ASSESSMENT REPORT

Docket 72-1024

U. S. DEPARTMENT OF ENERGY

DRY TRANSFER SYSTEM

November 13, 2000

CONTENTS

CONTENTS (cont'd)

CONTENTS (cont'd)

CONTENTS (cont'd)

Section | Page

CONTENTS (cont'd)

Section Page

CONTENTS (cont'd)

Section Page

CONTENTS (cont'd)

Section Page

CONTENTS (cont'd)

Section Page

CONTENTS (cont'd)

CONTENTS (cont'd)

Section Page

TABLES

ACRONYMS

ACI	American Concrete Institute
AHU	Air Handling Unit
ALARA	As Low As Is Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
AR	Assessment Report
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
B&W	Babcock & Wilcox
BWR	Boiling Water Reactor
CCTV	Closed Circuit Television
CMS	Cask Mating Subsystem
CNWRA	Center for Nuclear Waste Regulatory Analyses
CPU	Central Processing Unit
CTS	Cask Transfer Subsystem
DBT	Design Basis Tornado
DE	Design Earthquake
DHR	Decay Heat Removal
DTS	Dry Transfer System
DOE	U.S. Department of Energy
EPRI	Electric Power Research Institute
FCU	Fan Coil Unit
FEA	Finite Element Analysis
FWEC	Foster Wheeler Energy Company
HEPA	High-Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
IEEE	Institute of Electrical and Electronic Engineers
INEEL	Idaho National Engineering and Environmental Laboratory
LAA	Lower Access Area
LLW	Low-Level Waste
MPC	Multi-Purpose Canister
NFPA	National Fire Protection Association
NRC	Nuclear Regulatory Commission
NTS	National Technical Service
PA	Preparation Area
PC	Personal Computer
PHA	Peak Horizontal Acceleration
PLC	Programmable Logic Controller
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PVA	Peak Vertical Acceleration
PWR	Pressurized Water Reactor

ACRONYMS (cont'd)

QA	Quality Assurance
RAI	Request for Additional Information
REA	Roof Enclosure Area
SAR	Safety Analysis Report
SER	Safety Evaluation Report
SNF	Spent Nuclear Fuel
SSC	Structures, Systems, and Components
TC	Transfer Confinement
TCA	Transfer Confinement Area
TN	Transnuclear, Inc.
TSAR	Topical Safety Analysis Report

INTRODUCTION

The U.S. Department of Energy (DOE) submitted to the Nuclear Regulatory Commission (NRC) the Dry Transfer System (DTS) Topical Safety Analysis Report (TSAR) on September 30, 1996 (U.S. Department of Energy, 1996). The proposed DTS is intended to be used at multiple reactor sites and at several DOE nonreactor sites. In the management of spent nuclear fuel, there is a need to perform certain fuel transfer and packaging operations apart from the conventional pool. Facilities with weight or dimensional access limitations find the pool loading of large multi-element storage or transportation canisters not feasible. The DTS design was developed whereby a large canister can be loaded in a dry facility external to the reactor or fuel building through the repeated use of a small transfer cask carrying a small number of spent fuel assemblies. DOE is seeking NRC's evaluation of the DTS TSAR and the NRC issuance of a Safety Evaluation Report (SER) that can be used and referenced by an applicant seeking a site-specific license for the construction and operation of a DTS at a given site. However, because the TSAR has inherent limitations such as no site-specific parameters, limited to one B&W fuel assembly design, no damaged fuel handling capabilities, and limitations on the types of transfer casks and receiver casks that can be used, the NRC staff decided there was not enough information provided to allow a user to implement the DTS without a significant supplemental application. Therefore, the staff decided to issue an Assessment Report (AR) instead of a SER.

This AR documents the NRC staff review of those generic design, testing, operations, and maintenance activities described in the TSAR for the proposed DTS. The NRC staff assessment is based on the DTS meeting the applicable requirements of 10 CFR Part 72 for spent fuel storage and handling and 10 CFR Part 20 for radiation protection.

The scope of the review is limited to the information provided in the TSAR, the DOE responses to the NRC request for additional information (Stewart, 1999 a,b,c), and the references cited. Because this TSAR is not site-specific, a complete review addressing all the requirements of 10 CFR Parts 20 and 72 is not possible. Additional information that must be included in the site-specific Safety Analysis Report (SAR) of the DTS is identified. The format of this AR has been arranged according to the Standard Review Plan for Spent Fuel Dry Storage Facilities, NUREG–1567 (Nuclear Regulatory Commission, 1996). In addition, an appendix has been added to this AR documenting all the information that must be included in the site-specific SAR.

1 INTRODUCTION AND GENERAL DESCRIPTION

1.1 Review Objective

The objective for the review of this chapter is to ensure that the applicant has provided a basic summary of the design and the protection afforded the public health and safety. Because the Topical Safety Analysis Report (TSAR) (U.S. Department of Energy, 1996) is not site-specific, a complete review of the installation description as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. Compliance with appropriate regulations by any reference to site-specific information would be evaluated at a later time when the required site-specific information is available. The additional information that must be included in the site-specific Safety Analysis Report (SAR) for the Dry Transfer System (DTS) is identified.

1.2 Areas of Review

The following listing shows the areas of review addressed in Section 1.4, Conduct of Review:

Introduction

General Description of the Dry Transfer System Installation

General Description of Dry Transfer System Operational Functions

Identification of Agents and Contractors

Docketed Material Incorporated by Reference

1.3 Regulatory Requirements

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

- 72.2(a)
- 72.11(a)
- 72.18
- 72.22(a–c)
- 72.24(a), (b), and (n)

1.4 Conduct of Review

The TSAR describes the design and operation of the proposed DTS. The DTS is designed to allow dry transfer of spent nuclear fuel (SNF) from one cask to a larger storage or high capacity transport cask. The DTS facility consists of three areas: (i) preparation area (PA), (ii) lower access area (LAA), and (iii) transfer confinement area (TCA). The Nuclear Regulatory Commission (NRC) staff has evaluated the general description of the facility by reviewing Chapter 1, Introduction and General Description of Installation, of the TSAR, U.S. Department of Energy (DOE) responses to the NRC Request for Additional Information (RAI) (Stewart, 1999a,b), and references cited to ensure that adequate descriptions of the DTS components and operations were provided by the applicant.

1.4.1 Introduction

The NRC staff review of Section 1.1 of the TSAR included Subsections 1.1.1, Preparation Area; 1.1.2, Lower Access Area; 1.1.3, Transfer Confinement Area; and 1.1.4, Principal Features of the DTS.

The PA is used to prepare the casks for fuel transfer and later cask removal from the DTS. The DTS is designed to accommodate 30-ton source casks and 125-ton receiving casks with Babcock & Wilcox (B&W) pressurized water reactor (PWR) SNF assemblies. The PA consists of a weather resistant prefabricated type building at the level of the transfer facility. A single track railway extends into this area from outside; casks are loaded onto trolleys which convey them into the DTS through a large, roll-up entry door. Once inside the PA, the casks are prepared for fuel transfer by removal of their outer lids and emplacement of lifting pintles for inner lids. Other tasks, such as inerting the cask and radiation surveys, take place here. The PA includes lighting and video cameras so that operations can be viewed from the control center. The ambient air pressure inside the PA is maintained at less than ambient external pressure so that in the event of any airborne contamination, air flow will be from outside to inside to help maintain as low as reasonably achievable (ALARA) radiation exposure conditions. Radiation monitors are located in the PA to ensure that all operations are performed under safe conditions.

The casks enter the LAA from the PA through a sliding door, which is 7-to 9-inches thick. The LAA is located within the DTS concrete and steel structure, directly below the TCA. The LAA provides shielding, confinement, and positioning for the open source and receiving casks during SNF transfer. Human entry into the LAA is allowed only when the casks are closed. Lighting and camera equipment are located here to monitor the cask opening process. The cask lids/shield plug are removed remotely by a crane located at the TCA level, thereby, maintaining ALARA standards. Most of the heating, ventilation, and air conditioning (HVAC) equipment is located within the LAA, along with the radiation monitoring equipment.

The TCA is the upper level of the transfer facility, directly above the LAA. This is where fuel assembly transfer from source to receiving cask occurs. The TCA provides radiation confinement for the fuel assemblies during transfer. As in the LAA, fuel transfer and lid removal operations are under remote control within this area. The crane used to remove the lids from the casks is located in a roof enclosure area (REA), above the TCA. This area is enclosed by a protective steel structure that prevents any contamination from leaving the TCA below. Two openings between the REA and the TCA permit access by the crane to the casks below. Both areas are heated and cooled by the HVAC subsystem to maintain temperatures within acceptable limits as defined by a maximum 70°F temperature differential between interior and exterior surfaces of the DTS enclosure walls.

The radiation levels and potential for contamination release are highest in the TCA. Therefore, the ambient air pressure inside this area is maintained at lower than atmospheric and also lower than the PA and LAA. Air will flow from all other areas of the DTS (inside and out) to prevent leakage from the area of highest contamination potential, thus maintaining ALARA standards.

The DTS is designed to be located at multiple reactor sites and at several DOE nonreactor sites where dry transfer is required. The mechanical equipment can be removed and transported to another site after completion of the fuel transfer at a given site. Some of the principal design features of the DTS are:

- The crud catcher, which covers the end of the fuel transfer tube during transfer; a fuel transfer tube, which completely encloses the fuel assembly during transfer; and air pressure differentials, which minimize airborne contamination.

- SNF handling equipment is backed up by redundant systems, either by an independent system or by access for manual operation from a shielded location.

- Both cranes used in the DTS (fuel handling and upper) are designed as single-failure proof cranes.

- The DTS HVAC subsystem prevents the equipment from overheating and also ensures the decay heat removal (DHR) from the SNF is sufficient to keep the maximum fuel cladding temperature within acceptable limits.

- The building design provides sufficient shielding to ensure the requirements of 10 CFR Parts 20 and 72 are met and that radioactive particulates are confined.

- The ventilation subsystem is designed to ensure occupational radiation exposures will be ALARA.

- Because the DTS structure is constructed from steel and concrete, there is no possibility of a major fire.

- Radioactive wastes from the DTS of both solid and liquid form will be minimal.

1.4.2 General Description of the Dry Transfer System Installation

Review of the general description of the DTS included the summary of principal design criteria (Subsection 1.2.1), major structural subsystems (Subsection 1.2.2), major operations subsystems (Subsection 1.2.3), major support subsystems (Subsection 1.2.4), a description of the other subsystems not provided as part of the DTS (Subsection 1.2.5), and drawings (Figures 1.2-1 through 1.2-20 of the TSAR) showing the general design layout of the DTS facility.

