavy-haul SNF delivery transporters will be parked in a paved area next to the rail tracks. The queuing area will be a radiological control area whenever it holds a SNF delivery. ALARA precautions will be directed by site Radiation Protection (RP) staff, and radiation areas will be marked as required.

13.5.1.2.4 Switchyard

Electric power is delivered to the CISF switchyard. Power is transmitted to the CISF through a transmission line from the host utility. The line terminates in the CISF switchyard and is connected to the site's main transformer through a switchyard circuit breaker and associated disconnect switches. A 4.16 kV electrical switchgear is located in the switchgear building located at one end of the switchyard.

13.5.1.2.5 Security Complex

The CISF security complex is a rectangular, single-story structure located at the end of the main personnel and vehicular entrance in the protected area fence (Figure 13.5-2).

The security complex is composed of three areas: a badging area, a security area and a cargo access portal area, and combines the functions of the security building, protected area badge house and Controlled Access Area warehouse. Also included in the security complex are the security lighting panelboard, the surveillance and alarm systems, and the central alarm station

(CAS). The secondary alarm station (SAS) will be housed and monitored by local law enforcement.

The security complex controls the site emergency vehicles, and it is the main operation center for site security personnel. The one-story building has approximately 12,000 square feet of floor area.

The security complex provides secured, controlled entry for personnel, visitors and vehicles into the Controlled Access Area. The building houses security personnel and contains the necessary equipment to search and badge personnel and to inspect vehicles. The complex also contains the necessary support functions for personnel and a cargo access portal (CAP) to efficiently utilize security personnel.

The security complex is not directly involved in the CISF's principal SNF processing functions. Activities at the protected badging area of the Security complex include the following.

- Control and check employees, visitors, and vehicles entering and exiting through the Controlled Access Area fence
- Search personnel
- Issue and collect badges
- Inspect vehicles (site maintenance, site emergency, site personnel and off-site service) entering and leaving the protected area
- Provide visual and electronic surveillance of the protected area
- Provide CAP control and administration
- Serve as the primary Emergency Operations Center (EOC).

13.5.1.2.6 Inspection Gatehouse

The inspection gatehouse is located outside of the Controlled Access Area and is enclosed by an extension of the fence surrounding the Controlled Access Area. The mission of the inspection gatehouse is to receive and inspect SNF assembly shipments made by heavy haul and rail. The facility also provides final clearance for shipments off-site. Access to the CISF site is controlled by motorized rolling gates at roadway and railway penetrations. The first set of gates allows off-site vehicles into the inspection gatehouse enclosure. The second and third sets close off the Controlled Access Area during inspection. An interlock capability prevents all gates from being opened simultaneously.

13.5.1.2.7 Main Gatehouse

Personnel and vehicular access to the CISF is provided by the main gatehouse, located at the site boundary of the CISF (Figure 13.5-1). This gatehouse controls the access of personnel and vehicles to the CISF.

13.5.1.2.8 Water Utilities and Fire Protection

The major equipment supporting the water, sewer and fire protection systems is located in the Water Utilities and Fire Protection area designated in Figure 13.5-1.

The water and sewer system consists of the potable water system, the conventional wastewater system and the sanitary waste system.

The yard fire protection system distributes water to the automatic sprinkler systems and interior stand-pipe systems for building fire protection, and to fire hydrants throughout the site. A dedicated fire water storage and distribution system consists of redundant water storage tanks, a pumphouse with redundant fire pumps, underground supply piping, a looped distribution system and yard hydrants.

13.5.1.2.9 Concrete Cask Staging Area

The concrete cask staging area is located near the transfer facility, next to the queuing area. Empty SNF storage casks are received and stored in this area while they await CISF use.

13.5.1.2.10 Off-Normal Holding Area

The off-normal cask holding area is outside the transfer facility. This area is set aside to receive and temporarily store SNF shipments classified as not eligible for routine processing at the CISF. An example is a transportation cask with interior volume surface contamination exceeding CISF allowable contamination levels or a cask with some security concern. Access is provided for both rail and heavy haul transporters.

13.5.1.2.11 On-Site Receiving Area

The on-site receiving area is located just outside the inspection gatehouse. If SNF deliveries occur while a previous shipment is undergoing security inspection, the new shipment will remain in the on-site receiving area until it can be moved to the inspection area.

13.5.1.2.12 Transporter Wash-down Station

The transporter wash-down station removes road dirt from incoming cask transporters, as required, for security inspections and to aid in maintaining transfer facility cleanliness.

13.5.1.2.13 Receiving Gatehouse

The receiving gatehouse, the first access area for radioactive shipments, is located at the control boundary of the CISF and is staffed only when deliveries are expected. (See Figure 13.5-1.) SNF shipments obtain access to the protected area through this gatehouse. Non-SNF rail shipments also obtain access to the industrial support area through this gatehouse. The receiving gatehouse is not directly involved in the CISF's principal SNF processing functions. Its function is to control the access of both radioactive and non-radioactive shipments.

13.5.1.2.14 Typical Hazardous Chemicals

Table 13.5-2 lists typical chemicals and combustibles associated with the CISF.

Table 13.5-2. Estimated Inventory of Hazardous Chemicals

Chemicals	Inventory (Approximate)	Physical Form & Properties
Lubricants	100 gallons	Liquid, Flammable
#2 Diesel Fuel	<2,000 gallons	Liquid, Flammable
Acetylene	100 ft^3	Gas, Flammable
Oxygen	100 ft^3	Gas, Flammable
Gasoline	<100 gallons (site vehicles)	Liquid, Flammable

13.5.1.3 Description of Area Near the Site

This section is not applicable to a non-site-specific TSAR.

13.5.2 Types of Accidents

13.5.2.1 Postulated Accidents

In this section, postulated accidents and off-normal events are identified which serve as the bases for emergency planning. These events include those categorized as Design Events III and IV in ANSI/ANS 57.9-1984. Type III design events are those that occur infrequently, but could reasonably be expected to occur during the lifetime of the facility. Type IV events include those low probability design-basis accidents which are hypothesized because their consequences may result in the maximum potential impact on the surrounding environment. These also envelop the design basis events (DBE) analyzed in Chapter 12. The events analyzed in this section are listed below.

- Loss of shielding
- Severe weather (tornados, floods, high winds)
- Earthquake
- Explosion
- Fire
- Security events.

For each event, a description of the event, the means of detection, and the potential consequences are described.

13.5.2.1.1 Loss of Shielding

Description of Event: The loss of shielding event is postulated to involve the partial loss of the radiation shielding on the outer surface of a storage system (including storage and transfer casks) or transportation cask. This event is applicable only to those systems having exterior neutron shielding that is susceptible to damage. This event could occur as a result of a cask drop, or tornado missile during operations in the transfer facility or storage area, or enroute to the storage area.

Means of Detection: This event is detected principally by observation. If the event occurs within the transfer facility, the area radiation monitoring system will also detect any increased radiation levels caused by this event and alert plant personnel via local and remote alarms if radiation levels exceed preset limits.

Potential Consequences: As discussed in Section 12.2.10, no off-site consequences are postulated for this event, due to the limited duration of the event and the distance to the site boundary. Potential on-site consequences include locally elevated radiation levels that could result in temporary evacuations or access restrictions for plant personnel until recovery is complete.

13.5.2.1.2 Severe Weather

Description of Event: This event includes tornados, floods, hurricanes, and other severe weather phenomena.

Means of Detection: Severe weather warnings are provided to facility personnel via the National Oceanic and Atmospheric Administration (NOAA) early warning system. Actual tornado sightings and assessment of damage would be via surveillance by plant personnel.

Potential Consequences: As discussed in Section 3.3.1.4, the CISF is assumed to be located above the flood plain; therefore there are no flood impacts on the facility. As discussed in Section 12.2.5, tornado/extreme winds will not cause any failures of the transfer facility structure, or tipover of any storage casks. As discussed in Section 12.2.13, the only potential impact of tornado-generated missiles is localized damage to storage system shielding. This will not result in any off-site consequences. On-site consequences are limited to possible locally elevated radiation levels in the storage area that could result in access restrictions for plant personnel until recovery is complete.

13.5.2.1.3 Earthquake

Description of Event: An earthquake is a natural event that can occur at any time at the CISF and during any stage of a transfer or storage operation.

Means of Detection: An earthquake would be detected by plant personnel.

Potential Consequences: As discussed in Section 12.2.3, there are no postulated radiological consequences of an earthquake at the CISF. The transfer facility superstructure, cranes and other handling equipment are designed to withstand the design-basis earthquake described in Section 2.6.2. Storage, transportation and transfer casks are designed not to tip over, or are restrained to seismically designed equipment at all times.

13.5.2.1.4 Fire

Description of Event: This event consists of a fire accident exposing SSCs important to safety, either during handling at the transfer facility or during cask transporting. Typical fires that may occur include trash fires, vehicle fires, diesel fuel fires and electrical fires. Other fires that may be considered as site-specific, such as forest/grass fires, fires from accidents on nearby highways or fires from nearby industrial facilities, are beyond the scope of this TSAR.

Means of Detection: A fire within a facility structure would be detected by the facility-wide fire detection system or by initiation of fire suppression systems. A fire located in the storage area or surrounding areas would be detected by facility personnel.

Potential Consequences: As discussed in Section 12.2.7, there are no on-site or off-site radiological consequences from a credible fire accident at the CISF. As a matter of site practice, radiological surveys would be taken following a fire involving a storage, transfer or transportation cask, followed by visual inspections and instrumentation testing to ensure that no damage to the structures or radiological release had occurred.

13.5.2.1.5 Explosion

Description of Event: This event involves an on-site or off-site explosion which may damage important-to-safety SSCs at the CISF. An explosion may produce an incident or reflected pressure (overpressure), dynamic (drag) pressure, blast-induced ground motion, or blast-generated missiles.

Means of Detection: An explosion would be detected by plant personnel.

Potential Consequences: Off-site explosions are a site-specific issue, and are beyond the scope of this TSAR. As discussed in Section 12.2.4, all potential on-site sources of explosions have been analyzed, and the CISF design satisfies the Regulatory Guide 1.91

criteria for set-back distances from all potential explosion sources to the transfer facility. Therefore, there are no radiological consequences of on-site explosions.

13.5.2.1.6 Security Event

Description of Event: This event involves a compromise of CISF security. This event may range in severity from a failure of the security system up to the loss of physical control of the facility. Details of the range of security events, means of detection, and plant responses will be included in the Security Plan.

Potential Consequences: There are no direct radiological consequences of a security event. Events subsequent to a security event could involve potential radiological consequences, but these are enveloped by the other accidents analyzed in this section.

13.5.2.2 Detection of Accidents

The methods used to detect and alert CISF personnel of emergency conditions are provided in Section 13.5.2.1. The immediate personnel response to any emergency event is to notify security personnel, who are trained to notify the Transfer Facility Shift Supervisor. Upon assessment of the situation, the Transfer Facility Shift Supervisor will then direct activities as prescribed in the Emergency Plan Implementing Procedures.

13.5.3 Classification and Notification of Accidents

13.5.3.1 Classification System

The only classification category established for postulated incidents at the CISF is the Alert. There are no credible accidents that could lead to a significant release of radioactive or hazardous material and that would require a response by off-site organizations to protect persons off site. Specific instructions for declaring an Alert will be contained in the CISF Emergency Plan Implementing Procedures, which will be developed following site-specific licensing of the CISF and prior to the on-site receipt and possession of spent nuclear fuel.

General examples of Emergency Action Levels (EALs) that could lead to initiation of an Alert at the CISF are listed below.

- An on-site fire that might affect radioactive material or systems important to safety
- Severe natural phenomena that might affect radioactive material or systems important to safety
- Severe natural phenomena or other incidents that may have affected radioactive material or systems important to safety

- Elevated radiation levels or airborne contamination levels within the facility indicating severe loss of control (factor of 100 over normal levels)

- Ongoing security compromise (greater than 15 minutes)

- Other conditions that warrant precautionary activation of the CISF emergency response organization.