The DTS design is based on transferring B&W 15×15 PWR assemblies from a top loading source cask to a top loading receiving cask. These SNF assemblies are assumed to have an initial enrichment of 3.75 weight percent (wt %) of U-235 and 40,000 megawatt-days (MWd) per metric tons of uranium (MTU) burnup. The maximum storage capacities for the source and receiving casks are 4 and 21 PWR fuel assemblies, respectively. The radiation shielding analysis is based on 5-year cooled fuel and the maximum DHR for the thermal analysis is based on 10-year cooled fuel (21 SNF assemblies representing a maximum total DHR of 15.5 kW). This approach allows mixing of less than 10-year cooled fuel with longer cooled fuel to stay within the thermal limit. The DTS is designed to fill a receiving cask with a maximum capacity of 21 fuel assemblies within ten 24-hour days. The rate at which SNF assemblies can be transferred within the DTS cannot exceed the maximum of 4 fuel assemblies from a single source cask in any given 24-hour period.

The DTS has been subdivided into several subsystems, classified into three categories as follows:

- Major structural subsystems include those structural components that provide a physical confinement barrier during fuel transfer, radiation shielding of fuel assemblies during transfer and while in casks, structural support of the major operations subsystems, and access to the casks while in the LAA. The major structural subsystems include the following:

  — The concrete base pad of the DTS
  — The concrete building structure of the DTS
  — A roof plate above the TCA
  — The mezzanine floor plate between the LAA and TCA
  — The prefabricated building structure of the PA
  — The REA above the TCA
  — The sliding door between the PA and LAA
  — A roll-up entry door into the PA

- Major operations subsystems include those subsystems that permit handling the SNF and the receiving and source casks. These subsystems include the following:

  — The cask transfer subsystem (CTS)
  — The cask mating subsystem (CMS)
  — The cask transfer confinement (TC) port cover handling subsystem
  — The receiving cask shield plug and source cask lid handling subsystem
  — The fuel assembly handling subsystem
  — The control subsystem
  — The closed circuit television (CCTV) subsystem and lighting subsystem

- Major support subsystems include additional subsystems not part of the structural subsystems nor directly a part of the major operation subsystems. Support subsystems include the following:

  — The HVAC subsystem
  — The radiation monitoring subsystem
  — The receiving cask lid handling subsystem
  — The decontamination subsystem

Additional systems are required by the DTS operators to properly make use of the DTS, but are not included as a part of the DTS. These include the following:

- The cask transport and lifting subsystem
- The cask vacuum/inerting/leak test subsystem
- The canister welding subsystem
- A DTS power subsystem

ALARA principles are incorporated to the maximum extent practical throughout the design to reduce radiation exposure to facility personnel. The gantry-mounted fuel transfer crane, upper cranes, and associated equipment will be remotely operated from the control room. The control room is remotely located outside the DTS facility to minimize exposure.

Based on the DTS design, waste generation will be minimal. Only low volumes of solid, low-level waste (LLW) will be generated during routine DTS operations. No gaseous or liquid wastes are expected to be generated. Airborne particulate contamination will be collected by the high-efficiency particulate air (HEPA) filters and prefilters, which will be considered LLW after use. Other potential sources of solid, LLW will be from clean-up materials generated from loose crud inside the TCA. Small volumes of solid waste may be expected from routine operations involving contamination surveillance activities. Potential solid waste materials will be collected and temporarily stored onsite for processing and disposal by a waste disposal contractor.

1.4.3 General Description of Dry Transfer System Operational Functions

The NRC staff reviewed the general sequence of operations performed within the DTS as illustrated in Section 1.3, General Systems Description, of the TSAR. The operations can be divided into the following categories.

- Receiving cask receipt, preparation, inspection, and positioning
- Source cask receipt, preparation, inspection, and positioning
- Source cask mating and opening
- Receiving cask mating and opening
- Fuel transfer
- Source cask closing and detachment
- Receiving cask closing and detachment
- Source cask removal
- Receiving cask removal

The NRC staff found that the general systems description of the DTS meets the intent of the applicable design criteria of 10 CFR Part 72.

1.4.4 Identification of Agents and Contractors

Review of identification of agents and contractors (Section 1.4 of the TSAR) included a review of the organizations with responsibilities for design, construction, and operation of the proposed installations. Transnuclear, Inc. (TN) of Hawthorne, New York, was contracted by the Electric Power Research Institute (EPRI), Palo Alto, California, to design the DTS. The project was jointly funded by EPRI and the DOE. TN selected SGN Reseau Eurisys of France to perform the design and analysis of the mechanical equipment used for cask and fuel assembly handling. SGN Reseau Eurisys has previous experience with the design of another SNF reprocessing facility in France. TN selected Foster Wheeler Energy Company (FWEC) of Clinton, New Jersey, to perform design and analysis of the building structure. FWEC subcontracted to GEC Alsthom for much of this work. FWEC and GEC Alsthom have designed the Modular Vault Dry Store SNF storage system, similar to the DTS structure. TN selected National Technical Service (NTS) of Acton, Massachusetts, to provide design and analysis of the HVAC system. NTS subcontracted to the specialty HVAC design firm of Luchini, Milfort, Goodell and Associates, Inc. of Chelmsford, Massachusetts, to conduct the technical work.

The prime agent for the construction and operation of each DTS facility will be determined after site selection and will be identified in the site-specific SAR.

1.4.5 Docketed Material Incorporated by Reference

Where appropriate, chapters of the TSAR included a reference section that identifies all documents referred to in that chapter.

1.5 Evaluation Findings

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

1.5.1 Introduction

- The NRC staff has reviewed the information in Section 1.1, Introduction, of the TSAR, responses to round one RAIs 1-1, 1-3, and 1-4 (Stewart, 1999a), and the response to round two RAI 1-1 (Stewart, 1999b) and found reasonable assurance that the requirements for the introduction to the DTS TSAR under 10 CFR 72.2(a), 72.11(a), and 72.24(b) have been satisfied.

The site-specific SAR must contain at least the following information to satisfy the requirements of 10 CFR 72.24(a) and (n):

- Location of the site: vicinity and sketch of location on a map extract of approximately 1:100,000 or larger scale.

- The Quality Assurance (QA) program that satisfies the requirements of Subpart B, to be applied to:

    — Selecting the site
    — Constructing the facility
    — Fabricating and installing the equipment
    — Testing the systems
    — Operating the systems
    — Modification of equipment and facility
    — Decommissioning the facility and site

1.5.2 General Description of the Dry Transfer System Installation

- The NRC staff has reviewed the information in Section 1.2, General Description of the DTS Installation, of the TSAR, the responses to round one RAIs 1-2 and 1-5 (Stewart, 1999a), and the response to round two RAI 1-1 (Stewart, 1999b) and found reasonable assurance that the requirements for the general description of the installation of the DTS under 10 CFR 72.11(a) and 72.24(b) have been satisfied.

The site-specific SAR must contain at least the following information to satisfy the requirements of 10 CFR 72.24(a):

- A summary of principal site characteristics: potential for flooding; seismic characteristics; proximity to habitation, communities, and transportation and pipeline routes; soil conditions; and external events.

1.5.3 General Description of Dry Transfer System Operational Functions

- The NRC staff has reviewed the information in Section 1.3, General System Description, of the TSAR and found reasonable assurance that the requirements for the general system description of the DTS under 10 CFR 72.11(a) and 72.24(b) have been satisfied.

1.5.4 Identification of Agents and Contractors

- The NRC staff has reviewed the information in Section 1.4, Identification of Agents and Contractors, of the TSAR and found reasonable assurance that the requirements for identification of design agents of the DTS under 10 CFR 72.22(a–c) have been satisfied. The prime agent for the construction and operation of each DTS facility will be determined after site selection and will be identified in the site-specific SAR.

1.5.5 Docketed Material Incorporated by Reference

- The NRC staff has reviewed the information presented by referenced sections in the DTS TSAR and found reasonable assurance that the requirements of 10 CFR 72.18 have been satisfied.

1.6 References

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report.* Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

2 SITE CHARACTERISTICS

2.1 Review Objective

The objective of the site characteristics review is to ensure that the generic site design criteria developed and used by the DOE in the nonsite-specific design of the DTS are acceptably described. The determination whether the generic site design criteria were properly incorporated into the proposed design is made in the design review sections. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete review of the site characteristics as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

2.2 Areas of Review

The following listing shows the areas of review addressed in Section 2.4, Conduct of Review:

Geography and Demography

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

Nearby Industrial, Transportation, and Military Facilities

Meteorology

Regional Climatology
Local Meteorology
Onsite Meteorological Measurement Program

Surface Hydrology

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

Subsurface Hydrology

Geology and Seismology

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

2.3 Regulatory Requirements

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

- 72.24(a)
- 72.40(a)(2)
- 72.90
- 72.92
- 72.94
- 72.96
- 72.98
- 72.100
- 72.102
- 72.106
- 72.122(b)

2.4 Conduct of Review

The NRC staff evaluated site characteristics by reviewing Chapter 2, Site Characteristics, of the TSAR, DOE responses to the NRC RAIs (Stewart, 1999), and documents cited in the RAI responses.

The proposed TSAR, as modified by the response to round one RAI 2-1 (Stewart, 1999), describes the generic site characteristics and uses this information in developing the nonsite-specific design of the DTS. The original TSAR had no detailed information on the site characteristics. In the absence of any site-specific information, the DTS design is based on site characteristics selected to bound as much of the 48 contiguous United States as possible. Once a DTS site is selected, the actual site characteristics and parameters will be determined for site-specific design. If it is demonstrated that the generic site design criteria bound the site-specific values of a site, the DTS design products may be used in the site-specific design. If any DTS design criterion does not conservatively bound the actual site characteristics, the design criterion will be revised and the design will be changed as necessary. The altered design will be reverified and the supporting analyses and changes will be documented in the site-specific DTS SAR.

2.4.1 Geography and Demography

The TSAR and the RAI responses do not contain any information on the geography and demography of the site because the site for the DTS is yet to be selected.

2.4.2 Nearby Industrial, Transportation, and Military Facilities

Section 72.94 requires that the region be examined for manmade facilities that might endanger the proposed DTS. Because no site has been defined, the TSAR and RAI responses do not provide any site-specific information about nearby industrial, transportation, military, and nuclear fuel cycle facilities. The DOE, however, has committed to assess the hazards posed by nearby industrial, transportation, and military installations in the site-specific submittal and to verify that the design criteria associated with those hazards will be bounded by other design criteria in the revised Section 2.2, Nearby Industrial, Transportation and Military Facilities, provided in response to round one RAI 2-1 (Stewart, 1999).

The DTS will be collocated at a reactor site or DOE nonreactor site. The DTS relies on certain existing services that are readily available at all nuclear facilities

- Electric power
- Access to transportation
- Security system
- Waste disposal system
- Health physics organization
- Trained operations personnel

2.4.3 Meteorology

The following subsections from the response to round one RAI 2-1 (Stewart, 1999) were reviewed: Subsection 2.3.1, Regional Climatology; Subsection 2.3.2, Local Meteorology; Subsection 2.3.3, Onsite Meteorological Measurement Program; and Subsection 2.3.4, Diffusion Estimates.

Section 72.90 requires that the site characteristics affecting the safety and environmental impacts of the proposed DTS must be assessed. In the absence of any site-specific information, this nonsite-specific TSAR and the RAI responses have provided bounding design criteria related to maximum and minimum temperatures, extreme winds, tornadoes, hurricanes and tropical storms, and snow and ice storms.

The design ambient temperature values are identified as −20 to 115°F (−29 to 46°C). Based on the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) *1997 ASHRAE Handbook-Fundamentals* (American Society of Heating, Refrigeration and Air-Conditioning Engineers, 1997), the high temperature limit bounds the 48 contiguous United States. The low temperature defined requires operational constraints or will limit the location of the DTS. The design wind speed of 150 mph (3-second gust, nontornado) bounds all the 48 contiguous United States, based on the American National Standards Institute and American Society of Civil Engineers (ANSI/ASCE) 7-95 Standard (American National Standards Institute and American Society of Civil Engineers, 1995). The design basis tornado (DBT) wind speed is based on a Region I tornado and bounds all potential DTS sites in the 48 contiguous United States (Nuclear Regulatory Commission, 1974). Based on the ANSI/ASCE 7-95 Standard, the DTS design snow and ice load is identified as 100 psf, which bounds all the 48 contiguous United States. Because of the degree of local variability, the ANSI/ASCE 7-95 Standard does not provide design snow and ice loads in certain parts of the United States, particularly in mountainous areas.

The design probable maximum precipitation (PMP) values are not identified in the TSAR.

The DTS lightning protection subsystem will be designed in accordance with the National Fire Protection Association (NFPA) Code 780 (National Fire Protection Association, 1992). As this code is not based on geographic location, this criterion will encompass all the 48 contiguous United States. Design of the final lightning protection subsystem, however, will be site- and structure-specific.

This nonsite-specific TSAR and the RAI responses do not provide any information about local meteorology or the onsite meteorological measurement program. For the site-specific SAR, existing National Weather Service or best available data will be used to validate the bounding values used in the TSAR. The site-specific SAR should describe the onsite meteorological measurement program if sufficient data are not available.

Concentrations of gaseous radionuclides at the site boundary following routine releases and accident releases given in the TSAR and the RAI responses are based on NRC Regulatory Guide 1.145 (Nuclear Regulatory Commission, 1982).

2.4.4 Surface Hydrology

The following sections from the response to round one RAI 2-1 (Stewart, 1999) were reviewed: Subsection 2.4.1, Hydrologic Description, and Subsection 2.4.2, Floods. The bounding assumptions regarding some of the site characteristics are presented.

The design of the DTS assumes that all systems, structures, and components (SSCs) important to safety will be located above the probable maximum flood (PMF) level, as defined in ANSI/American Nuclear Society (ANS) 2.8-1992 (American National Standards Institute and American Nuclear Society, 1992). A detailed flood analysis will be conducted following NRC Regulatory Guide 3.48 (Nuclear Regulatory Commission, 1989) if the selected site is not clearly a flood-dry site. The site drainage facilities will be designed to accommodate the PMP runoff and drainage without flooding any SSCs important to safety.

2.4.5 Subsurface Hydrology

This section is not applicable to this nonsite-specific TSAR. Therefore, no information pertaining to the subsurface hydrology of the DTS site has been provided in Section 2.5 of the response to round one RAI 2-1 (Stewart, 1999).

2.4.6 Geology and Seismology

Review of this section of the response to round one RAI 2-1 (Stewart, 1999) included Subsection 2.6.1, Basic Geology and Seismic Information; Subsection 2.6.2, Vibratory Ground Motion; Subsection 2.6.3, Surface Faulting; Subsection 2.6.4, Stability of Subsurface Materials; Subsection 2.6.5, Slope Stability; and Subsection 2.6.6, Volcanism.

This nonsite-specific TSAR and RAI responses do not provide information about the basic geology and seismic potential with a map showing the epicenters of historical earthquakes and nearby capable faults. This current nonsite-specific design of the DTS assumes that all SSCs important to safety will be located away from any capable fault, as defined in 10 CFR Part 100, Appendix A IV(b)(4). Additionally, the DOE committed to investigate all capable faults as a part of the site investigation after the site is selected. Avoidance of faults will be the preferred approach for DTS siting.

The DTS design presented in this TSAR is based on a design earthquake (DE) having a peak horizontal acceleration (PHA) of 0.25g and a peak vertical acceleration (PVA) of 0.17g applied at the structure foundation. The TSAR indicates that 0.25g PHA will bound the PHA values at most sites east of the Rocky Mountain Front, as defined in 10 CFR 72.102(a)(2). The DOE, however, needs to demonstrate that a PHA of 0.25g will bound the estimated PHA at the selected site following the procedures outlined in 10 CFR Part 100, Appendix A, if the selected site is west of the Rocky Mountain Front (west of approximately 104 W longitude) and in other areas of known potential activity (including but not limited to the regions around New Madrid, Missouri; Charleston, South Carolina; and Attica, New York). The response spectra are defined by NRC Regulatory Guide 1.60 (U.S. Atomic Energy Commission, 1973a). The damping values are defined by NRC Regulatory Guide 1.61 (U.S. Atomic Energy Commission, 1973b).

The TSAR assumes a flat site for DTS design. Consequently, there is no discussion of stability of the slopes. The generic DTS design also assumes there are no nearby volcanic centers capable of impacting the DTS through explosive forces, lava flow, or ash fall. Consequently, no ash fall criteria are specified for the generic DTS design. The DOE will conduct site-specific investigations to determine if ash fall from volcanic eruptions will affect the safety and environmental impact of the proposed DTS.

2.5 Evaluation Findings

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

2.5.1 Geography and Demography

Geography and demography are considered not applicable for the nonsite-specific TSAR.

The site-specific SAR must contain at least the following information to satisfy the requirements of 10 CFR 72.24(a), 72.90, 72.96, 72.98, 72.100, and 72.106:

- Information on site location including site host state and county; site latitude, longitude, and Universal Mercator coordinates; and map and aerial photographs with radial coverage extending a minimum of 8 km (5 miles) from the site.

- A detailed site description indicating the site boundary and the controlled area, controlled area access points, and the distances from the boundary to significant features of the installation, as required by 10 CFR 72.106.

- Maps showing the site topography and surface drainage patterns as well as roads, railroads, transmission lines, wet lands, and surface water bodies of the site.

- Descriptions of the vegetative cover and surface soil characteristics.

- Demographic information, such as current population data and projections throughout the planned period of operation of the DTS.

- A sector map of population dividing the area within an 8 km radius of the site by concentric circles with radii of 1.5, 3.0, 5.0, 6.5, and 8.0 km and by 22.5-degree segments, each segment centered on one of the 16 compass points.

- Population data overlaid on a base map showing the nearby cities or towns.

- Locations of maximally exposed individual(s) identified including the rationale for selection.

- A description of the land and water use within an 8 km radius of the site.

2.5.2 Nearby Industrial, Transportation, and Military Facilities

Nearby industrial, transportation, and military facilities are not considered applicable in the nonsite-specific TSAR.

The following information must be included in the site-specific SAR as a minimum to satisfy the requirements of 10 CFR 72.24(a), 72.40(a)(2), 72.90, 72.94, 72.96, 72.98, 72.100, and 72.122(b):

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

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

- A description of the services supplied by the collocated nuclear facility or DOE nonreactor site.

- An analysis of the impact of the DTS on the collocated nuclear facility or DOE nonreactor site.

2.5.3 Meteorology

- The NRC staff has reviewed the information presented in the TSAR and Section 2.3 provided in response to round one RAI 2-1 (Stewart, 1999) and found reasonable assurance that the information satisfies the requirements for the general description of both regional and local meteorology of the site, as identified by bounding values for this nonsite-specific DTS, under 10 CFR 72.24(a) and 72.122(b).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.40(a)(2), 72.90, 72.92, and 72.98:

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

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

- Define the PMP.

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

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

- The site characteristics must demonstrate that the probability of occurrence of floods, tsunami, and seiches is sufficiently low to consider them noncredible events. This includes adequate supporting documentation to claim the selected site is flood dry, as indicated in ANSI/ANS 2.8-1992, taking into account PMF on adjacent streams and rivers, seismically induced dam failures, and ice-jam flooding. As identified in the accident analysis chapter, Section 12.1 of this assessment report (AR), these natural phenomena are not addressed.

2.5.4 Surface Hydrology

- The NRC staff has reviewed the information presented in the TSAR and Section 2.4 provided in response to round one RAI 2-1 (Stewart, 1999) and found reasonable assurance that the information satisfies the requirements for the general description of the surface hydrology of the site for this nonsite-specific DTS, under 10 CFR 72.24(a).

The site-specific SAR for the DTS must include the following information to satisfy the requirements of 10 CFR 72.40(a)(2), 72.90, 72.92, 72.98, and 72.122(b):

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

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

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

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

2.5.5 Subsurface Hydrology

Subsurface hydrology is not considered applicable in the nonsite-specific TSAR.

The site-specific SAR for the DTS must at least include the following information to satisfy the requirements of 10 CFR 72.24(a); 72.40(a)(2); 72.90(e); 72.98(b), (c)(2 and 3); and 72.122(b):

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

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

- A description of the water table history and anticipated groundwater conditions beneath the site during DTS construction and operation.

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

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

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

2.5.6 Geology and Seismology

- The NRC staff has reviewed the information presented in the TSAR and Section 2.6 provided in response to round one RAI 2-1 (Stewart, 1999) and found reasonable assurance that the information satisfies the requirements for the general description of geology and seismology of the site, for the bounding conditions defined in this nonsite-specific TSAR, under 10 CFR 72.24 and all paragraphs of 72.40(a) except for 72.40(a)(2).