13.5.3.2 Notification and Coordination

All CISF personnel receive General Employee Training and Emergency Plan and Emergency Plan Implementing Procedure training on a periodic basis. This training covers CISF systems and equipment, industrial and radiological safety, and the proper response of facility personnel to an Alert condition.

Facility personnel are trained to judge the severity of an emergency situation based on the type of emergency, the plant area, equipment involved and surrounding conditions. The TSAR defines radiation protection objectives, on-site contamination control, guidelines and approaches, off-normal conditions and accidents in Chapters 9 and 12.

A person observing an off-normal or accident condition leaves the area, contacts security personnel located in the security complex and provides them with initial information regarding the event. Security personnel then initiate the following actions.

- Notify the Transfer Facility Shift Supervisor of the event.
- Dispatch security personnel, as necessary.
- Dispatch the fire brigade, as necessary.
- Initiate evacuation and access control of the affected area, as necessary.

The Transfer Facility Shift Supervisor classifies the off-normal or accident situation using the EALs contained in the Emergency Plan Implementing Procedures. If the Transfer Facility Shift Supervisor determines the facility to be in an Alert condition, he or she assumes the responsibility of the Emergency Coordinator and retains this responsibility until relieved by the CISF Site Manager or designee. Upon being relieved, the Transfer Facility Shift Supervisor continues to assist the Emergency Coordinator in returning the facility to a normal, safe status.

Upon declaration of the facility being in an Alert condition, the Emergency Coordinator (either the Transfer Facility Shift Supervisor or CISF Site Manager or designee), initiates the following actions.

- Notifies facility personnel of an Alert condition by sounding a pre-determined alarm, followed by an announcement stating that the facility is in an Alert condition and providing a brief description of the incident.

- Announces instructions for facility personnel (e.g., "proceed to muster area 'A' and staff the primary EOC").

- Notifies the appropriate off-site assistance organizations and the NRC. The off-site organizations will be notified within 15 minutes following a declaration of Alert, after which the NRC will be immediately notified. In all cases, the NRC will be notified within one hour of declaring an Alert.

Small fires are reported to the Security Complex and the Transfer Facility Shift Supervisor. If trained, the person reporting the fire may attempt to extinguish the fire using portable fire extinguishers. If necessary, the fire brigade shall respond to extinguish the fire.

13.5.3.3 Information to be Communicated

EOC personnel will have direct communication with the necessary off-site organizations/ personnel to facilitate immediate emergency response. These off-site organizations, to be identified in the site-specific CISF license application following designation of the CISF site, include local, state and federal government agencies and officials, as well as local law enforcement officials, hospitals, fire departments and ambulance services.

To facilitate consistent and concise transmittal of Alert information to off-site response organizations, a standardized message format is used to issue both initial and follow-up emergency response information. This Emergency Response Report Form is included as Form 13.5-1. Blank copies are located in the primary EOC (security complex) and the alternate EOC (Temporary Administration Building). The off-site organization points-of-contact and other persons on the emergency response notification list will also have copies of the blank form.

Once communication is established between the CISF and off-site organization points-of-contact, the format may be modified by the off-site agencies to meet the needs of the developing situation. All messages transmitted from the CISF are assigned a message number. The Emergency Response Report Form serves as a communications update to off-site organizations during an emergency event and is updated at least once per hour throughout the course of the event.

Form 13.5-1

Emergency Response Report Form

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1. Emergency Classification: Alert / Not Classified

2. Facility Status - System / Area Impacted:
   _____ Storage Yard
   _____ Transfer Facility
   _____ Off-site
   _____ Other: ____

3. Type of Event: _____ Fire _____ Security _____ Radiological _____ Other

4. Emergency Actions Underway at the Facility:
   ____
   ____
   ____
   ____

5. On-site Support Needed From Off-site Organizations:
   ____
   ____
   ____
   ____

6. Source and Description of On-site Radiological Release:
   ____
   ____
   ____
   ____

7. Persons or Agencies Notified: [To be developed - site-specific]
   ____

Release of this
Message Approved: ______________________________ Time/Date:__________
Emergency Coordinator

13.5.4 Responsibilities

13.5.4.1 Normal Facility Organization

The normal facility operating organization is shown in Figure 13.5-3. Detailed information regarding the normal facility organization is in Section 13.1 of the TSAR.

13.5.4.2 On-site Emergency Response Organization

The on-site facility organization during emergency conditions is shown in Figure 13.5-4. The relationship of these personnel to their normal responsibilities and duties is unchanged during an emergency condition.

13.5.4.2.1 Direction and Coordination

Initial activities at the CISF during any emergency condition are directed by the Transfer Facility Shift Supervisor who shall assume the functions of the Emergency Coordinator until the CISF Site Manager or designee arrives to assume those functions. The Emergency Coordinator has the authority and the responsibility to immediately and unilaterally initiate any emergency actions, including:

- Protective action recommendations for on-site personnel

- Notification of the off-site emergency organizations having a response role

- Continued assessment of actual or potential consequences, both on-site and off-site, throughout the evolution of the emergency condition

- Effective implementation of countermeasures, including protective actions for affected areas, implementation of monitoring teams and facilities to evaluate the environmental consequences of the emergency condition, and prompt notification of and communication with off-site authorities

- Continued maintenance of adequate state-of-emergency preparedness until the situation has been effectively managed and the facility is returned to a normal, safe condition.

13.5.4.2.2 On-site Staff Emergency Assignments

During non-regular hours (i.e., back shifts, weekends), at a minimum, the following personnel are present at the CISF while transfer operations are performed:

- One Transfer Facility Shift Supervisor
- One Radiation Protection Technician
- One Transfer Facility Crane Operator
- Four Cask Handling Operators

- One Site Operator
- Requisite number of security personnel.

Therefore, the following positions in the Emergency Organization (Figure 13.5-4) are staffed by on-site personnel:

- Emergency Coordinator (filled by Transfer Facility Shift Supervisor)
- Cask Handling Operators
- Radiation Protection Technician
- Security (filled by security personnel).

A fire brigade organization staffed with on-site personnel is equipped, trained and prepared to respond to fire emergencies and contain fire damage. If assistance is needed, the off-site fire department is available. The brigade members are trained and equipped to respond to fire emergencies and contain fire damage until off-site help from a neighboring fire department arrives to assume control and responsibility for all fire fighting activities. If the CISF is not located within reasonable distance of an off-site fire department, all fire fighting responsibilities will be performed by the on-site fire brigade.

The remainder of the Emergency Organization is staffed by personnel summoned to the facility.

An authorized EOC person will call emergency personnel to duty to augment the activities of personnel already at the facility. All telephone numbers will be placed near communications equipment in the security complex (primary EOC) and the Temporary Administration Building (alternate EOC). Procedures for staffing during emergency conditions are discussed in the Emergency Plan Implementing Procedures. Training of all CISF personnel is described in Section 13.5.7.2 of the Emergency Plan.

The emergency response capabilities provided by the various groups within the Emergency Organization are shown in Figure 13.5-4. The responsibilities of each position are outlined below.

13.5.4.2.3 Transfer Facility Shift Supervisor

The Transfer Facility Shift Supervisor ensures that all actions required during any emergency condition have been performed and that all actions necessary for the protection of persons and property are being taken. Upon being relieved of Emergency Coordinator functions, the Transfer Facility Shift Supervisor shall continue to take all actions necessary to ensure that an emergency situation is brought under control. This includes analysis of the event and directing personnel to bring the situation under control and restore facility systems and equipment to a safe condition.

13.5.4.2.4 Emergency Coordinator

The Emergency Coordinator or, in his/her absence, a designated alternate, shall have complete responsibility for activation and staffing of the EOC with those personnel deemed necessary to effectively assess an emergency condition. The Emergency Coordinator shall institute procedures necessary for the EOC to gain immediate control of the emergency. With direct communication via telephone or radio with off-site response teams, and via telephone to the NRC, the Emergency Coordinator shall maintain lines of communication and consultation to ensure that those agencies are informed of the emergency condition at all times, in accordance with this Emergency Plan.

13.5.4.2.5 Operations Manager

The Operations Manager, when designated, shall assume the duties of the CISF Site Manager. The Operations Manager provides technical expertise to the Emergency Coordinator and the Transfer Facility Shift Supervisor regarding solutions to operational problems. Responsibilities include ensuring that each operating shift is staffed with competent personnel trained and prepared to manage all off-normal or accident conditions, and augmenting personnel resources as necessary to accomplish this goal. The Operations Manager shall provide technical expertise to other members of the EOC, and shall work closely with the Superintendent of Maintenance in restoring station equipment to operational status during and after an off-normal or accident condition.

13.5.4.2.6 Technical Services Manager

The Technical Services Manager, when designated, shall assume the duties of the CISF Site Manager. The Technical Services Manager provides expertise to the CISF Site Manager and the Transfer Facility Shift Supervisor regarding solutions to technical problems, and provides technical expertise to other EOC members in the areas of industrial safety and engineering. Duties also include communication with off-site emergency response groups. The Technical Services Manager shall ensure that all areas of responsibility under his or her direction are staffed with competent personnel properly trained and prepared to support an off-normal or accident condition.

13.5.4.2.7 Maintenance Manager

The Maintenance Manager, when designated, shall assume the duties of the CISF Site Manager. The Maintenance Manager provides expertise to the CISF Site Manager and the Transfer Facility Shift Supervisor regarding solutions to maintenance problems. Responsibilities include providing technical and engineering expertise to other EOC members in the areas of mechanical maintenance, planning, instrument and electrical maintenance, and materials support. The Maintenance Manager shall ensure that all areas of responsibility under his or her direction are staffed with competent personnel properly trained and prepared to support an off-normal or accident condition.

13.5.4.2.8 Regulatory and Licensing Manager

The Regulatory and Licensing Manager, when designated, shall assume the duties of the CISF Site Manager. The Regulatory and Licensing Manager provides technical expertise to the CISF Site Manager and the Transfer Facility Shift Supervisor regarding conditions at the facility, and to other EOC members in the areas of licensing and emergency preparedness. This includes responsibilities for communications with the NRC and the EOC. It is the responsibility of the Regulatory and Licensing Manager to ensure that all areas under his or her direction are staffed and prepared to provide support for an off-normal or accident condition.

13.5.4.2.9 Evacuation Coordinator

The Site Services Manager, when designated, shall assume the duties of the CISF Site Manager. The Site Services Manager acts as the Evacuation Coordinator. Responsibilities include providing administrative support to the EOC and, as Evacuation Coordinator, supervising security personnel in coordinating and controlling facility evacuation and facility personnel accounting.

13.5.4.2.10 Radiation Protection Supervisor

The Radiation Protection Supervisor shall be responsible for providing EOC personnel information and recommendations concerning contamination or radiation levels at the facility. Responsibilities include gathering and compiling on-site and off-site radiological monitoring data, and making recommendations to the Emergency Coordinator concerning on-site and off-site actions deemed necessary for limiting exposure to facility personnel and members of the general public. This individual also has prime responsibility for decontamination activities, with assistance from others as necessary.

13.5.4.2.11 Community Relations Coordinator

The Community Relations Coordinator shall be responsible for coordinating news releases to the public, ensuring that news releases are coordinated with other agencies making related news releases. A direct line of communication exists between the CISF Community Relations Coordinator and the CISF Site Manager to ensure current and factual news releases.

13.5.4.3 Local Off-site Assistance to Facility

The CISF shall establish and maintain, on an annual basis, formal written emergency assistance agreements with the following agencies/groups:

- Local hospital
- Local ambulance provider
- Local fire department
- Local and state law enforcement agencies
- Other state and local agencies as necessary.

Copies of emergency assistance agreements and other related correspondence will be contained in an Appendix to the site-specific Emergency Plan.

A current telephone listing of all off-site response organizations that might be needed during site emergency situations is maintained in the Emergency Plan Implementing Procedures. The facility Emergency Coordinator or a designated representative is responsible for contacting and requesting assistance from local off-site emergency organizations, if required, during emergency situations. Radio communication must be established and maintained with all off-site response organizations in case of telephone loss. Applicable equipment and procedural training needed by the local police, fire department and hospitals to deal with CISF emergencies or radiological exposures are discussed in the Emergency Plan Implementing Procedures.

The Emergency Plan Implementing Procedures discuss more thoroughly the functions and services of each off-site response organization. The specific locations of these off-site organizations relative to the CISF will be identified in the site-specific Emergency Plan.

The locations of the response organizations will be shown on the 10-mile radius map included in the site-specific Emergency Plan.

During emergencies, normal visitor access controls are suspended and off-site assistance organizations requiring access to the controlled access area (CAA) are met at the entrance gate by security personnel, immediately assigned an escort, and allowed site access. This procedure is practiced during emergency exercise drills.

When off-site assistance organizations (e.g., fire, medical, law enforcement) arrive on site, their escort is responsible for directing and coordinating their activities.

13.5.4.4 Coordination with Participating Government Agencies

The principal state and local agencies/organizations responsible for radiological or other hazardous material emergencies in the vicinity of the CISF will be listed in this section of the site-specific Emergency Plan.

CISF emergency response personnel meet at least annually with each off-site assistance group to provide training and review items of mutual interest.

To ensure effective communication, the radios used by CISF personnel and off-site assistance organizations are compatible. Controls are established with off-site organizations to ensure that only accurate information is released to off-site assistance and media organizations. Controls may be in the form of password verification or call-back verification procedures.

13.5.5 Emergency Response Measures

13.5.5.1 Activation of Emergency Response Organization

A person observing an off-normal event or accident condition leaves the area, contacts security personnel in the security complex and provides them with initial information regarding the event. Security complex personnel then initiate the following actions.

- Evacuate the area by dispatching either operators or security personnel to the accident area.

- Contact the Transfer Facility Shift Supervisor who confirms the incident. This confirmation may be given by other personnel who relate the incident to the Shift Supervisor.

- Using the criteria provided in a Emergency Plan Implementing Procedure specifically written to determine Emergency Action Level (EAL), the Transfer Facility Shift Supervisor determines the EAL. (Specific examples of these criteria are provided in Section 13.5.3.1)

Upon determining that the incident is an Alert, the Transfer Facility Shift Supervisor declares the facility to be in the Alert EAL and assumes the responsibility of the Emergency Coordinator. The Transfer Facility Shift Supervisor retains this responsibility until relieved by the CISF Site Manager or designee. Upon being relieved, the Transfer Facility Shift Supervisor continues to assist the Emergency Coordinator in containing and assessing the impact of any material released and restoring the facility to normal and safe status.

Upon declaration of the facility being in an Alert EAL, the Emergency Coordinator (the Transfer Facility Shift Supervisor or the CISF Site Manager or designee) initiates the following actions:

- Sounds a pre-determined alarm, followed by notification that the facility is in an Alert EAL and a brief description of the incident

- Provides instructions for facility personnel (e.g., "proceed to muster area 'A' and staff the primary EOC").

Personnel in the affected areas or the entire facility then evacuate and proceed to the muster area. The Evacuation Coordinator initiates a personnel count, and an Emergency Response Report Form is issued.

Radiation Protection personnel set up radiological air sampling and contamination control point(s) if there is potential involvement of radioactive material. If the situation involves a spill of hazardous material, the EOC directs a spill control/cleanup team.

The EOC coordinates appropriate recovery activities and operations. Anytime the EOC is activated, the entire EOC organization (Figure 13.5-4) is activated. Any personnel needed from offsite (e.g., off duty personnel) are summoned to the facility by telephone.

13.5.5.2 Assessment Actions

The Emergency Coordinator monitors the situation to ensure personnel and public safety and to secure and protect facility equipment. Appropriately trained emergency response personnel or teams respond as necessary to protect personnel, secure the facility, and terminate and/or control cause(s) of situations. If a liquid or gaseous release occurs, radiological/chemical spill control teams initiate containment, control and cleanup efforts, and projections of radiation and hazardous material exposures are made for the event. The Emergency Coordinator or designee advises off-site assistance organizations of the situation and requests their assistance if needed.

For those incidents in which radioactive material is released, monitoring and sampling is performed to assess the extent and amounts of material released. (Refer to Section 13.5.2 for a description of potential release scenarios.) This includes water, air and soil samples, both upwind/upstream and downwind/downstream of the release. Urine and fecal samples are taken from exposed workers. Depending on the extent and amount of contamination, cleanup begins as soon as possible. Sampling and monitoring would continue until decontamination is complete.

13.5.5.3 Mitigating Actions

Alarm systems that indicate abnormal operating conditions are provided in the transfer facility for SNF dry cask storage systems and in the security complex for fire detection systems. Radio and public address audio communication with facility personnel in the operating areas provide the detection and communication capacity to trigger a plant-wide alarm for protection of workers and the start of mitigation procedures.

If the main alarm systems are inoperable, radio communication is the next immediate avenue of activation of this contingency plan. Facility personnel provide nearly continuous surveillance of all operating areas through routine inspections and observations.

The fire protection system consists of fire hose standpipes, portable fire extinguishers, wet pipe sprinkler systems, pre-action sprinkler systems, fire barriers, fire detection and alarm systems, and smoke control systems. Fire hose stations are located so that any interior location of the facility can be protected with an effective hose stream. Hose nozzles are selected based on the hazard protected.

Portable extinguishers are located throughout all buildings, and are positioned in accordance with National Fire Protection Association (NFPA) 10. Sprinkler systems are engineered to protect specific hazards in accordance with parameters established by Fire Hazards Analysis. Automatic wet pipe sprinkler systems, designed and tested in accordance with NFPA 13, are provided.

A facility-wide fire alarm system, including a microprocessor-based intelligent central alarm console, is located in the security complex.

The fire protection system is designed to mitigate the results of a fire. Features of the fire protection program and systems include the following.

- Fire Hazards Analysis identifies potential hazards.
- Fire detection systems are installed to provide prompt notification of fire consistent with parameters established by the design basis.
- Manual fire fighting equipment such as fire hydrants, fire hoses, hose stations and portable fire extinguishers are provided to support extinguishment of an incipient fire.
- A fire protection water supply is provided to ensure adequate water supply to automatic fire protection systems and fire hose stations from redundant water storage tanks and fire pumps. The system is arranged to ensure that, if the primary fire suppression system is impaired, the backup system is operational.
- Automatic sprinkler systems are engineered to actuate and suppress fire prior to unacceptable damage, consistent with parameters established by the design basis.
- Barriers with fire resistance ratings consistent with the current edition of NFPA 101 and Fire Hazards Analysis are provided to prevent unacceptable fire propagation, consistent with parameters established by the design basis.
- A smoke control system is provided to prevent the unacceptable spreading of particles of combustion, consistent with parameters established by the design basis.
- A fire prevention program is implemented to minimize the potential ignition and propagation of fire. This program includes control of ignition sources and combustible materials.
- A surveillance and maintenance program is implemented to ensure that fire protection systems and equipment remain operable and will function properly when needed to detect and suppress fire.
- A fire fighting pre-plan is developed, and a fire brigade organization is equipped, trained and prepared to respond to fire emergencies and contain fire damage to an acceptable level.

Additional information regarding the fire protection systems at the CISF may be found in Chapter 4 of this TSAR.

Procedures developed and maintained for responding to emergency conditions and directions for manual actions to bring the facility to a safe condition are contained in the Operating Procedures.

13.5.5.4 Protective Actions

13.5.5.4.1 On-site Protective Actions

13.5.5.4.1.1 Personnel Evacuation and Accountability

Evacuations from facility areas to assembly or muster areas are determined by the Emergency Coordinator based on the emergency conditions/events at hand. Subsequent evacuation procedures and routes are outlined in the Emergency Plan Implementing Procedures.

Situations not requiring staff response for control, containment and recovery are brought to the attention of appropriate personnel directly or by means of a coded announcement over the public address (PA) system or telephone. Examples of this type of situation include localized radioactive material spills, personnel injuries and localized fires.

Audible alarms and visual flashing lights are used to initiate facility area evacuations. A system functioning in conjunction with the radiation monitoring systems provides an automatic evacuation signal upon receiving a high-level signal from any two radiation monitors. This system may also be triggered manually. An additional manual fire alarm system can also initiate a facility area evacuation. The PA system, radiation alarms and fire alarms have emergency backup power.

Key personnel and support groups such as the Monitoring Teams and Emergency Response Team are informed of the staff's analysis of the situation, and their response may result in evacuation from affected areas to an assembly or muster area.

In the event of a facility area evacuation, visitors and contractor personnel are the responsibility of the plant employee designated as the visitor escort. A register of CISF visitors is kept at the security complex and is available to the Evacuation Coordinator.

The Evacuation Coordinator is responsible for accounting for all site personnel and conducting a missing persons check through a system of defined muster areas. Upon accounting for personnel, the Emergency Coordinator decides whether to dismiss non-essential personnel from the site. The Radiation Protection Supervisor initiates radiological monitoring of evacuees, decontamination and selection for medical attention.

The personnel assembly areas (Figure 13.5-2) are the Temporary Administration Building and the Employee Canteen next to the transfer facility. The Emergency Coordinator is responsible for deciding whether a facility area evacuation is necessary and which evacuation route is used.

13.5.5.4.1.2 Use Of Protective Equipment And Supplies

The Radiation Protection Field Monitoring and Monitoring Team members are trained in the use of respirators and protective clothing. To become qualified, each team member must pass an appropriate medical examination. The Emergency Coordinator decides when protective equipment needs to be issued.

Supplies and equipment are located in the CISF first aid room, in lockers in the security complex and in emergency equipment areas inside and outside the main facility buildings. The distribution of supplies and equipment is coordinated by the Industrial Safety Coordinator, and their use and distribution are an integral part of periodic training.

Details of the locations, types and quantities of protective equipment and supplies, including respiratory protection equipment and protective clothing, are posted in the transfer facility and the security complex. Protective equipment and supplies will be inventoried and tested once per quarter to ensure supplies and equipment are available in case of emergency.

13.5.5.4.1.3 Contamination Control Measures

A contamination control line, if needed, is established as close as possible to the contaminated area and is designated by a physical barrier if possible. All equipment, material and personnel leaving the contaminated area pass through the control line for surveying.

Contaminated equipment and material are put in plastic bags or wrapped in plastic, and contaminated personnel are decontaminated and sent to the muster area. Injured personnel are decontaminated prior to leaving the CAA, if injuries permit. In the event that personnel cannot be decontaminated, the contaminated areas are wrapped, and injured personnel are transported to appropriate facilities.

Return of personnel and equipment to routine operations is made after:

- Airborne activity levels are less than 25 percent of the appropriate 10 CFR 20 limits

- Surface contamination levels do not present a personnel hazard through direct radiation exposure, inhalation/ingestion, further spread of contamination or re-suspension in the air

- The cause of the incident has been investigated and measures to prevent recurrence have been developed and implemented

- Safety systems are operational or an acceptable substitute has been installed.

13.5.5.4.2 Off-site Protective Actions

No off-site protective actions are necessary for the CISF.

13.5.5.5 Exposure Control in Radiological Emergencies

13.5.5.5.1 Emergency Radiation Exposure Control Program

13.5.5.5.1.1 Radiation Protection Program

In any case involving radiation exposure, efforts are made to satisfy ALARA criteria. The Emergency Coordinator is responsible for authorization of workers receiving emergency doses. Exposure and contamination control is outlined in CISF Emergency Procedures which include further discussion on exposure to radiation.

Any on-site or off-site workers who agree to emergency doses during emergencies are informed of the potential dangers. Emergency dose levels are an emergency planning training topic for on-site workers as well as off-site assistance organization personnel. Emergency exposure guidelines are provided in Table 13.5-3.