The site-specific SAR for the DTS must include at least the following information to satisfy the requirements of 10 CFR 72.40(a)(2), 72.90, 72.92, 72.98(a), 72.102, and 72.122(b):

- Geologic history of the area describing its lithologic, stratigraphic, and structural conditions.

- A large scale map of the site showing surface geology and the location of major faults.

- Stratigraphic columns and cross sections of the site.

- Planar and linear features such as folds, faults, synclines, anticlines, basins, and domes identified on a geologic map showing bedrock surface contours.

- A description of the site morphology including areas of potential landslide or subsidence along with a topographic map showing geomorphic features and principal site facilities.

- Any physical evidence of behavior of surficial site materials during previous earthquakes.

- If the site is located in an active volcanic region, then site-specific investigations should be performed to determine if ash fall from volcanic eruptions will affect the safety and environmental impact of the proposed DTS.

- Maps showing all potentially significant faults or parts of faults within 161 km of the site and epicenters of historical earthquakes with all capable faults (as defined in 10 CFR Part 100, Appendix A) identified.

- A description of any mapped faults 300 meters or longer within an 8 km area of the site.

- A description of the stability of the rock (defined as having a shear velocity of at least 1,166 m/s) and soil beneath the foundations of the DTS structures.
- A description of the geologic features, such as areas of potential uplift or collapse, or zones of deformation, alteration, structural weakness, or irregular weathering.
- A description of the static and dynamic engineering properties of the materials underlying the site as well as physical properties of foundation materials.
- A plot plan showing the locations of all borings, trenches, seismic lines, piezometers, geologic cross sections, and excavations with all DTS structures superimposed illustrating relationships among major foundations and subsurface materials, structure, and the water table.
- Plans and profiles of any excavation and backfill with compaction criteria.
- An analysis of rock and soil responses to dynamic loading along with estimation calculations of the liquefaction potential and safety factors.
- A contour map to demonstrate that the selected site is flat without potential for slope stability problems.
- A discussion of the potential effects of erosion and deposition.
- A detailed discussion of potential hazards to the site from nearby volcanoes.
- A description of any dissolution features or karst deposits.

2.6 References

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

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

American Society of Heating, Refrigeration, and Air-Conditioning Engineers. *1997 ASHRAE Handbook-Fundamentals*. New York: American Society of Heating, Refrigeration, and Air-Conditioning Engineers. 1997.

National Fire Protection Association. *Standard for the Installation of Lightning Protection Systems.* NFPA No. 780. Quincy, MA: National Fire Protection Association. 1992.

Nuclear Regulatory Commission. *Design Basis Tornado for Nuclear Power Plants.* Regulatory Guide 1.76. Revision 0. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1974.

Nuclear Regulatory Commission. *Atmospheric Dispersion Models for Potential Accident Consequence Assessments of Nuclear Power Plants.* Regulatory Guide 1.145.

Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1982.

Nuclear Regulatory Commission. *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage)*. Regulatory Guide 3.48. Revision 1. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1989.

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities*. NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999.

U.S. Atomic Energy Commission. *Design Response Spectra for Seismic Design of Nuclear Power Plants.* Regulatory Guide 1.60. Revision 1. Washington, DC: U.S. Atomic Energy Commission. 1973a.

U.S. Atomic Energy Commission. *Damping Values for Seismic Design of Nuclear Power Plants*. Regulatory Guide 1.61. Washington, DC: U.S. Atomic Energy Commission. 1973b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report.* Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

3 PRINCIPAL DESIGN CRITERIA

3.1 Review Objective

The objective of the review of this chapter is to ensure that the applicant acceptably defines (i) the limiting characteristics of the SNF to be transfered, (ii) the classification of SSCs according to their importance to safety, and (iii) the design criteria and design bases, including the external conditions during normal and off-normal operations, accident conditions, and natural phenomena events. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete review of the principal design criteria as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

3.2 Areas of Review

The following listing shows the areas of review addressed in Section 3.4, Conduct of Review:

Materials to Be Stored

Classification of Structures, Systems, and Components

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

General
Structural
Thermal
Shielding/Confinement/Radiation Protection
Criticality
Decommissioning Considerations
Retrieval Capability
Satisfaction of ALARA Goals

Design Criteria for Other Structures, Systems, and Components Subject to NRC Approval

3.3 Regulatory Requirements

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

- 72.2(a)(1 and 2)
- 72.3
- 72.6(b)
- 72.11
- 72.24
- 72.102(a–f)
- 72.106
- 72.120(a)
- 72.122(a–l)
- 72.124(a) and (b)
- 72.126
- 72.128
- 72.130
- 72.182
- 72.236

3.4 Conduct of Review

The NRC staff evaluated the DTS principal design criteria by reviewing Chapter 3, Principal Design Criteria, of the TSAR (U.S. Department of Energy, 1996), DOE responses to the NRC RAIs (Stewart, 1999a,b), and supporting documentation. Limited hand calculations were performed to evaluate data provided in the TSAR. The principal design criteria identified by the DOE were compared to standard engineering practice such as those identified in ANSI/ANS 57.9 (American National Standards Institute and American Nuclear Society, 1984), ANSI/ASCE 7-95 (American National Standards Institute and American Society of Civil Engineers, 1996), Regulatory Guide 1.60 (U.S. Atomic Energy Commission, 1973a), Regulatory Guide 1.61 (U.S. Atomic Energy Commission, 1973b), Regulatory Guide 1.76 (U.S. Atomic Energy Commission, 1974a), and NUREG–0800 (Nuclear Regulatory Commission, 1981).

3.4.1 Materials to Be Stored

The materials to be stored are identified in Subsection 3.1.1, Materials to be Transferred, of the TSAR. Tables 3-1 through 3-3 convey the SNF assembly characteristics and normalized gamma and neutron source spectra provided in the TSAR and responses to NRC RAIs (Stewart, 1999a,b).

Table 3-1. Spent fuel assembly characteristics

Fuel Assembly Characteristics	Pressurized Water Reactor
Weight (including hardware) (lbs)	1720 (780 kg)
Uranium (metric tons uranium)	0.49
Overall Length (including hardware) (inches)	180 (4,750 mm)
Section Type	Square
Initial Enrichment (wt % of U-235)	3.75
Design Burnup (Megawatt days/metric tons uranium)	40,000
Criticality Array Configuration	Babcock & Wilcox 15 × 15
Cooling Time (years since reactor discharge)	minimum 5
Fuel Region Gamma Source (γ/sec)—Avg/Peak	$7.8 \times 10^{15}/9.9 \times 10^{15}$
Fuel Region Neutron Source (n/sec)—Avg/Peak	$2.4 \times 10^{8}/5.4 \times 10^{8}$
End Fitting Co-60 Source (Ci) Top/Bottom	114/127

The DTS design presented in the TSAR is based on B&W 15×15 PWR assemblies. Other fuel assemblies can be used but will require changes to the fuel grapple and fuel transfer tube and checks of the shielding and thermal analyses. In addition, note that the minimum 5-year cooling time since reactor discharge appears to be inconsistent with the 10-year cooling time required for thermal considerations. It is important to recognize that the design basis SNF must be cooled for at least 5 years because of radiation shielding limitations. From a thermal perspective, however, the maximum decay heat load that the DTS can accommodate is 15.5 kW, which is equivalent to 21 10-year cooled SNF assemblies. As a consequence, 5-year cooled fuel can be mixed with longer then 10-year cooled fuel to achieve a net decay heat load below the 15.5 kW limitation.

Table 3-2. Normalized gamma source spectra characteristics for fuel region fission products, actinides and activated light elements

Mean Energy MeV	Fraction Pressurized Water Reactor 5 Years Decay
1.00×10^{-2}	2.25×10^{-1}
2.50×10^{-2}	5.33×10^{-2}
3.75×10^{-2}	5.71×10^{-2}
5.75×10^{-2}	4.47×10^{-2}
8.50×10^{-2}	2.91×10^{-2}
1.25×10^{-1}	2.93×10^{-2}
2.25×10^{-1}	2.43×10^{-2}
3.75×10^{1}	1.44×10^{-2}
5.75×10^{1}	3.85×10^{-1}
8.50×10^{1}	9.26×10^{-2}
1.25×10^{0}	4.45×10^{-2}
1.75×10^{0}	5.70×10^{-4}
2.25×10^{0}	2.94×10^{-4}
2.75×10^{0}	9.48×10^{-6}
8.50×10^{1}	9.26×10^{-2}
3.50×10^{0}	1.21×10^{-6}
5.00×10^{0}	1.27×10^{-9}
7.00×10^{0}	1.77×10^{-10}
9.50×10^{0}	1.69×10^{-11}

Table 3-3. Normalized neutron source spectra for fuel region spontaneous fission and alpha-n reaction sources

Group Number	Mean Energy (MeV)	Fraction Pressurized Water Reactor 5 Years Decay
1	6.43×10^{0}–2.00×10^{1}	1.85×10^{-2}
2	3.00×10^{0}–6.43×10^{0}	2.10×10^{-1}
3	1.85×10^{0}–3.00×10^{0}	2.32×10^{-1}
4	1.40×10^{0}–1.85×10^{0}	1.31×10^{-1}
5	9.00×10^{-1}–1.40×10^{0}	1.77×10^{-1}
6	4.00×10^{-1}–9.00×10^{-1}	1.93×10^{-1}
7	1.00×10^{-1}–4.00×10^{-1}	3.78×10^{-2}

Damaged fuel will not be accepted at the DTS facility. Damaged fuel is considered as fuel that is not dimensionally or structurally sound and that cannot be handled by normal means. Fuel assemblies damaged in transit will not be transferred.

The radioactive waste expected to arise from operations will be spalled crud, decontamination swabs, swipes or both, used HEPA filters, contaminated lubricants and equipment, and HVAC condensation liquid.

3.4.2 Classification of Structures, Systems, and Components

The classification of SSCs for the DTS installation is identified in Sections 3.4, Classification of Structures, Components, and Systems; 4.1, Summary Description; and in Table 3.4-1 of the TSAR and the DOE response to round two RAI 1-1 (Stewart, 1999b). The TSAR tabulates the classifications and describes the SSCs and their functions. Sufficient information is provided on the description and function of the systems to allow evaluation of their importance to safety. Table 3-4 summarizes the major components of the DTS and their classification.