Table 13.5-3. Emergency Exposure Guidelines

Operations	**Non-Lifesaving** **Whole Body (Rem)**	**Lifesaving** **Whole Body (Rem)**
Removal of injured	15	25
Undertaking corrective action	15	25
Performing assessment actions	15	25
Providing first aid	15	25
Performing personnel decontamination	15	25
Providing ambulance service	15	25

13.5.5.5.1.2 Monitoring

Dose estimation techniques may be subdivided into several categories:

- TLD badges are worn by CISF employees and off-site organization personnel to monitor beta gamma exposure. Off-site organization personnel receive badges when they arrive on-site, prior to proceeding into the CAA.
- Air sampling is used in situations involving airborne dispersal of radioactive material.
- Bioassay sample collection (fecal, urine and nose smears) are used for assessing exposure to internal emitters.

Dose records are evaluated and maintained by the Radiation Protection Supervisor.

13.5.5.5.2 Decontamination Of Personnel

Personnel decontamination in the event of a minor or localized incident is accomplished using standard Radiation Protection practices. Available facilities include personnel showers for whole body decontamination and a decontamination kit for localized contamination involving a limited body area. Decontamination efforts are directed and evaluated by Radiation Protection personnel. Radiation Protection procedures specify the extent of decontamination efforts which may be undertaken without medical supervision. To support personnel decontamination during a facility evacuation, a decontamination kit, including selected decontamination agents, is included with the emergency supplies. This kit enables prompt gross decontamination when low levels are involved.

Action levels for determining the need for personnel decontamination and the means for decontamination of personnel, wounds, supplies, instruments and equipment shall be at the direction of the Radiation Protection Supervisor. In cases of personal injury accompanying contamination, decontamination efforts shall not interfere with or take precedence over proper medical care. All instances of contamination above limits shall be properly documented and, if appropriate, reported to the NRC in accordance with 10 CFR Part 20.

13.5.5.6 Medical Transportation

In the event of an injury to facility personnel who may also be radiologically contaminated, the local hospital is contacted to provide ambulance transportation from the CISF to the hospital. The injured, contaminated individual will be accompanied by a qualified Radiation Protection representative.

13.5.5.7 Medical Treatment

The local hospital provides medical services to the facility in the event of a medical emergency. Physicians associated with the hospital participate in annual emergency training involving the transportation and treatment of radiologically contaminated patients. Details regarding medical treatment arrangements between the CISF and an off-site hospital will be described in letters of agreement contained in an Appendix to the site-specific Emergency Plan.

As discussed in Section 13.5.7.2.3, off-site organizations, including the local hospital personnel, are trained to provide emergency support to the CISF. This training includes instructions on treating contaminated injuries. Through contact with other organizations, hospital personnel will also have access to expert advice on possible internal contamination.

13.5.5.8 Public and Media Access to Information

The CISF Community Relations Coordinator shall be responsible for coordinating news releases to the media and general public. Guidelines and provisions for public and media access to information are discussed in the Emergency Plan Implementing Procedures. A direct line of communication exists to the CISF Site Manager to ensure current and factual news releases.

In the event of an Alert condition, the Community Relations Coordinator will notify designated media contacts, provide them with an approved news release and advise them of any planned news conferences. Copies of news releases will be telecopied or carried by runner to local and state emergency response agencies.

13.5.6 Emergency Response Equipment and Facilities

13.5.6.1 Command Center

The principal point for responding to emergencies is the primary EOC located in the Security complex. The EOC has direct communication equipment to all principal points within and outside the facility. The alternate emergency response point is the alternate EOC located in the Temporary Administration Building. Identification of the emergency control point for the facility is determined by the Emergency Coordinator or a representative, depending on the nature and location of the emergency response situation.

The two EOCs are located in different buildings, and it is very unlikely that both areas would be unavailable simultaneously.

13.5.6.2 Communications Equipment

13.5.6.2.1 On-site Communications

There are four primary communication systems at the CISF: (1) the facility telephone system, (2) the public address system, (3) alarm systems and (4) two-way radios. These systems are designed so that a failure in one system does not leave the facility without communication capability. Redundant devices provide emergency communications, and backup power is supplied to essential devices to ensure communication during off-normal or accident conditions. The major communication system used during emergency situations is radio equipment maintained by the Security department. Extra equipment or spare portable communication radios are maintained in the security complex (primary EOC), as well as at the alternate EOC location. Backup communication under emergency conditions is provided by mobile telephones to be used in case of telephone outage or power failure. All monitoring equipment, including power supplies, is checked on a regular basis to ensure availability and functionality.

13.5.6.2.2 Off-site Communications

Two primary systems are used to communicate between the CISF and off-site response organizations, the facility telephone system and two-way radios. Direct communication with the NRC is accomplished via telephone. Backup telephone communication is provided by mobile telephones to be used in case of telephone outage or power failure. Radio communication must be established and maintained with all off-site response organizations in case of telephone loss. Radios used by CISF personnel and off-site assistance organizations are compatible.

13.5.6.3 On-site Medical Facilities

The following dedicated first aid equipment is located in the transfer facility:

- Standard first aid supplies recommended by the American Red Cross, and oxygen resuscitation equipment
- A shower and bathtub for radioactive material decontamination
- Portable and laboratory-type radiation detection and survey instruments
- Portable air sampling equipment
- Self-contained breathing apparatus.

An ambulance (security vehicle) with resuscitation equipment and stretcher is maintained on site.

13.5.6.4 Emergency Monitoring Equipment

13.5.6.4.1 Air Monitors

Air quality monitoring devices assess concentrations of radioactive material being released to the environment . The details of the program, including locations of sampling points, are described in Chapter 9 of the TSAR.

Following an incident in which radioactive material could potentially be released to the environment, samplers' filters would be collected and analyzed as soon as possible following the incident to aid in recovery from the event.

13.5.6.4.2 Emergency Equipment

Available emergency equipment includes protective clothing, respirators, portable α (alpha) and β (beta) monitors, and hand-foot monitors located at Controlled Access Area entrance/exit points. The clothing consists of a full body suit, usually worn in conjunction with a respirator (i.e., Scott Air Pack).

Emergency equipment is located outside of but adjacent to the transfer facility area, in the remote operating areas and building vestibules indicated in Figure 13.5-5. These locations ensure access to the equipment for the potential accidents postulated in Section 13.5.2.

13.5.7 Maintaining Emergency Preparedness Capability

13.5.7.1 Written Emergency Plan Procedures

A formal set of Emergency Plan Implementing Procedures will be developed for the CISF. These documents provide the necessary guidance for implementing specific emergency procedures for accident conditions described in Section 13.5.5 and for all other categorized non-routine operational events. The procedures indicate facility management responsibility for preparing and implementing emergency plans, and provide for review and annual update of procedures. Individuals and groups assigned emergency responsibilities are informed of any changes in procedural requirements.

Emergency instructions pertinent to specific accident scenarios and other categorized non-routine operational events are developed and included in the Emergency Plan Implementing Procedures.

13.5.7.2 Training

13.5.7.2.1 General Aspects

The CISF Training Program is designed specifically to train operating and maintenance personnel in the safe handling of SNF and the effective operation of equipment. Both classroom instruction and in-plant training cover four basic program elements:

- Radiation Safety
- Facility Operations
- Equipment Operation
- Emergency Procedures.

13.5.7.2.2 Employee Safety Training

Initial training for new employees includes health and safety topics presented in formal lectures and demonstrations by Radiation Protection and Industrial Safety personnel.

After initial training and prior to the new employee's work assignment, the CISF Site Manager or designee discusses with the employee the importance of rules pertaining to radiation and industrial safety. A safety orientation checklist is maintained and stored in the employee's training record.

Radiation Protection staff review the Employee Safety Handbook with new personnel and conduct training in radiation safety, protective equipment and emergency procedures. Transfer Facility Shift Supervisors provide on-the-job training for newly assigned personnel, including awareness of safety hazards related to the employee's job assignment.

During the first month of in-plant training, or after ten days on a work assignment, the Radiation Protection and Industrial Safety groups further instruct new employees in contamination control priorities, the respiratory protection program, the plant emergency warning system and industrial safety matters.

Periodic safety meetings are conducted by supervisors and/or Radiation Protection personnel to ensure continued awareness of facility safety.

Additional training is required of emergency response individuals (i.e., any employee who is a potential staff member of the Emergency Organization shown in Figure 13.5-4). The additional training provides specific information on Emergency Organization response during emergency conditions. Topics include EOC staffing during normal and off-normal working hours, determining and estimating potential releases of radiation, and interface with off-site assistance organizations. This training, at least four hours in length, must be provided to every employee in the Emergency Organization at least once every year.

13.5.7.2.3 Off-site Organization Personnel Training

Off-site assistance organization personnel are periodically trained in CISF emergency planning procedures. This training includes facility tours, information concerning facility access control (normal and emergency), potential accident scenarios, exposure guidelines, personnel monitoring devices, communications, contamination control, and the off-site assistance organization's role in responding to an emergency.

13.5.7.3 Drills and Exercises

Written tests follow each radiological safety training program and respirator protection training program. Procedures also provide for quarterly training consisting of emergency drills, first aid training, use of self-contained breathing apparatus, and review of applicable procedures. Off-site response organizations are invited to participate in these quarterly training sessions.

Responsibility for planning, scheduling and conducting emergency response exercises for the CISF is established by joint agreement between the DOE's Chief Safety Officer and the CISF operating contractor's Emergency Preparedness Coordinator.

13.5.7.3.1 Biennial Exercises

Exercises are conducted on a biennial basis, and off-site organizations are invited to participate. A written description of the biennial exercise arrangement and any advance materials are provided to selected non-participating controllers, evaluators, and official state and federal personnel. This description contains the exercise objectives and scenario, and is submitted to the NRC for review and comment at least 60 days prior to the exercise. It also contains criteria for a participant's acceptable performance. For example, one criterion would be the notification of local off-site assistance organizations within 15 minutes of the declaration of an Alert.

Responsibility for planning, scheduling and conducting emergency response exercises for the CISF is established by joint agreement of the DOE's Chief Safety Officer and the CISF operating contractor's Emergency Preparedness Coordinator.

Exercises are conducted on a biennial basis and are required of all off-site response organizations. In addition, as stated in the agreement letter with a local hospital, an annual emergency exercise is required of hospital personnel. A written description of the exercise arrangements and any advance materials are provided to selected non-participating controllers, evaluators and official state and federal personnel. Exercise scenarios differ from year to year to ensure all major emergency situations are tested over a five-year period. Some exercises are unannounced to participants and are conducted during adverse weather conditions and at different work shift periods.

13.5.7.3.2 Quarterly Communication Checks

Emergency telephone numbers contained in the facility's Emergency Plan Implementing Procedure are verified and updated on a quarterly basis by the CISF Emergency Preparedness Coordinator.

13.5.7.4 Critiques

Evaluation and critiques of all emergency response exercises are conducted by non-participating observers (i.e. local, state and federal) as soon as possible after the exercise, and the findings are communicated in writing to the DOE's Chief Safety Officer. Identified changes (need for corrective actions, etc.) are communicated to participating organizations and groups as soon as possible following the exercises. All plans are revised to reflect necessary changes.

The CISF Emergency Preparedness Coordinator is responsible for tracking deficiencies and ensuring corrective actions are implemented.

13.5.7.5 Independent Audit

The Emergency Plan Implementing Procedures developed for the CISF are reviewed and updated on an annual basis to meet state and federal requirements. Reviews are performed by individuals assigned by the CISF Site Manager. Any changes to the Emergency Plan or its Implementing Procedures are approved by the CISF Site Manager. Plans and procedures, as well as changes, are handled and distributed to participants via written procedures.

An annual audit of the Emergency Plan and its Implementing Procedures is conducted by an independent group (e.g., Quality Assurance) to ensure continued effectiveness.

The CISF Emergency Preparedness Coordinator is responsible for tracking corrective actions based on audit findings and for ensuring corrective actions are implemented.

13.5.7.6 Maintenance and Inventory of Emergency Equipment, Instrumentation and Supplies

All equipment described in the plan is inventoried and checked for operability on a quarterly basis by facility personnel. This includes instrument calibrations and material shelf-life check as appropriate, as well as checking equipment to ensure it is in good working order.

13.5.7.7 Letters of Agreement

Changes to the Emergency Plan are handled and distributed to appropriate off-site response organizations using written procedures.

The CISF establishes and maintains formal written emergency assistance agreements with off-site response organizations identified in Section 13.5.4.3 of the Emergency Plan. These letters of agreement are reviewed annually and renewed at least every four years, and more frequently if needed. Copies of letters of agreement, when available, will be contained in an appendix to the site-specific Emergency Plan.

13.5.8 Records and Reports

13.5.8.1 Records of Incidents

Records are maintained of incidents that resulted or might have resulted in radiation exposure in excess of normal exposure. Included are off-normal events, accidents and equipment failures. Records of incidents are maintained for the life of the facility and serve as lessons learned for future use.

An internal Occurrence Report is used to record and report such incidents, identify causes of incidents and recommend corrective action. The report includes:

- Date and time of occurrence
- Description of equipment involved
- Cause(s) of incident
- Results of incident
- Corrective action recommended
- Names of personnel involved
- Exposure received
- Type of protective equipment used
- Corrective action taken.

Contamination occurrence will be so noted on the Occurrence Report under "Results of Incident." These reports are distributed to CISF management, are maintained on file at the facility for the life of the facility, and are inspected by the NRC as necessary. Occurrence Reports are maintained for decommissioning purposes as discussed in Section 13.4 of the TSAR. The CISF Regulatory and Licensing Manager is responsible for maintaining the records associated with Occurrence Reports.

13.5.8.2 Records of Preparedness Assurance

Records are kept on file at the CISF that confirm ongoing preparedness to respond to radiological incidents and other emergencies. These records include training, drills, emergency equipment inventories and maintenance, agreements with off-site organizations, and reviews and updates of the Emergency Plan. These records are maintained for at least three years.

Training records, which include copies of lesson plans and test questions, are maintained by the Site Services Department. All other records (e.g., emergency equipment inventories), including exercise critiques and recommended corrective actions, are maintained by the CISF Emergency Preparedness Coordinator.

13.5.9 Recovery and Plant Restoration

The Emergency Coordinator is responsible for assessing damage, completing repairs, and restoring and testing important-to-safety and other equipment needed to restore normal and safe operations. The Emergency Coordinator is also responsible for documenting the recovery effort in accordance with the Occurrence Report described in Section 13.5.8.1. Restoring the CISF to safe status begins with the termination of the cause of the radiological incident. Assessments of damage, if any, can then be made. Decontamination of the areas involved in the incident is performed by CISF personnel using proper protective equipment to maintain exposures within 10 CFR 20 limits. The facility's capabilities to contain radioactivity is restored after all safety-related equipment involved in the incident has been checked and returned to an operable status. Damage is assessed by facility management and standard procedures are followed to repair or replace facilities and equipment as required.

Operations are resumed as soon as normal facility conditions are restored, the cause of the incident has been determined and corrective actions have been taken.

13.5.10 Compliance with Community Right-to-Know Act

Beginning with construction and continuing into facility operation, DOE shall ensure and maintain compliance with the Superfund Amendments and Reauthorization Act (SARA) entitled "Emergency Planning and Community Right-to-Know Act of 1986," through the following activities.

- Conducting annual inventories regarding the description, hazards, amounts and location of hazardous chemicals present or maintained at the facility, as defined in the Occupational Safety and Health Administration (OSHA) Hazards Communications Standard

- Compiling inventory information into the official inventory form used by the CISF host state

- Advising and training construction and operating personnel regarding the marking, storage and location of all hazardous chemicals, including regulatory requirements for reporting accidental releases of these substances.

14. TECHNICAL SPECIFICATIONS

This chapter presents the CISF technical specifications or conditions of operation, operating controls and limits. The term technical specifications may be considered synonymous with operating controls and limits. The technical specifications define the conditions that are deemed necessary and sufficient for safe operation of CISF. The technical specifications define operating limits and controls, monitoring instruments and control settings, surveillance requirements, design features and administrative controls that ensure safe operation of the facility.

The vendors of individual storage cask systems have imposed operating controls and conditions on their systems (Ref. 14.1-1 through 14.1-8) which are also imposed on the storage cask systems at the CISF with some clarifications as provided in this chapter.

This TSAR seeks NRC concurrence that:

- The technical specifications proposed for the CISF are appropriate and acceptable.

14.1 FUNCTIONAL/OPERATING LIMITS AND MONITORING LIMITS/ LIMITING CONTROL SETTINGS

Functional and operating limits for the CISF are limits on fuel or waste handling and storage conditions found to be necessary to protect the integrity of the stored fuel or waste container, to protect employees against occupational exposures and to guard against the uncontrolled release of radioactive materials. Monitoring instruments and limiting control settings for the CISF are related to fuel or waste handling and storage conditions having significant safety functions.

The operating controls and conditions listed in Table 14.1-1 are vendor/design specific and are taken directly from the applicable cask vendor SARs or Certificates of Compliance without modification.

Table 14.1-1 Vendor Supplied Controls and Conditions

Control or Condition	Applicable Systems
Maximum temperature limits for storage casks	Westinghouse Large/Small MPC System VECTRA NUHOMS® System Sierra TranStor™ System
Storage cask cavity pressure maintenane requirements	NAC STC System
Hydraulic ram maximum pressure limits	Westinghosue Large/Small MPC System VECTRA NUHOM® System
Crane lift load limitation for lifting a loaded spent nuclear fuel canister	Sierra TranStor™ System

The following operating controls and conditions apply to all cask systems and envelop the vendor limits.

- The radiation doserate limits for storage casks, horizontal storage modules and TSCs shall be less than 10 mrem/hr at two meters from any vertical surface.

- The maximum removable surface contamination for all casks prior to transfer to the storage area shall be as follows.

- 30,000 dpm/100 cm^2 gamma-beta
- 3,000 dpm/100 cm^2 alpha.

- Maximum removable surface contamination for all transportation casks prior to transport off site shall be as follows.

  - 2,200 dpm/100 cm^2 gamma-beta
  - 220 dpm/100 cm^2 alpha.

14.2 LIMITING CONDITIONS FOR OPERATION

Limiting conditions for operation (LCO), which are the lowest functional capability or performance levels of equipment required for safe operation, cover two general classes: (1) equipment and (2) technical conditions and characteristics of the installation necessary for continued operation, as discussed below.

Equipment: Operating controls and limits establish the lowest acceptable level of performance for a system or component, and the minimum number of components or the minimum portion of the system that should be operable or available.

Technical Conditions and Characteristics: Technical conditions and characteristics are stated in terms of allowable quantities, e.g., storage structure temperatures, area radiation levels, or allowable configurations of equipment and canisters during transfer operations.

14.2.1 Storage Unit Temperature Monitors

LCO/Specification: The temperature monitors for each storage unit shall be operable.

Applicability: Sierra TranStor™, VECTRA NUHOMS® MP 187, Westinghouse MPC (Large/Small) systems.

Objective: To comply with vendor technical specifications which prevent exceeding the allowable storage unit temperatures and overheating of spent nuclear fuel.

Actions: If the storage unit temperature monitors are inoperable, temperature measurements will be taken manually according to the storage unit vendor's schedule until the storage unit temperature monitors are returned to service.

Surveillance Requirements: The temperature monitors for each storage unit shall be checked for operation daily.

Bases: The temperature monitors must be operable in order to comply with technical specifications for monitoring storage unit temperatures.

14.2.2 Storage Unit Air Temperature Rise

LCO/Specification: The vendor technical specifications for storage unit cooling air temperature rise shall be met.

Applicability: Sierra TranStor™, VECTRA NUHOMS® MP 187, Westinghouse MPC (Large/Small) systems.

Objective: To comply with vendor technical specifications which prevent exceeding the allowable storage unit temperatures and overheating of spent nuclear fuel.

Actions: If the vendor technical specifications for storage unit cooling air temperature rise are exceeded, the operator shall perform the actions required for that condition in the vendor technical specifications.

Surveillance Requirements: The ambient and outlet vent temperature difference for each storage unit shall be measured and recorded daily.

Bases: Excessive concrete temperatures may occur in an accident condition of complete blockage of all air inlets and air outlets. Excessive concrete temperatures can have an adverse effect on concrete strength and durability. Vendor technical specifications must be met which prevent exceeding the allowable storage unit temperatures and overheating of spent nuclear fuel cladding.

14.2.3 Storage Cask Pressure Monitors and Remote Alarms

LCO/Specifications: The storage cask interlid space pressure monitors and remote alarms shall be operable.

Applicability: NAC STC System.

Objective: To comply with vendor technical specifications for maintenance of storage cask interlid space pressure.

Actions: If the storage cask interlid space pressure monitors and remote alarms are inoperable, pressure measurements will be taken manually according to the vendor's schedule until the storage unit pressure monitors are returned to service.

Surveillance Requirements: The storage cask interlid space pressure monitors and remote alarms for each storage unit shall be checked for operation daily.

Bases: The storage cask pressure monitors and associated alarms must be operable in order to comply with technical specifications on storage cask pressure.

14.2.4 Storage Cask Pressure Maintenance

LCO/Specification: The vendor technical specifications for maintaining storage cask interlid space pressure shall be met.

Applicability: NAC STC System

Objective: To comply with vendor technical specifications for maintenance of storage cask interlid space pressure.

Actions: If the vendor technical specifications for maintaining storage cask interlid space pressure are not met, the operator shall perform the actions required for that condition in the vendor technical specifications.

Surveillance Requirements: The storage cask interlid space pressure shall be monitored and the alarm board shall be checked daily in accordance with vendor technical specifications.

Bases: All of the openings/penetrations of the NAC STC have a primary seal and a secondary seal to contain any radioactive fission products within the cask. The inner lid has two o-rings: the inner metallic o-ring, which provides the primary confinement seal; and a larger diameter concentric metallic o-ring that provides an annulus, which is evacuated to test the seal effectiveness of the inner o-ring. Vent and drain ports are located in the inner lid and are sealed by two metallic o-rings in the port cover plates. These o-rings are tested by evacuating the annulus between them. The inner lid also has an interseal test port, which is closed by a stainless steel plug with a metal o-ring. The interlid port and the pressure port, located in the top forging, are sealed by o-rings located in the port cover for each of the ports. Additionally, the interlid volume is initially pressurized to 7.7 atm for storage. This ensures that during a 20-year storage period no cavity gas can be released to the environment nor can air be admitted to the cask cavity. During storage, a pressure transducer monitors the interlid pressure.

Leakage during storage will be detected by monitoring the interlid pressure transducer, noting that the pressure in the interlid region has changed and that the change is not due to diurnal variations, seasonal variations or normal radioactive decay of fuel in the cask.

14.2.5 Hydraulic Ram System Pressure Monitor

LCO/Specifications: The hydraulic ram system pressure monitor shall be operable.

Applicability: VECTRA NUHOMS® MP 187, Westinghouse MPC (Large/Small) systems.

Objective: To comply with vendor technical specifications for monitoring of hydraulic ram system pressure.

Actions: If the hydraulic ram system pressure monitor is inoperable, operation of the hydraulic ram to move a loaded dry storage canister or multi-purpose canister shall not be performed until the pressure monitor can be repaired or replaced.

Surveillance Requirements: The hydraulic ram system pressure shall be monitored continuously during canister transfers.

Bases: The hydraulic ram system pressure monitor must be operable in order to comply with vendor technical specifications for monitoring of hydraulic ram system pressure.