The confinement boundary during the SNF transfer process consists of the reinforced concrete base mat and superstructure, the protective cover, and the sliding door. The receiving and source casks provide the confinement boundary for the SNF at other times of the operation. The roof and mezzanine plates provide support for the important to safety systems. They also provide boundaries for the TCA and LAA as part of the design to ensure that air will flow from regions of lowest potential contamination to regions of highest potential contamination. They are protected from the DBT by the concrete structure and protective cover.

The structure to house fans and programmable logic controllers (PLCs) is not considered important to safety, although it is designed to remain intact following the DE and DBT events. This protection is provided to ensure the fans and PLC are not damaged. The PA enclosure is also not considered important to safety. Loss of this structure would not affect the confinement function of the DTS. Repairs would have to be made prior to continuation of the transfer process.

Table 3-4. Summary of classification of structures, systems, and components of the Dry Transfer System

Structure, Component, or System	Safety Function	Classification Category
Confinement and Protective Structures		
Reinforced Concrete Basemat	Structural integrity during normal and accident events and confinement.	Important to Safety
Reinforced Concrete Superstructure (encloses TCA and LAA)	Structural integrity during normal and accident events, confinement, and shielding.	Important to Safety
Roof Enclosure Area	Structural integrity during normal and accident events, protection from water intrusion, confinement, and shielding.	Important to Safety
Sliding Door	Structural integrity during normal and accident events, confinement, and shielding.	Important to Safety
Structural Steel Roof Plate (supports upper crane)	Structural integrity during normal and seismic events, shielding, and protection against fuel damage during handling.	Important to Safety
Mezzanine Plate (supports cask mating subsystem)	Structural integrity during normal and seismic events and shielding.	Important to Safety
Protective Enclosure to House Fans and PLC	—	Not Important to Safety
PA Enclosure	—	Not Important to Safety
Auxiliary Systems		
HVAC Subsystem-HEPA Filtration, HEPA Filter Monitoring Subsystem, and Exhaust Air Temperature Monitoring Subsystem	Confinement	Important to Safety
CCTV and Lighting Subsystems	Provides visibility to the operator for normal and off-normal events, as well as accident recovery.	Important to Safety
HVAC System - Environmental Conditions and Exhaust Fans		Not Important to Safety

Table 3-4. Summary of classification of structures, systems, and components of the Dry Transfer System (cont'd)

Structure, Component, or System	Safety Function	Classification Category
Electrical Subsystem		Not Important to Safety
Air Supply Subsystem (air to inflate the seals on the sliding door)		Not Important to Safety
Radiation Monitoring Subsystem		Not Important to Safety
Criticality Monitoring Subsystem	Monitor neutron activities during fuel transfer.	Important to Safety
Spent Fuel and High-Level Radioactive Waste Handling Operation Systems		
Receiving and Source Cask Transfer Subsystem (locking pins, trunnion tiedowns, and seismic restraints including rails and anti-derailing devices)	Structural integrity during normal and accident events.	Important to Safety
Overlid with Gripping Device	Structural integrity during normal and accident events.	Important to Safety
Receiving and Source Cask Transfer Confinement Port Cover Handling Subsystem (upper shield port cover locking device only)	Structural integrity during normal and seismic events.	Important to Safety
Receiving Cask Shield Plug and Source Cask Lid Handling Subsystem	Structural integrity during normal and seismic events.	Important to Safety
Fuel Assembly Handling Subsystems	Structural integrity during normal and seismic events.	Important to Safety
Upper Shield Port Covers	Shielding	Important to Safety
Receiving and Source Cask Mating Subsystem		Not Important to Safety
Control Subsystem including Control Room/Trailer		Not Important to Safety

Table 3-4. Summary of classification of structures, systems, and components of the Dry Transfer System (cont'd)

Structure, Component, or System	Safety Function	Classification Category
Legend:		
TCA – Transfer confinement area		
LAA – Lower access area		
PLC – Programmable Logic Controller		
PA – Preparation area		
HVAC – Heating, ventilation, and air-conditioning		
HEPA – High-efficiency particulate air		
CCTV – Closed circuit television		

Of the auxiliary subsystems, only the HEPA filtration, HEPA filter monitoring subsystem, and exhaust air temperature monitoring subsystem in the HVAC subsystem and the CCTV and lighting subsystems are considered important to safety. The HEPA filters ensure contamination is not released to the environment through the airborne path. The filter and air temperature monitoring subsystems are indicators of the performance of the confinement and HVAC subsystems. On review of the operational procedures and trips to Idaho National Engineering and Environmental Laboratory (INEEL) to view a prototype of the fuel assembly handling subsystem, it was determined that it was not possible to insert the fuel bundles into the cask without visual aid. Therefore, the CCTV and lighting subsystems are considered important to safety. Assurance is required that primary power can be reestablished, or emergency power will be available, in conjunction with the backup subsystems to operate the CCTV and lighting subsystems in the event of an accident within an acceptable time frame.

The portion of the HVAC subsystem used for environmental control is not considered important to safety. The DOE has analyzed the influence of the loss of HVAC on the differential thermal gradient through the concrete walls and the temperature of the full cladding. The exhaust fans provide the mechanism to ensure air will flow from regions of lowest potential contamination to regions of highest potential contamination. This is considered an additional level of confinement, which is not important to safety.

The electrical, air supply, and radiation monitoring subsystems are not considered important to safety. Loss of these systems would not impair the confinement function of the DTS. However, they would have to be restored before DTS operations could resume.

As required by 10 CFR 70.24(a) and 72.124(c), criticality monitoring is needed for operation of the DTS.

A number of components of the SNF handling operation subsystems are considered important to safety. These are designed to ensure the SNF is not placed in an unanalyzed condition. The control subsystem, including the PLC, are necessary to the automated process of fuel transfer. They are not considered important to safety, and manual operation is considered the backup. The PLC hardware is protected from damage during accident events by the protective enclosure that houses the exhaust fans and PLC.

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

The following sections from the TSAR were reviewed: Section 3.1, Purposes of Installation; Section 3.2, Structural and Mechanical Safety Criteria; Section 3.3, Safety Protection System; Section 3.5, Decommissioning Considerations; and Section 3.6, Summary of Design Criteria.

3.4.3.1 General

As identified in the TSAR, the DTS is designed to maintain

- Criticality control by the design of the source and receiving casks.

- The integrity of the SNF assemblies against gross rupture during handling and normal and off-normal events.

- The capacity to shield operators and the general public from direct radiation and contamination. Exposure to operations personnel will be limited in accordance with 10 CFR 20.1201. Exposure to the general public will be limited in accordance with 10 CFR 20.1301.

- Prevent gross collapse during all design events and preclude dropping heavy objects onto the fuel or onto SSCs important to safety as a result of building structure failure.

A summary of design criteria is given in Section 3.6 of the TSAR and is based on bounding generic site characteristics. The design life of the DTS is identified in the TSAR as 20 years. Table 3-5 provides a summary of the principal design criteria provided in Tables 1.2-1 and 3.2-5 of the TSAR.

Detailed design criteria are given in Chapter 3 of the TSAR and in response to round one RAIs 3-1, 3-6, 3-9, 3-11, 3-14, 3-15, 3-17, and 3-18 (Stewart, 1999a). The applicable codes and standards are also identified in Chapter 3 of the TSAR. The design criteria satisfy the requirements for protection against environmental conditions, natural phenomena, and fires and explosions. These design criteria are applicable to the physical protection of the proposed DTS facility.

Table 3-5. Principal design criteria of the Dry Transfer System

Criteria or Parameter	Value	Reference
Tornado Maximum Wind Speed Rotational Speed Translational Speed Radius Pressure Drop	Region I 360 mph 290 mph 5 to 70 mph 150 ft 3.0 psi at 2 psi/sec	Regulatory Guide 1.76, NUREG–0800
Tornado Missiles	Spectrum II, Region I	NUREG–0800
Wind Velocity	150 mph, Exposure C, Annual Probability of 0.02	ANSI/ASCE 7-95
Snow and Ice Pressure	100 psf, 100-year load	ANSI/ASCE 7-95
Dead Loads	Dead load of structure and attachments	ANSI/ANS 57.9
Live Loads	250 psf uniformly distributed concentrated loads as necessary	ANSI/ANS 57.9 ANSI/ASCE 7-95
Normal Handling Loads	Based on equipment description in Chapter 5 of the TSAR	ANSI/ANS 57.9
Loads Due to Maximum Drop	Fuel Assembly—28 inches Source Cask Lid—10 inches Receiving Cask Lid—16 inches	ANSI/ANS 57.9
Internal Pressure	Enveloped by other design basis events	10 CFR Part 72
Fire	The TSAR asserts that fire is a noncredible accident event.	See Subsection 12.5.2.6 of this AR
Explosion	Enveloped by other design basis events.	Regulatory Guide 1.91 10 CFR 72.122
Seismic	East of Rocky Mountain Front 0.25g Horizontal 0.17g Vertical West of Rocky Mountain Front Site-specific DE in accordance with 10 CFR Part 100, Appendix A	Regulatory Guide 1.60, Regulatory Guide 1.61, 10 CFR 72.102

Table 3-5. Principal design criteria of the Dry Transfer System (cont'd)

Criteria or Parameter	Value	Reference
Flood	DTS will be sited at an elevation above flood level	Site-specific evaluation is required if these conditions are not met
Ambient Temperature	−20 to 115 °F	Site-specific evaluation is required if these conditions are not met
Ambient Relative Humidity	0 to 100%	Site-specific evaluation is required if these conditions are not met
Solar Heat Load	Typical of US site at 43 °N Latitude	1997 ASHRAE Handbook-Fundamentals
Legend:		
ANSI – American National Standards Institute		
ASCE – American Society of Civil Engineers		
ANS – American Nuclear Society		
AR – Assessment report		
DE – Design earthquake		
ASHRAE—American Society of Heating, Refrigeration, and Air-Conditioning Engineers		

3.4.3.2 Structural

The design bases and criteria for structures categorized as important to safety are summarized in Table 3-5. These parameters are applied to the SSCs in accordance with specified load combinations identified in the TSAR for different types of structures, along with their bases and respective summary tables provided in the TSAR, [i.e., Reinforced Concrete Structure (American Concrete Institute, 1985) (TSAR Table 3.2-6), Structural Steel (American National Standards Institute and American Institute of Steel Construction, 1989) (TSAR Table 3.2-8), and Major Operation Equipment (American Society of Mechanical Engineers, 1995)].