14.2.6 Hydraulic Ram System Pressure

LCO/Specifications: The vendor technical specifications for hydraulic ram system pressure shall be met.

Applicability: VECTRA NUHOMS® MP 187, Westinghouse MPC (Large/Small) systems.

Objective: To comply with vendor technical specifications for limiting hydraulic ram system pressure, to prevent damage to the dry storage canister or multi-purpose canister and to prevent damage to the horizontal storage module or storage cask, and to ensure that there will be no loss of confinement for the dry storage canister or multi-purpose canister.

Actions: If the vendor technical specifications for limiting hydraulic ram system pressure are not met, the operator shall perform the actions required for that condition in the vendor technical specifications.

Surveillance Requirements: The hydraulic ram system pressure shall be monitored continuously during canister transfers.

Bases: The maximum ram push/pull forces are limited automatically by features in the ram system design to a maximum load equal to 25% of the dry shield canister (DSC) loaded weight. The potential for misalignment and/or interference between components during handling and loading operations was evaluated as an off-normal event in the Sacramento Municipal Utility District's Rancho Seco independent spent nuclear fuel storage installation (ISFSI) SAR (Ref.14.1- 4) and VECTRA's NUHOMS® Horizontal Modular Storage SAR (Ref.14.1-3). Jamming is described in these evaluations as either axial sticking of the DSC or binding of the DSC, and is evaluated separately. In both postulated jamming events, the axial sticking and binding of the DSC during transfer to the Horizontal Storage Module (HSM), and the stress on the DSC shell and transfer cask inner liner are demonstrated to be much less than ASME Code allowable stress limits. Even when an 80,000-pound ram force is applied to the DSC with an obstacle present or with a one-degree-angle difference between structure center lines, no permanent DSC shell damage would be expected.

In the Westinghouse SARs (Ref. 14.1-1 and 14.1-2) it is postulated that misalignment and/or interference may cause jamming of the multi-purpose canister MPC inside the storage container when the MPC is pulled from the transportation cask. A maximum hydraulic ram load of 80,000 pounds was considered in this analysis. Results of calculations determined that the MPC shell can withstand loadings caused by misalignment. The evaluation concludes that there would be no radiological releases or adverse radiological consequences as a result of this off-normal event.

14.2.7 Crane Lift Load Indicator

LCO/Specification: The crane lift load indicator shall be operable.

Applicability: Sierra TranStor^{TM} System.

Objective: To comply with vendor technical specifications for monitoring of crane lift load when raising a canister into a transfer cask and when lowering a canister into a storage cask or transportation cask.

Actions: If the crane lift load indicator is inoperable, operation of the crane to raise a loaded canister shall not be performed until the crane lift load indicator can be repaired or replaced.

Surveillance Requirements: The crane lift load indicator shall be monitored continuously during canister transfers.

Bases: The crane lift load indicator must be operable in order to comply with vendor technical specifications for monitoring of the crane lift load.

14.2.8 Crane Lift Load

LCO/Specification: The vendor technical specifications for the crane lift load when lifting a loaded canister shall be met.

Applicability: Sierra TranStor^{TM} System.

Objective: To comply with vendor technical specifications for limiting crane lift load when lifting a loaded canister into a transfer cask and when lowering a canister into a storage cask or transportation cask, so as to prevent damage to the canister and ensure that there will be no loss of confinement for the canister.

Actions: If the vendor technical specifications for limiting crane lift load are not met, the operator shall perform the actions required for that condition in the vendor technical specifications.

Surveillance Requirements: The crane lift load shall be monitored continuously during canister transfers.

Bases: The maximum crane lift load is expected to be the weight of the loaded canister. A load in excess of the weight of the loaded canister (other than that due to canister acceleration) would occur if there were binding between the canister and the transfer cask. If the binding between the canister and the transfer cask became excessive, damage to the canister could occur and there could be loss of confinement for the canister.

14.3 SURVEILLANCE REQUIREMENTS

In addition to the surveillance requirements imposed to ensure compliance with the LCOs, a visual surveillance of the exterior of the storage unit air inlets and outlets shall be conducted as necessary to ensure that cask air inlets and outlets are not blocked. Visual surveillance is intended to be a backup to the temperature monitoring requirements of Section 14.2.1.

14.4 DESIGN FEATURES

Changes to the design of QA 1 and QA 5 SSCs are strictly controlled at the CISF by implementing the configuration control program described in Section 14.5.

14.5 ADMINISTRATIVE CONTROLS

Administrative controls include the organization and management structure, response plans, procedures, programs and controls, record keeping requirements, review and audit procedures and reporting necessary to ensure that the operations involved in the storage of spent fuel at the CISF are performed in a safe manner.

The following administrative controls are imposed on CISF.

14.5.1 Responsibility

The CISF Site Manager shall be responsible for the overall safe operation of the site and shall have control over those activities necessary for safe operation of the site. The CISF Site Manager shall delegate, in writing, the succession to this responsibility during any absences.

An Operations Manager, or in his absence the Transfer Facility Shift Supervisor, shall be responsible for directing day-to-day operation of the site. As part of this command function, the Operations Manager or Transfer Facility Shift Supervisor shall ensure that the operation of the site is in accordance with approved Technical Specifications.

14.5.2 Organization

Lines of authority, responsibility and communication shall be defined and established for the highest management levels, through intermediate levels, down to and including all operating organization positions. These relationships shall be documented and updated, as appropriate, in the form of organizational charts, functional descriptions of departmental responsibilities and relationships, and job descriptions for key personnel positions, or equivalent forms of documentation.

The individuals who are responsible for training the operating staff, carrying out radiological control, or performing QA functions shall have sufficient organizational freedom to ensure their independence from operating pressures.

14.5.2.1 Transfer Facility Staff

The facility staff organization shall be as follows.

- A current list of facility support personnel by name, title, and work and home telephone numbers shall be maintained. This list should include management, Radiation Protection and technical support personnel.

- A minimum facility shift crew composition shall be maintained at all times to ensure that essential operations can be performed.

- Administrative procedures shall be implemented to limit the working hours of staff who perform important-to-safety functions (e.g., personnel required to meet the minimum shift crew composition). Adequate shift coverage shall be maintained without routine heavy use of overtime. The overtime should be controlled in accordance with the following guidelines.

- An individual shall not be permitted to work more than 16 hours straight, excluding time for shift turnover or safety meetings.

- An individual shall not be permitted to work more than 24 hours in any 48-hour period, nor more than 72 hours in any seven-day period, all excluding time for shift turnover or safety meetings.

- A break of at least two days is required after 14 consecutive days on shift. A 24-hour break interrupts the consecutive-day sequence.

Any deviation from these requirements must be authorized in advance by the CISF Site Manager (or designee) in accordance with approved administrative procedures and with justification for granting the deviation.

14.5.3 Qualification

A program shall be established to ensure that facility staff who perform important-to-safety functions meet established qualification requirements for their positions. This program shall adhere to qualification requirements established in accordance with applicable NRC regulations.

14.5.4 Training

An initial training and retraining program for the facility staff shall be established and maintained. This program shall adhere to training requirements established in accordance with applicable NRC regulations.

14.5.5 Response Plans

The purpose of a response plan is to ensure that additional analysis or administrative and management controls are in place when abnormal situations arise and when the facility is outside of normal operating limits defined by the Technical Specifications. The response plan has two functions. The first function is to restore the site to Technical Specification compliance. The second function is to determine what further actions are required to ensure that the site is operating within the framework of the Technical Specifications. Response plans are intended to provide personnel with the direction needed to safely achieve a stated endpoint. These plans, however, do not prohibit reliance upon operator training and experience in the correction of the condition for immediate mitigation of an unsafe or worsening condition.

The first type of response plan is typically implemented when restoration of Technical Specification compliance may be complex and involve numerous variables, or when the time required to complete the required action(s) cannot be quantified.

The second type of response plan addresses the situation in which a Technical Specification cannot be met (e.g., due to equipment in operability) and the facility must operate in continual Technical Specification noncompliance (e.g., there is no mode in which the noncompliant LCO or Administrative Control is not applicable). While the Technical Specification requirements are being restored, site operations shall be bounded by an approved response plan.

The response plan shall evaluate process area or facility conditions to determine the risk to the facility and the public from the limited operations allowed in the applicable mode. These plans will typically implement compensatory actions or surveillance to reduce risk. Because most conditions, and the hazards associated with them, can be evaluated prior to the need for a response plan, the plan can be implemented using approved emergency procedures or abnormal response procedures. These procedures may be referenced in the response plan but cannot take the place of a response plan. This implementation is acceptable provided that the emergency procedures or abnormal response procedures state what operations are permitted, including the initial conditions and precautions necessary to perform the operations in a safe manner. However, some situations may require unique response plans to be developed.

The response plans shall be evaluated using the Unreviewed Safety Question (USQ) process prior to performance and shall be approved by the CISF Site Manager (or designee) and the Facility Safety Review Committee (FSRC).

14.5.6 Reviews and Assessments

14.5.6.1 Facility Safety Review Committee

14.5.6.1.1 Responsibilities

The FSRC reports to the DOE CISF Project Manager and advises the CISF Site Manager on matters affecting the operation of the site and associated activities that affect safety. During the performance of reviews, a cross-disciplinary determination/evaluation may be necessary. If deemed necessary, such reviews shall be performed by personnel of the appropriate discipline. Individual reviewers shall not review their own work or work for which they have direct responsibility. FSRC functions and responsibilities will be established according to approved procedure and shall contain the following as a minimum: Review of proposed changes to Technical Specifications and bases; and review of proposed activities that involve a USQ evaluation.

14.5.6.1.2 Composition

The committee members must possess sufficient education, experience and diversified expertise, along with safety analysis and technical training, to undertake the reviews that the committee is intended to perform.

14.5.6.2 Unreviewed Safety Question Evaluation

The USQ evaluation shall: (1) be performed on proposed activities (including temporary modifications), reviewed, approved and documented in accordance with an approved procedure, and (2) be approved by the NRC prior to implementation of the proposed activity when a positive USQ is involved.

14.5.7 Technical Specification and Technical Specification Bases Control

Changes to thc Technical Specifications and to the bases shall be made under appropriate administrative controls.

Changes may be made to the Technical Specifications bases without prior NRC approval, provided the changes do not involve any of the following.

- A change in the Technical Specifications
- A change to the design basis that involves a USQ
- A change to the Technical Specifications bases which results in a change to the Technical Specifications intent.

Proposed changes that meet one or more of the above criteria shall be reviewed and approved by the NRC prior to implementation. Changes to the Technical Specifications bases that are implemented without prior NRC approval shall be provided to NRC at least annually.

14.5.8 Procedures, Programs and Manuals

14.5.8.1 Procedures

14.5.8.1.1 Scope

Written procedures shall be established, implemented and maintained covering the following activities.

- Operational activities
- Maintenance activities (including corrective and preventive maintenance)
- Emergency and abnormal operating procedures
- Security plan implementation
- Emergency plan implementation

- All surveillances required by Technical Specifications
- Administrative aspects of facility operation
- USQ Program
- Quality Assurance/Control activities.

14.5.8.1.2 Review, Revision, and Approval

Procedures (for activities listed above), and revisions thereto, shall be reviewed and approved in accordance with approved administrative procedures prior to implementation, and reviewed periodically as set forth in administrative procedures.

14.5.8.1.3 Temporary Changes

Temporary changes to procedures may be made provided the change is documented and reviewed in accordance with approved administrative procedures.

14.5.8.2 Programs and Manuals

The following programs shall be established, implemented, and maintained.

14.5.8.2.1 Emergency Response Program

The Emergency Plan shall define specific measures, policies and actions to prevent or minimize injuries, damage to property, and impact on the environment caused by accidents, natural disasters, or deliberate damage within the area of responsibility.

The CISF Site Manager shall ensure that an Emergency Plan is established in accordance with applicable NRC requirements, based on formal hazards assessment and requirements. The Emergency Plan shall contain the following elements.