The characteristics of the multi-purpose canister (MPC), transportation overpack, and source cask used in the design of the SSCs are given in Tables 3.1-4, 3.1-5, and 3.1-6 of the TSAR, respectively. These were used as a design basis, and if other systems are used they must be compared to these and additional analysis performed if necessary. In its responses to round one RAI 3-16 (Stewart, 1999a) and round two RAI 3-5 (Stewart, 1999b), the DOE modified the definition of the loading for the receiving and source cask transfer trolleys under seismic loading to account for the full weight of the casks in the horizontal and vertical directions. The design bases for the cask transfer trolleys are in accordance with standard engineering practice.

Live loads based on the capacity of the cranes and fuel handling equipment are

• Fuel Handling Crane	1.7 tons
• Upper Crane	5 tons
• Receiving Cask Transfer Trolley	125 tons
• Source Cask Transfer Trolley	30 tons
• TC Port Cover	5 tons

As identified in the TSAR, soil interaction has not been included in the analysis. A hard rock site is assumed. Site-specific response spectra will have to be generated for sites at which the soil will influence response of the DTS structure and additional analysis performed.

3.4.3.3 Thermal

The design bases for normal and off-normal thermal loads have been identified. Under accident conditions, one scenario includes loss of the environmental conditioning portion of the HVAC subsystem. Information has been provided by the DOE to determine the influence of the loss of HVAC environmental conditioning on the thermal loads on the DTS. The thermal loads during accident conditions have been identified. Temperature limits on the fuel cladding, concrete, and important to safety equipment have been identified.

3.4.3.4 Shielding/Confinement/Radiation Protection

The DTS is designed to maintain the capacity to shield operators and the general public from direct radiation and contamination. As identified in the TSAR, the design basis is B&W 15×15 PWR fuel assemblies and specific source and receiving casks. The DTS is designed to maintain onsite and offsite doses ALARA during transfer operations. Exposure to operations personnel will be limited in accordance with 10 CFR 20.1201. Exposure to the general public will be limited in accordance with 10 CFR 20.1301.

3.4.3.5 Criticality

The TSAR asserts that the DTS criticality control is maintained by the design of the source and receiving casks. The NRC staff has not reviewed the SAR and supporting documentation for the source and receiving casks for criticality determination. The assumption is made that the source and receiving casks will be licensed by the NRC under separate regulatory actions.

As required by 10 CFR 70.24(a) and 72.124(c), criticality monitoring is needed for operation of the DTS. This monitoring equipment needs to be added to Table 3.4-1 of the TSAR with supporting discussion provided in the text.

3.4.3.6 Decommissioning Considerations

No evaluation of decommissioning considerations was conducted because the TSAR is non-site-specific. The decommissioning issues will be evaluated during review of the site-specific SAR.

3.4.3.7 Retrieval Capability

The ability to retrieve damaged fuel assemblies arising from various accident scenarios as required in 10 CFR 72.122(l) is addressed in Chapter 12, Accident Analysis, of this AR.

3.4.3.8 Satisfaction of As Low As Reasonably Achievable Goals

Sections 3.3 and 7.1 of the TSAR provide evidence that the proposed design and concomitant design criteria are rationally developed, including consideration of ALARA goals. The most significant radiation protection design feature is the heavy shielding used to reduce personnel exposure. Policy, design, and operational considerations are used to achieve ALARA goals.

3.4.4 Design Criteria for Other Structures, Systems, and Components Subject to Nuclear Regulatory Commission Approval

Design bases for other SSCs will be in accordance with accepted engineering practice. Where applicable, the design basis identified in Subsection 3.4.3 will be applied to these SSCs.

3.5 Evaluation Findings

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

3.5.1 Materials to Be Stored

- The NRC staff has reviewed the information presented in Subsection 3.1.1, Materials to be Transferred, of the TSAR and found reasonable assurance that the SNF to be stored at the site is identified and characterized, in conformance with the requirements in 10 CFR 72.2(a)(1 and 2) and 72.6(b).

- The NRC staff has reviewed the information presented in Subsection 3.1.1, Materials to be Transferred, of the TSAR and found reasonable assurance that the radioactive waste generated at the site is identified and characterized, as required by 10 CFR 72.128(b) and that only solid waste form will be handled, as required by 10 CFR 72.120(b).

3.5.2 Classification of Structures, Systems, and Components

- The NRC staff has reviewed the information presented in Section 3.4, Classification of Structures, Components and Systems; and Section 4.1, Summary Description of the TSAR, and found reasonable assurance that the SSCs have been classified according to their function as important to safety or not important to safety and meet the requirements in 10 CFR 72.3 and 72.24(n). The NRC staff concurs with the identification of SSCs important to safety, the safety function they perform, and those features that are important to safety.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.122(k):

- It must be demonstrated that either primary or emergency power will be sufficient and available within an acceptable time frame for all credible accident scenarios.

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

3.5.3.1 General

- The NRC staff has reviewed the information in Chapter 3, Principal Design Criteria, of the TSAR and found reasonable assurance that the principal design criteria required by 10 CFR 72.11, 72.24(c)(1, 2, and 4), and 72.120(a) are identified. Design criteria for fabrication, construction, testing, maintenance, and performance requirements are in Chapter 3 of the TSAR.

- The NRC staff has reviewed the information presented in Section 3.1, Purposes of Installation, of the TSAR and found reasonable assurance that the design bases and criteria meet the general requirements in 10 CFR 72.24(c)(1, 2, and 4) and (n); 72.102(a); 72.106(a) and (c); 72.120(a); 72.122(a–l); and 72.182 (a) and (b). The applicable codes and standards are identified. The design criteria satisfy the requirements for protection against environmental conditions and natural phenomena and against fires and explosions. These design criteria are also applicable to the physical protection considerations for the proposed DTS facility.

3.5.3.2 Structural

- The NRC staff reviewed the information presented in Section 3.2, Structural and Mechanical Safety Criteria, of the TSAR and found reasonable assurance that the design basis and criteria for structures categorized as important to safety meet the requirement of 10 CFR 72.24(c)(1, 2, and 4) and (n); 72.102(a); 72.120(a); and 72.122(a), (b)(1–3), (c), (d), and (f–k).

The site-specific SAR must contain the following information to satisfy the requirements of 10 CFR 72.102(b), (c), (d), and (f):

- The characteristics of the soil in relationship to a hard rock site analyzed in the TSAR (U.S. Department of Energy, 1996). Site-specific response spectra will have to be generated for sites at which the soil will influence response of the DTS structure.

3.5.3.3 Thermal

- The NRC staff has reviewed the information presented in Section 3.2, Structural and Mechanical Safety Criteria, and Section 3.3, Safety Protection Systems, of the TSAR and found reasonable assurance that the design bases and criteria for thermal consideration meet the regulatory requirements in 10 CFR 72.122(a), (b)(1–3), (c), (d), and (f–i); and 72.128(a)(4). The TSAR meets the regulatory requirements for design criteria for fire protection in Regulatory Guide 1.120 (Nuclear Regulatory Commission, 1977).

3.5.3.4 Shielding/Confinement/Radiation Protection

- The NRC staff has reviewed the information presented in Section 3.3, Safety Protection Systems, of the TSAR and found reasonable assurance that the design bases and criteria for shielding, confinement, radiation protection, and ALARA considerations meet the regulatory requirements in 10 CFR 72.24(c)(1, 2, and 4) and (n); 72.106(a) and (c); 72.122(a–i); 72.126; and 72.128(a)(1 and 5) and (b).

The site-specific SAR must contain the following information on the source and receiving casks to satisfy the requirements of 10 CFR 72.106(b) and 72.128(a)(2–4):

- The characteristics of the fuel assemblies and the specific source and receiving casks including geometry, design characteristics, and SNF characteristics. If these characteristics are bounded by those given in the TSAR, no additional analysis is required. If the site-specific data are not bounded by the TSAR, additional shielding and confinement analysis will be required.

3.5.3.5 Criticality

- The NRC staff has reviewed the information presented in Section 3.3, Safety Protection Systems, of the TSAR and found reasonable assurance that the design bases and criteria for criticality safety meet the regulatory requirements in 10 CFR 72.124(a) and (b).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(a) and 72.124(c):

- The design details and specifications of the criticality monitoring system to be employed at the DTS, reference also criticality monitoring as defined in Subsection 10.5.1 of this AR.

3.5.3.6 Decommissioning Considerations

- No evaluation of decommissioning considerations was conducted because the TSAR is non-site-specific. The decommissioning issues will be evaluated during review of the site-specific SAR.

3.5.3.7 Retrieval Capability

- The evaluation findings pertaining to the ability to retrieve damaged fuel assemblies arising from various accident scenarios as required in 10 CFR 72.122(l) can be found in Chapter 12, Accident Analysis, of this AR.

3.5.3.8 Satisfaction of As Low As Reasonably Achievable Goals

- The NRC staff has reviewed the information presented in Section 3.3, Safety Protection Systems; and Section 7.1, Ensuring that Occupational Exposures are ALARA, of the TSAR and found reasonable assurance that ALARA goals are considered in the design criteria and proposed design of the DTS, in conformance with the requirement of 10 CFR 72.24 and 72.126.

3.5.4 Design Criteria for Other Structures, Systems, and Components Subject to Nuclear Regulatory Commission Approval

- The NRC staff has reviewed the information provided in the TSAR and found reasonable assurance that the design bases and criteria for other SSCs not designated as important to safety but subject to NRC approval meet the general regulatory requirements in 10 CFR 72.24(a–g) and (l); and the appropriate requirements in Subparts E and F of 10 CFR Part 72.

3.6 References

American Concrete Institute. *Code Requirements for Nuclear Safety Related Concrete Structures and Commentary*. ACI 349–85 and ACI 349R–85. Detroit, MI: American Concrete Institute. 1985.

American National Standards Institute and American Institute of Steel Construction. *Specifications for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities.* ANSI/AISC N690. New York: American National Standards Institute and American Institute of Steel Construction. 1989.

American National Standards Institute and American Nuclear Society. *Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type).* ANSI/ANS 57.9–1984. La Grange Park, IL: American National Standards Institute and American Nuclear Society. 1984.

American National Standards Institute and American Society of Civil Engineers. *Minimum Design Loads for Buildings and Other Structures.* ANSI/ASCE 7–95. New York: American National Standards Institute and American Society for Civil Engineers. 1996.

American Society of Mechanical Engineers. *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder).* ASME NOG–1–1995. New York: American Society of Mechanical Engineers. 1995.

Nuclear Regulatory Commission. *Fire Protection Guidelines for Nuclear Power Plants.* Regulatory Guide 1.120. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1977.