- Emergency response organization
- Operational emergency event classes
- Notification
- Consequence assessment
- Protective actions
- Medical support
- Recovery and reentry
- Emergency facility and equipment
- Training
- Drills and exercises
- Program administration.

14.5.8.2.2 Fire Protection Program

A Fire Protection program shall be established to minimize threats to the public health or welfare resulting from a fire, and undue hazards to site personnel from a fire.

The Fire Protection program shall address the following:

- Fire-resistive construction and control of combustibles
- Control of ignition source
- Site inspections
- Handling of combustible or flammable liquids and gases
- Fire control
- Automatic detection/suppression and alarm systems
- Fire patrols/watches (as necessary)
- Proper availability and maintenance of facility firefighting equipment
- Identification of firefighting personnel, responsibilities and training
- 24-hour firefighting coverage.

14.5.8.2.3 Nuclear Criticality Safety Program

The CISF Site Manager shall ensure that facility personnel receive appropriate nuclear criticality safety training.

14.5.8.2.4 Configuration Control Program

A configuration control program shall be established, implemented and maintained that:

- Identifies and documents the technical baseline of structures, systems and components (SSCs) and computer software

- Ensures that changes to the technical baseline are properly developed, assessed, approved, issued and implemented

- Maintains a system for recording, controlling and indicating the status of technical baseline documentation on a current basis

- Controls the configuration of the SSCs specified in the design features section of this Technical Specifications chapter.

14.5.8.2.5 Installed Process Instrumentation Program

An Installed Process Instrumentation (IPI) program shall be established, implemented and maintained that identifies and programmatically controls IPI. Controls include the following.

- Traceability of Technical Specifications-related IPI items

- Calibration frequencies for Technical Specifications-related IPI items

- Evaluation of Technical Specifications-related IPI items found outside of calibration tolerances.

14.5.8.2.6 Environmental Compliance Program

An environmental compliance program shall be established, implemented and maintained that:

- Protects site workers and the public from normal operational releases and exposures as well as postulated accidental releases of radioactive and hazardous materials

- Ensures site compliance with federal and state environmental regulation.

An Industrial Safety program shall be established, implemented and maintained that:

- Achieves compliance with DOE Orders and DOE-prescribed standards for controlling occupational exposures to specific chemical, physical and biological hazards.

- Establishes essential elements to address identification, evaluation and control of these hazards within the workplace.

14.5.8.2.7 Radiation Protection Program

A Radiation Protection program shall be established, implemented and maintained that:

- Ensures that exposure of employees, subcontractors, visitors and the general public to radiological hazards are maintained well below NRC limits with an ALARA approach to exposure management.

- Ensures that individual and collective radiological exposures are maintained ALARA by implementing the following items.

  - Integrating the support functions of Radiation Protection and Industrial Safety into daily operations and long term planning

  - Participating in required site Radiation Protection training

  - Creating barriers for and posting controlled areas

  - Utilizing Radiological Work Permits

  - Monitoring and controlling accumulated doses to workers

- Controlling the generation and spread of radiological contamination
- Managing radioactive material
- Monitoring and controlling radioactive effluent streams.

The following administrative controls are included in the radiation protection program.

- Radiological survey instruments shall be calibrated and tested regularly.
- The maximum transportation cask external dose rate from all types of radiation and the maximum surface contamination shall be in accordance with 10 CFR 71.87. The external surface dose rate of a transportation cask shall be measured immediately following its arrival on site.
- The maximum storage unit external dose rate from all types of radiation shall be 10 mrem/hr at two meters from any vertical surface. The external surface dose rate of a storage unit shall be measured immediately following loading of the storage unit and its placement on the storage pad in its final configuration.
- The removable surface contamination of transportable storage cask units and canister exteriors shall be limited as follows in accordance with 10 CFR Part 72.

- 30,000 dpm/100cm^2 gamma-beta
- 3,000 dpm/100cm^2 alpha

If the contamination limit is exceeded, then decontamination shall be performed as required prior to placement into storage.

- The removable surface contamination of transportable storage casks' exterior prior to transport off-site shall be limited as follows, in accordance with 10 CFR Part 71.

- 2,200 dpm/100 cm^2 gamma-beta
- 220 dpm/100 cm^2 alpha

If the contamination limit is exceeded, the transportable storage casks shall be decontaminated prior to transport off-site.

- The transfer facility area radiation monitors and alarms shall be operable during cask/canister operations.
- The transfer facility constant air monitors shall be operable during transport cask venting and lid removal activities.

- The transfer facility vent monitors and alarms shall be operable during cask/canister operations.

- The radioactive gas sampling system shall be operable to detect radionuclide activity in the gas of the annular space between the transportation cask and the spent nuclear fuel canister prior to and during opening of the transportation cask.

- Radiation detection devices (e.g., TLDs) shall be present at all times at specified site boundary locations to measure radiation.

- The transfer facility HVAC System shall be operable during cask/canister operations inside the transfer facility.

14.5.8.2.8 Radioactive and Hazardous Materials Shipping and Receiving Program

A radioactive and hazardous materials shipping and receiving program shall be established, implemented and maintained to ensure the following.

- Complete documentation

- Implementation and compliance with the requirements of federal and state agencies

- Compliance with applicable federal and state requirements by pre-shipment verification

- Assurance that designated cognizant personnel are trained in radioactive and hazardous material shipping and receiving

- Retention of programmatic and shipment records in accordance with Quality Assurance and records management directives.

14.5.8.2.9 Quality Assurance Program

The site QA program shall:

- Require that sufficient records be maintained for activities affecting important-to-safety SSCs

- Support independent assessment/verification requirements to ensure compliance with the QA program

- Provide for a graded approach to the application of QA requirements throughout the life of the site.

14.5.8.2.10 Equipment Maintenance Program

An equipment maintenance program shall be established, implemented and maintained to ensure that effective measures are taken so that important-to-safety SSCs are capable of performing their intended function.

14.5.8.2.11 Work Control Program

A Work Control program shall be established, implemented and maintained to provide a methodology for safely and efficiently identifying, managing, tracking and documenting work activities.

14.5.8.2.12 Conduct of Operations Program

A Conduct of Operations program shall be established, implemented and maintained to satisfy NRC requirements for conducting site operations in a safe and efficient manner.

14.5.8.2.13 Performance Indicators Program

A Performance Indicators program shall be established, implemented and maintained to monitor site compliance with applicable safety goals and requirements.

14.5.8.2.14 Testing and Maintenance Programs

A Testing and Maintenance program shall be established, implemented and maintained to comply with the requirements established by the NRC and prescribed standards to ensure operability and configuration compliance. Acceptance tests, return-to-service tests, surveillance tests, as well as special tests shall be performed as necessary for modifications. Post-maintenance testing, control and calibration of measuring and test equipment, and maintenance history and trending, shall be performed as necessary for maintenance activities.

14.5.8.2.15 Radioactive and Hazardous Waste Management Program

A Radioactive and Hazardous Waste Management program shall be established, implemented and maintained to ensure that radioactive and hazardous wastes are managed in a safe and efficient manner in accordance with applicable requirements of federal and state agencies.

14.5.8.2.16 Process Controls That Address Cask Tipover, Cask Drop, Loss of Confinement and Vehicular Impact

The following process controls shall be in place for preventing, mitigating or responding to cask tipover, cask drop, loss of confinement, vehicular impact and fire.

- There shall be a low speed limit for transporters and tractor/trailers in storage areas.

- Rail line switch settings or positions shall be controlled.
- Storage and transportation casks shall not be placed on rail lines or throughways at the transfer facility.
- All rail cars in a queue shall have brakes applied.
- Gantry rails shall be kept clear of equipment and debris.
- Transportation and storage cask travel paths shall be kept clear of equipment and debris.
- Cask alignment shall be verified before canister transfer.
- The Sierra TranStor™ System canister shall be verified to be fully inside the transfer cask prior to movement of the transfer cask.
- An administrative control shall be in place which limits the travel path of the top cover plate of the VECTRA NUHOMS® System MP187 and the Horizontal Storage Module door during canister removal or insertion in the storage area.
- The dry storage canister position shall be verified before disengaging the hydraulic ram and the MP187.
- The transfer or transportation cask shall be aligned with respect to the storage unit in accordance with vendor specifications before transferring a canister.
- The lift height of loaded storage casks, transportable storage casks, transportation casks and transfer casks shall be monitored and shall not exceed the lift heights identified and analyzed by the vendors.
- The maximum lift height for the Sierra TranStor™ System cask lid shall be monitored and limited.
- Closed circuit television shall be provided at the transfer facility to aid in operations and to ensure that radiological exposure to personnel is ALARA.

14.5.9 Reporting Requirements

14.5.9.1 General Requirements

Written reports and oral notifications shall be submitted to the NRC in accordance with NRC regulations regarding reporting requirements. These reports and notifications shall be prepared, reviewed and approved in accordance with approved procedures.

14.5.9.2 Technical Specifications Violations

Violations of the Technical Specifications occur as a result of the following three circumstances.

- Failure to meet both the requirements of an LCO and its associated Required Action(s) and Completion Time(s)

- Failure to perform a surveillance requirement within the required time limit

- Failure to comply with an Administrative Control requirement.

Technical Specification violations must be reported to the NRC in accordance with applicable reporting requirements.

14.5.9.3 Conditions Outside the Technical Specifications

In an emergency, if a situation develops that is not addressed by the Technical Specifications, site personnel are expected to use their training and expertise to take actions to correct or mitigate the situation. Also, site personnel may take actions that depart from a requirement in the Technical Specifications provided that (1) an emergency situation exists, (2) these actions are needed immediately to protect the public health and safety, and (3) no action consistent with the Technical Specifications can provide adequate or equivalent protection. Such action must be approved as a minimum by the Transfer Facility Shift Supervisor.

14.5.10 Record Retention

The following records shall be retained for the period specified by the record retention schedule. (Refer to Section 13.4.2 for additional information and the record retention schedule.)

- Records of facility operation

- Records of principal maintenance activities, inspections, repairs and replacements of principal items of equipment related to nuclear safety

- Records of reportable events and occurrences

- Records of surveillance activities, inspections and calibrations required by the Technical Specifications

- Records of changes made to procedures

- Records and drawing changes reflecting facility design modifications made to systems and equipment described in the SAR

- Records of radiation exposure for all individuals entering Radiological Control Areas
- Records of gaseous and liquid radioactive material released to the environment
- Records of facility tests and experiments
- Records of training and qualification for current members of the facility operations staff
- Records of USQ evaluations performed for changes or tests and experiments
- Results of reviews and assessments.

14.6 REFERENCES

Section 14.1

14.1-1. MPC-CD-02-016. *Safety Analysis Report for Large On-Site Transfer and On-Site Storage Segment.* Rev. 1. Westinghouse Government and Environmental Services Co. June 1996.

14.1-2. MPC-CD-02-017. *Safety Analysis Report for the Small On-Site Transfer and On-Site Storage Segment.* Rev. 1. Westinghouse Government and Environmental Services Co. June 1996.

14.1-3. NUH-003. Docket No. 72-1004. *Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel.* Rev. 3A. VECTRA Technologies Inc. June 1995.

14.1-4. Docket No. 72-0011. *Safety Analysis Report for Rancho Seco Independent Spent Fuel Storage Installation.* Rev. 1. Sacramento Municipal Utility District. October 1993.

14.1-5. SNC-96-72SAR. *Safety Analysis Report for the TranStor™ Storage Cask* System. Rev. A. Sierra Nuclear Corporation. May 1996.

14.1-6. Docket No. 72-0017. *Trojan Independent Spent Fuel Storage Installation Safety Analysis Report.* Portland General Electric Co. March 1996.

14.1-7. NAC-T-90002. Docket No. M-55. *Topical Safety Analysis Report for the NAC Storable Transport Cask for Use at an Independent Spent Fuel Storage Installation.* Rev. 3. NAC Services Inc. July 1994.