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

Nuclear Regulatory Commission. *Missiles Generated by Natural Phenomena, Standard Review Plan*. NUREG–0800 (Formerly NUREG–76/087). Revision 2. Washington, DC: Nuclear Regulatory Commission. 1981.

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999b.

U.S. Atomic Energy Commission. *Design Response Spectra for Seismic Design of Nuclear Power Plants.* Regulatory Guide 1.60. Revision 1. Washington, DC: U.S. Atomic Energy Commission. 1973a.

U.S. Atomic Energy Commission. *Damping Values for Seismic Design of Nuclear Power Plants.* Regulatory Guide 1.61. Washington, DC: U.S. Atomic Energy Commission. 1973b.

U.S. Atomic Energy Commission. *Design Basis Tornado for Nuclear Power Plants*. Regulatory Guide 1.76. Washington, DC: U.S. Atomic Energy Commission. 1974a.

U.S. Atomic Energy Commission. *Termination of Operating Licenses for Nuclear Reactors.* Regulatory Guide 1.86. Washington, DC: U.S. Atomic Energy Commission. 1974b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report.* Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

4 OPERATING SYSTEMS

4.1 Review Objective

The objective of the review of the Operating Systems chapter is to evaluate for clarity and completeness the description of all operations, including systems, equipment, and instrumentation, particularly as they relate to handling and transfer of SNF, confinement of nuclear material, and management of expected and potential radiological dose. Sufficient detail is provided to ensure that reviewers understand the operations and the operations effects on the design evaluations. Safety features required to maintain the installation in a safe condition are described. However, those features have been evaluated in the appropriate technical sections. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete review of all operating systems of the DTS installation as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

4.2 Areas of Review

The following listing shows the areas of review addressed in Section 4.4, Conduct of Review:

General Operating Functions

Spent Fuel Handling Systems

Pool and Pool Facility Systems

Other Operating Systems

Operation Support Systems

Control Room and Control Areas

Analytical Sampling

Shipping Cask Repair and Maintenance

4.3 Regulatory Requirements

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

- 72.11(a)
- 72.24(b) and (e)
- 72.26
- 72.40(a)
- 72.44(c)
- 72.104(b)
- 72.120
- 72.122 (e–g) and(i–k)
- 72.124(a)
- 72.126(a) and (b)
- 72.128(a)
- 72.150
- 72.166

4.4 Conduct of Review

The NRC staff evaluated the operating systems by reviewing Chapter 5, Operation Systems, of the TSAR (U.S. Department of Energy, 1996), DOE responses to the NRC RAIs (Stewart, 1999a,b), and documents cited in the TSAR. The NRC staff conducted the review based on the requirements of 10 CFR Part 72.

4.4.1 General Operating Functions

The NRC staff has reviewed the proposed operation description in Section 5.1, Operation Description, of the TSAR to ensure DOE fully described the appropriate procedures, equipment involved, and personnel requirements. In addition, the review evaluated appropriate sections of Chapter 1, Introduction and General Description of Installation, of the TSAR.

Chapter 5, Operation Systems, in the TSAR describes the operations to be performed using the DTS, whose features are summarized in Chapter 1, Introduction and General Description of Installation, of the TSAR. The operational procedures to transfer SNF from the source to receiving cask are described in nine steps: (i) receiving cask receipt, preparation, inspection, positioning and mating to the TCA; (ii) source cask receipt, preparation, inspection, positioning and mating to the TCA; (iii) source cask opening; (iv) receiving cask opening; (v) fuel transfer; (vi) source cask closing; (vii) receiving cask closing; (viii) source cask detachment and removal;and (ix) receiving cask detachment and removal. These operations are accomplished at the DTS facility. Maintenance and repair of casks are not performed at the DTS; if damaged casks are received, they will be sent to another site for repair.

The procedures necessary to accomplish each of the tasks listed previously are described in Subsection 5.1.1, Narrative Description, as a series of clearly delineated step-by-step activities. The NRC staff believes that these general step-by-step activities described in the TSAR form the comprehensive bases for developing detailed operational procedures.

During the review, the NRC staff assessed the extent to which the material presented in Section 5.1, Operation Description, of the TSAR addressed the overall storage functions and operation of the DTS installation. The review included consideration of lessons learned from prior reviews and the documentation submitted by the applicant. The review also determined that the TSAR presented a description and identification of the sequence of significant operations and actions important to safety and that this description and identification provided the technical and safety basis for the development of detailed procedures. Specifically, the review determined that the level of detail in the operation description was adequate to develop procedures that would protect health and minimize danger to life or property, protect the SNF from significant damage or degradation, and provide for the safe operation of the DTS. The NRC staff also evaluated the adequacy of the TSAR information with respect to: (i) identification of the major operating procedures; (ii) measures to control processes and mitigate potential hazards; (iii) conformance with the operating controls and limits presented in TSAR Chapter 10, Operating Controls and Limits, (iv) planning to ensure compliance with ALARA requirements, to control offsite doses, and to preclude unplanned and uncontrolled release of radioactive materials; and (v) provisions for testing, surveillance, maintenance, and contingency operations. The NRC staff assessed flowsheets and narratives for the major operations and found that activities were presented sequentially in the anticipated order of performance. TSAR Chapter 5, Operation Systems, and Chapter 9, Conduct of Operations, were examined and the NRC staff verified that procedures will include appropriate prerequisite, preparation, and inspection activities. Finally, the review determined that an adequate description of the major tools and equipment necessary to support cask preparation, cask docking, SNF transfer, and cask undocking operations in the DTS was provided. The generic descriptions of the equipment involved in the transfer of the SNF from source to receiving casks are then presented in Section 5.2, Fuel Handling Systems, of the TSAR.

Operation of the DTS will take place at a site-specific facility, typically at a reactor installation. Therefore, certain site-specific aspects of operation could not be reviewed. For instance, Chapter 9, Conduct of Operations, of the TSAR normally describes the organizational structure for the DTS, but this information is site-specific and will be addressed in the site-specific SAR. Preoperational testing and operational procedures, Section 9.2 of the TSAR, are included in this chapter. The DOE includes adequate descriptions of the controls used to promote safety and ensure compliance with the regulations under which the DTS facility will operate. More specific operational steps to accomplish SNF transfer in the DTS will be included in the site-specific operation procedures of the SAR.

4.4.2 Spent Fuel Handling Systems

The NRC staff reviewed the description of the SNF handling systems described in Sections 4.7, Spent Fuel and Waste Handling Operation System, and, 5.2, Spent Fuel Waste Handling Systems, of the TSAR.

The descriptions of the CTS (Subsection 5.2.1 of the TSAR), the CMS (Subsection 5.2.2 of the TSAR), the TC port cover handling subsystem (Subsection 5.2.3 of the TSAR), the cask lid handling subsystem (Subsection 5.2.4 of the TSAR) and the fuel assembly handling subsystem (Subsection 5.2.5 of the TSAR) were reviewed. The NRC staff found the descriptions of the SNF handling systems, the cask transfer and mating subsystems, and its proposed use during the stages of operation of the DTS to be clear and complete.

The material presented in the TSAR was reviewed to assess the overall operation of SNF transfer and handling systems. The review verified that SNF handling procedures described in Chapter 5, Operation Systems, and Chapter 9, Conduct of Operations, of the TSAR would adequately accommodate inspection, system surveillance, and maintenance requirements. The NRC staff, however, has not reviewed the functions of transfer from transportation vehicles, receipt inspection, and initial decontamination. The review of these functions will be addressed independently in the site-specific cask transport plan.

The fuel transfer subsystem is described in Section 5.2 of the TSAR. This section illustrates the hardware and procedures required for operation of the DTS.

The DTS equipment required to transfer the SNF from source to receiving casks includes the following major operational subsystems:

- The CTS consists of two trolleys that are mounted on one set of rails. The rails run from outside the DTS structure, through the PA, and into the LAA. Each trolley is motor driven and operated using identical control panels located in the PA and the LAA. The CTS supports the casks during operations within the DTS and prevents the casks from tipping over in a seismic event.

- The CMS provides mating of the casks with the mezzanine floor of the TCA to provide a confinement seal. The cask mating devices each consist of an overlid with a gripping device, confinement bellows, and a motorized annular platform that supports the overlid. The overlid protects the upper surface of the cask lid from contamination. The gripping device is activated by a drive shaft that is driven by the motorized grapple of the upper crane. The confinement bellows, the annular platform, and a static seal between the annular platform and the cask top surface provide the confinement barrier between the TCA and the LAA. Three electrical screw jacks enable platform lowering and lifting. The CMS provides a physical confinement barrier with the HVAC performing a secondary confinement function to prevent gross spread of contamination from the TCA to the LAA. Additional confinement is provided by the sliding door between the LAA and the PA. A camera in the LAA provides partial viewing of these operations. The CMS is described in detail in Subsection 5.2.2 of the TSAR.

- The TC port covers are rail mounted trolleys activated by electrical screw jacks. One port cover is positioned above each cask opening in the mezzanine floor. The openings allow access into the casks from the TCA for the lid and shield plug grapple and the fuel assembly grapple. The main characteristics of the TC port covers are presented in Subsection 5.2.3 of the TSAR.

- The receiving cask shield plug and source cask lid handling subsystem consists of two separate parts. The first part is the upper shield port covers, which provide access into the TCA from the REA. The second part is the upper crane, which is housed in the REA. The upper crane is used to lift and lower the receiving cask shield plug and the source cask lid. The receiving cask shield plug and source cask lid handling subsystem is described in detail in Subsection 5.2.4 of the TSAR.

- The fuel assembly handling subsystem consists primarily of an American Society of Mechanical Engineers (ASME) NOG–1 (American Society of Mechanical Engineers, 1995), type 1 gantry crane, which is used to transfer SNF assemblies between source and receiving casks. This crane consists of two bridge structures for positioning in X- and Y-directions, a rotating platform supporting hoists for Z-direction motion and rotational direction, a fuel transfer tube, a SNF assembly grapple, and a crud catcher at the bottom of the transfer tube. The fuel assembly handling subsystem also includes two cameras with lighting mounted at the bottom of the transfer tube for alignment of the fuel over the cask fuel assembly compartment. The fuel handling crane is described in detail in Subsection 5.2.5 of the TSAR.

4.4.3 Pool and Pool Facility Systems

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

4.4.4 Other Operating Systems

The NRC staff reviewed the proposed other operating systems described in Section 5.3, Other Operating Systems, of the TSAR. The other operating systems of the DTS include:

- HVAC Subsystem—as described in Chapter 4.3.1 of the TSAR

- Welding Subsystem—for welding the lids and shield plugs onto casks

- Inerting Subsystem—for inerting the casks prior to final closure.