14.1-8. HOLTEC Report HI-941184. Docket No. 72-1008. *Topical Safety Analysis Report for Packaging for the Holtec International Storage, Transport and Repository Cask System (HI-STAR 100 Cask System).* Rev. 3. Holtec International. August 1995.

15. QUALITY ASSURANCE

This chapter of the TSAR describes the Office of Civilian Radioactive Waste Management (OCRWM) Quality Assurance (QA) program and its applicability to activities associated with the CISF. The OCRWM QA program is defined by the OCRWM Quality Assurance Requirements and Description document (QARD), DOE/RW-0333P.

This TSAR seeks NRC concurrence that:

- The OCRWM QA program as defined in the QARD (DOE/RW-0333P) describes the requirements, procedures and controls that, when properly implemented, comply with the requirements of 10 CFR 72, Subpart G.

15.1 OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT QUALITY ASSURANCE PROGRAM

The U. S. Department of Energy (DOE) is authorized by the Nuclear Waste Policy Act (NWPA), as amended in 1987, to site, obtain a license for, construct and operate a geologic repository and a monitored retrievable storage facility, and to provide for the safe transportation of spent nuclear fuel and high-level waste to these locations. The NWPA established OCRWM within DOE to carry out this mission. It is the policy of OCRWM that these obligations will be met through the implementation of a comprehensive, documented QA program that complements management actions to achieve the level of quality needed for the safe transportation, storage and disposal of spent nuclear fuel and high-level waste as required by the Nuclear Regulatory Commission (NRC) licensing requirements. The OCRWM QA program is defined by the OCRWM Quality Assurance Requirements and Description document (QARD), DOE/RW-333P.

The OCRWM QA program, as defined by the QARD, has been evaluated by the NRC and found to meet the requirements of Title 10 of the Code of Federal Regulations (CFR), Part 71 (Reference docket number 07100786, approval number 0786, expiration date 8/31/99). The QARD is the Civilian Radioactive Waste Management document that provides policy and requirements for development and implementation of consistent QA procedures at every level within the OCRWM program. The QARD is based on and implements the requirements of Title 10 CFR, Part 50, Appendix B; Part 60, Subpart G; Part 71, Subpart H; and Part 72, Subpart G.

The QA program requirements necessary to achieve the high level of quality demanded by the transportation and storage of spent nuclear fuel and high-level waste are mandatory, imposed upon, and implemented by OCRWM and each organization participating in the program. Each participant organization in the OCRWM program is required to develop implementing documents that translate applicable QARD requirements into work processes, and must prepare a matrix that identifies where QARD requirements are contained in their implementing documents.

The activities associated with the Centralized Interim Storage Facility will be governed by the applicable portions of the OCRWM QA program. Table 15-1 provides a cross-reference between 10 CFR Part 72 and the OCRWM QARD requirements.

Table 15.1-1. QA Requirements Cross-Reference

10 CFR Part 72	**OCRWM QARD Section**
Section 72.142 - Quality Assurance organization	Section 1.0 - Organization
Section 72.144 - Quality Assurance program	Section 2.0 - Quality Assurance program
Section 72.146 - Design control	Section 3.0 - Design control
Section 72.148 - Procurement document control	Section 4.0 - Procurement document control
Section 72.150 - Instructions, procedures and drawings	Section 5.0 - Implementing documents
Section 72.152 - Document control	Section 6.0 - Document control
Section 72.154 - Control of purchased material, equipment and services	Section 7.0 - Control of purchased items and services
Section 72.156 - Identification and control of materials, parts and components	Section 8.0 - Identification and control of items
Section 72.158 - Control of special processes	Section 9.0 - Control of special processes
Section 72.160 - Licensee inspection	Section 10.0 - Inspection
Section 72.162 - Test control	Section 11.0 - Test Control
Section 72.164 - Control of measuring and test equipment	Section 12.0 - Control of Measuring and Test Equipment
Section 72.166 - Handling, storage and shipping control	Section 13.0 - Handling, storage and shipping
Section 72.168 - Inspection, test and operating status	Section 14.0 - Inspection, test and operating status
Section 72.170 - Nonconforming materials, parts or components	Section 15.0 - Nonconformances
Section 72.172 - Corrective action	Section 16.0 - Corrective action
Section 72.174 - Quality assurance records	Section 17.0 - Quality Assurance records
Section 72.176 - Audits	Section 18.0 - Audits

Additionally, the OCRWM QARD contains five supplemental QA requirements for processes not specifically addressed by the 18 criteria which OCRWM has identified as requiring QA controls. Those supplements are as follows.

- Supplement I, Software
- Supplement II, Sample Control
- Supplement III, Scientific Investigation
- Supplement IV, Field Surveying
- Supplement V, Control of the Electronic Management of Data.

The OCRWM QA program identifies seven categories for classifying structures, systems, and components (items) for the application of QA controls and development of Q-Lists. The categories of items subject to QARD requirements are as follows.

- Items important to public radiological safety as defined by 10 CFR Parts 60, 71 and 72
- Items required for the control and management of site-generated radioactive waste other than spent fuel and high-level waste
- Items required for the protection of items important to safety and waste isolation from the hazards of fire
- Items not intended to perform a safety function but those failure could impair the capability of other items to perform their intended safety or waste isolation functions
- Items required for physical protection as defined by 10 CFR Part 73
- Items required to control occupational radiological exposure.

NOTE: One additional category, items and natural barriers important to waste isolation as described in 10 CFR Part 60, is only applicable to the Mined Geological Disposal System (i.e., repository).

Items important to public radiological safety include all structures, systems and components (SSCs) important to safety as defined in 10 CFR Part 72.

The other categories for classifying items under the OCRWM program were selected by management to assure application of appropriate QA controls based on the relative importance of the items and the activities associated with those items.

An item may have more than one category, depending on the location and function of the item. The design process establishes the design criteria and acceptance standards for the items in each category and activities related to the items on the Q-Lists. The design criteria for the CISF SSCs are discussed in Chapter 3.

16. DECOMMISSIONING

This chapter describes the CISF Decommissioning program, including provisions for funding, required records retention, and facility design measures to facilitate decommissioning and minimize associated wastes.

A conceptual decommissioning plan, which includes a preliminary cost estimate, has not been developed for the TSAR. The decommissioning plan is considered site-specific and will be submitted with the CISF license application. The TSAR does present a summary level of information, however.

This TSAR seeks NRC concurrence that:

- The design features of the facility, including the proposed use of dual purpose cask systems, minimize the quantity of produced radioactive waste, contaminated equipment, and secondary waste streams; facilitate the removal of radioactive waste and contaminated materials at the time of decommissioning; and maintain occupational and public exposures during operations and decommissioning ALARA.

- The TSAR adequately addresses decommissioning record keeping, and those records designated as decommissioning records.

16.1 PROPOSED DECOMMISSIONING PLAN

At the end of facility life, the CISF will be decommissioned and the site will be prepared for unrestricted use or returned to the original site condition to the extent possible. The decommissioning plan is to decontaminate or remove all materials from the site which prevent release of the facility for unrestricted use. This approach, referred to as the DECON option, avoids long-term storage and monitoring of on-site wastes. The order of activities will generally be as follows.

- Shipment of all SNF off site
- Equipment dismantling and removal
- Decontamination
- Sale of salvage
- Disposal of wastes
- Completion of a final radiation survey
- Dismantling and disposal of facilities.

A final decommissioning plan will be prepared and submitted in accordance with 10 CFR 72.54 to support CISF license termination. Preparation of the plan will include a review of current facility and site conditions, along with a review of facility historical records. The facility QA program will be reviewed to ensure consistency with decommissioning activities, and procedures will be written and approved to control the performance of decommissioning activities.

Worker radiation exposures will be maintained ALARA in the performance of decommissioning activities through the use of radiation and contamination surveys, temporary shielding, special or temporary ventilation systems, and work area air sampling. All radioactive and hazardous wastes will be disposed of in licensed waste facilities.

A final radiation survey plan will be developed to demonstrate that the facilities, site, and applicable adjacent environs will meet criteria for release for unrestricted use, or for return of the site to the original condition to the extent possible if the site was not previously available for unrestricted use.

16.2 DECOMMISSIONING FUNDING PLAN

In accordance with 10 CFR 72.30(c)(4), the CISF license application will contain a statement of intent, including a cost estimate indicating that funds will be available for decommissioning the CISF. A method will be included to periodically revise the cost estimate over the life of the CISF.

16.3 DECOMMISSIONING FACILITATION

The CISF utilizes both design features and operating practices to minimize potential radioactive contamination and facilitate the decontamination and decommissioning efforts associated with license termination.

The CISF handles only canistered SNF or SNF in transportable storage casks. Only very small quantities of radioactive contamination are anticipated in the transfer and handling of the sealed canisters and casks. It is expected that an occasional incoming transportation cask will require decontamination as a result of the cask having been submerged in utility fuel pools. For this condition, a cask decontamination booth is provided; however, it is not expected that the resultant washwater will exceed permissible release limits or require disposal as radioactive liquid wastes. A small volume of solid radioactive waste is also expected from cask contamination surveillance and decontamination activities. Disposal and off-site processing of liquid and solid radioactive wastes are provided by contracted vendors. In summary, the residual quantities of radioactive contamination remaining after SNF removal are expected to be extremely small, requiring minimal facility and site decontamination.

The decommissioning of vendor cask/canister systems is described in the vendor SARs listed in Table 3.1-1.

Where appropriate, interior walls and floors are coated with epoxy, sealant, or paint for ease of cleaning and decontamination. Coatings required to enhance decontamination of surfaces shall conform to ASTM D5144-91 (Ref. 16.3-1). Fire protection system piping into areas of expected radioactive particulate contamination is equipped with backflow prevention devices to preclude internal contamination of the system. The transfer facility is maintained at a slightly negative pressure in order to prevent the potential migration of radiological contamination.

Contaminated areas within the facility are minimized. Equipment and systems are provided to measure radioactive surface contamination levels within the facility and decontaminate these surfaces when necessary.

16.4 RECORD KEEPING FOR DECOMMISSIONING

Record keeping for Centralized Interim Storage Facility (CISF) decommissioning meets the requirements of 10 CFR 72.30(d) and Draft Regulatory Guide DG-3001 (Ref. 16.4-1). Records of information important to the safe and effective decommissioning of the CISF are maintained for the life of the facility. These records include:

- Event reports of spills or other unusual occurrences involving the spread of radioactive contamination in and around the facility, equipment or site. Information concerning radioactive nuclides, estimated quantities, forms and concentrations is included.

- As-built drawings and modifications of structures and equipment in radiologically controlled areas where radioactive materials are used and/or stored. Information includes locations of possible inaccessible contamination, such as buried pipes, which may be subject to radioactive contamination. Old or superseded drawings are retained if they contain information relevant to potential locations of contamination.

- A listing of all areas designated or formerly designated as restricted areas as defined under 10 CFR 20.1003 and all areas outside of restricted areas that require documentation under 10 CFR 72.30(d)(1). The listing is maintained in a single document and updated no less than every two years.

- Background radiation levels prior to work with radioactive materials. Records include surveys and isotopic analyses of building materials and soil samples made prior to initial facility use.

- Records of the cost estimate performed for the decommissioning funding plan and records of periodic revisions to this estimate.

The location of decommissioning records are clearly identified and designated to contain records and information important to safe decommissioning.

Additional information on CISF record keeping requirements is provided in Chapter 13.

16.5 REFERENCES

Section 16.3

16.3-1 ASTM D 5144-91. *Standard Guide for Use of Protective Coating Standards in Nuclear Power Plants.* American Society for Testing and Materials, 1991.

Section 16.4

16.4-1 Draft Regulatory Guide DG-3001. *Records Important for Decommissioning for Licensees Under 10 CFR Parts 30, 40, 70 and 72.* U.S. NRC. July 1989.