In addition, the NRC staff evaluated Subsection 4.3.1 of the TSAR, which describes the DTS HVAC subsystem. The NRC staff did not evaluate the welding subsystem for welding the lids and shield plugs onto casks nor did they evaluate the inerting subsystem for inerting casks prior to final closure because details of this equipment were not included in the TSAR.

Subsection 5.1.3.4, Instrumentation, of the TSAR, identifies typical instruments that may be used to measure conditions or control the operations during source cask unloading, fuel transfer, and receiving cask loading. Table 4-1 describes commercial grade equipment that may be used to fulfill the need to measure or control operations.

The Other Operating Systems are not necessary to maintain the conditions required for safe operation of the DTS or prevent damage to the SNF during handling and transfer without undue risk to the health and safety of the public or DTS personnel. The review confirmed that the list of auxiliary systems not important to safety had been included in Section 4.3 of the TSAR and the systems were adequately covered and consistent with the narrative description and flow charts provided.

4.4.5 Operation Support Systems

The NRC staff reviewed the proposed operation support systems described in Section 5.4, Operation Support Systems, of the TSAR. In addition, the NRC staff evaluated Section 5.1, Operation Description, and appropriate sections in Chapter 4, Installation Design, of the TSAR that identify the SSCs important to safety.

The Operation Support Systems of the DTS are the instrumentation and control features associated with operations. These systems include the surveillance, control, and monitoring systems for the fuel transfer system (Section 5.4 of the TSAR). The review confirmed that the information provided for Operation Support Systems conforms to the requirements of NUREG–1567 (Nuclear Regulatory Commission, 1996).

Process instrumentation throughout the DTS allows monitoring of all mechanical equipment (including the fuel assembly handling subsystem), the HVAC subsystem operation, and the radiation monitoring subsystem. The DTS has installed radiation monitoring equipment that continuously monitors and displays the radiation dose rates (Subsection 5.1.3.4 of the TSAR).

Access to the LAA is restricted through interlocks with the monitoring system during SNF transfer to prevent inadvertent access to the LAA during fuel transfer. The monitoring equipment has readout capability at the highest anticipated radiation levels and positive readout at the lowest radiation levels.

The TSAR describes instrumentation systems to be used periodically to monitor the DTS as not important to safety. Based on the review of the SSCs using the 10 CFR Part 72 criteria identified previously, the instrumentation system will not be important to safety over the anticipated ranges for normal and off-normal operations. Table 4-1 identifies the instrumentation and its purpose to monitor the DTS.

Table 4-1. Instrumentation used for Dry Transfer System operations

Instrumentation	Function
Gross Gamma/Beta/Neutron Detection	Continuously monitor dose rates inside DTS Transfer Containment Area, Preparation Area, Roof Enclosure Area, Lower Access Area, and HVAC Subsystem
Pressure and Vacuum Gauges	Measure air and vacuum pressures inside the DTS areas; measure pressure drop across HEPA filters
Air Particulate Measuring Equipment	Measure air samples for airborne activity through DTS facility exhaust stack
Criticality Monitoring Equipment	Monitor neutron activity during fuel transfer

The Operation Support Systems do not appear to be necessary to maintain the conditions required for safe containment of SNF inside the DTS during nonfuel transfer operations. Although the operator controls all motions during normal and abnormal situations, the operator commands are processed by the instrumentation and control system to actuate the appropriate equipment. In addition, failure of interlocks and their associated instrumentation has the potential to cause damage to the SNF or other equipment necessary for safe operations. These failure modes and their compensating actions are addressed in Attachment 1 of the second round of RAIs. Therefore, the instrumentation and control systems must be of sufficient quality to prevent unnecessary challenges to the operator or other DTS important to safety systems.

4.4.6 Control Room and Control Areas

The NRC staff examined the information provided in Section 5.5, Control Room and Control Areas, of the TSAR. The NRC staff evaluated the sections pertaining to monitoring instruments, limits, and controls of the DTS from Chapters 3, Principal Design Criteria, and 10, Operating Controls and Limits, of the TSAR. In addition, the responses to round two RAIs 5-14 and 5-15 (Stewart, 1999b) were evaluated.

The DTS control areas are distributed among several areas: an external trailer, wall panels in the PA for control of sliding and roll-up doors, cask transfer control panels within the DTS structure, and controls in the protective structure for the exhaust fans and PLC. The control center will be located in a trailer outside the DTS building. The instrumentation included within this trailer to remotely control and monitor operations during normal conditions includes a video system, the main control panel, a personal computer (PC), a monitoring display, and an audio system. The sliding door to the LAA and the roll-up door into the PA are controlled with panels located on both sides of each door. Also, two identical control panels are located in the LAA and in the PA to control the CTS during normal conditions.

The remote control/monitoring area (trailer) will be provided with the DTS facility for remote monitoring and operator control of the SNF transfer process. This portable control area has been provided for operators to control, observe, and monitor operations of fuel transfer from source to receiving casks from a sufficiently remote location (outside the DTS structure) to maintain worker doses ALARA. Also, the control room is portable so that in the event of severe weather or other conditions it can be moved quickly to a safe location.

The CCTV displays in the control room provide viewing of the LAA, the TCA, and the top of the cask baskets. They allow the operator to validate operations and guide the SNF into position in the receiving cask. Cameras are also provided in the PA for viewing the welding process and for security reasons. Every remote operation is controlled from the control panel in the control room. A general emergency push button is provided that de-energizes all the mechanical equipment when activated and generates alarms.

The DTS has redundant backup systems or manual overrides for most equipment. In the event that the control room is lost during a natural (e.g., seismic or tornado) event, special tools would be used to lower SNF into the cask and disengage it from the crane. Replacement of the control room would not be time critical in this event. Periscopes or fiberscopes would be used to monitor operations until the control room is repaired or replaced. The control subsystem has been classified as not important to safety because the SNF can be maintained or placed in a safe condition without it.

Because the DTS will be collocated at existing nuclear facilities or DOE nonreactor sites, monitoring for site security will be integrated into existing security systems. Details of the security monitoring system are site-specific and will be supplied in the site-specific SAR.

4.4.7 Analytical Sampling

The NRC staff review of Analytical Sampling of the DTS is covered in Subsection 5.4.2.5 of this AR.

4.4.8 Shipping Cask Repair and Maintenance

No cask maintenance or repair will be conducted in the DTS. Therefore, an NRC staff review of this section was not required.

4.5 Evaluation Findings

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

4.5.1 General Operating Functions

- The NRC staff reviewed the operation description provided in Chapter 5 of the TSAR. The NRC staff found reasonable assurance that the operation description provides acceptable descriptions and discussions of the projected operating characteristics and safety considerations, in compliance with 10 CFR 72.11(a); 72.24(b) and (e); 72.26; 72.40(a)(1, 5, and 13); 72.44(c)(1, 3, and 4); 72.104(b); 72.120; 72.122(e–g) and (i–k); 72.124(a); 72.126(a) and (b); 72.128(a); and 72.166.

The site-specific SAR must include at least the following information to satisfy the requirements of 10 CFR 72.150:

- The site-specific operation steps to accomplish SNF transfer in the DTS.

4.5.2 Spent Fuel Handling Systems

- The NRC staff has reviewed the description of the SNF handling subsystems provided in Chapter 5, Operation Systems, of the TSAR. The SNF handling subsystems were found to be in conformance with regulations described in 10 CFR 72.24(b) and (e); 72.104(b); 72.124(a); 72.128(a); and 72.166.

The site-specific SAR must contain at least the following information to satisfy the requirements of 10 CFR 72.26 and 72.150:

- Procedures for cask transfer from transportation vehicles, cask receipt inspection, and initial cask decontamination.

- Confirmation that the PLC selected meets all conditions specified in the response to round two RAI 5-7 (Stewart, 1999b).

- Confirmation that the technical specifications and scheduled maintenance procedures for the selected CCTV system components comply with the specifications given in response to round two RAI 5-9 (Stewart, 1999b).

4.5.3 Pool and Pool Facility Systems

This section does not pertain to the DTS review because neither a pool, or any system supporting a pool, is incorporated into the DTS.

4.5.4 Other Operating Systems

- The NRC staff has reviewed the other operating systems provided in Section 5.3, Other Operating Systems, of the TSAR. The other operating systems were adequately supported by descriptions and drawings showing the design guidelines for the other DTS operating systems. The NRC staff found reasonable assurance that

    — The proposed design of the DTS does not require utility systems during short-term SNF storage. This design is in compliance with 10 CFR 72.122(k)(2).

    — The proposed design of the DTS other operating systems does not include systems and subsystems that require continuous electric power to permit continued functioning. See Subsection 3.5.2, Classification of Structures, Systems, and Components, of this AR for additional information that must be provided in the site-specific SAR for the DTS related to the availability of electrical power.

    — The design and performance of Other Operating Systems satisfy the additional requirements of 10 CFR 72.24(b) and (e); 72.44(c); 72.104(b); 72.122(f), (g), and (i); 72.124(a); 72.126(a) and (b); 72.128(a); and 72.166.

The site-specific SAR must include at least the following information to satisfy the requirements of 10 CFR 72.150:

- A description of, and operation procedures for, the welding subsystem used to open and seal cask lids and shield plugs.

- The operational procedures that will be employed to ensure that the weld cutting operation used in the PA to unseal the source cask lid has been completed satisfactorily.

- A description of, and operation procedures for, the inerting subsystem used for inerting the receiving cask after it has been filled with SNF assemblies.

- A description of, and operation procedures for, the portable decontamination vacuum subsystem.

4.5.5 Operation Support Systems

- The NRC staff has reviewed the description of the operation support systems provided in Chapter 5, Operation Systems, and appropriate sections in Chapter 4, Installation Design, of the TSAR. The TSAR presents an acceptable description of the functions of operation support systems. The operation descriptions incorporate considerations for meeting ALARA requirements. The operation descriptions provide reasonable assurance that surveillance and monitoring systems are acceptable for the operation of the DTS. The NRC staff has reviewed the information provided on Operation Support Systems and found reasonable assurance that the design and performance of these systems are compliant with regulations described in 10 CFR 72.24(b) and (e) and 72.122(f), (g), and (i).

The site-specific SAR must contain at least the following information to satisfy the requirements of 10 CFR 72.26:

- Design specifications of the sensors and other relevant instrumentation demonstrating these devices can function as intended within the radiation and temperature ranges expected under normal, off-normal, and accident conditions.

- Safety requirements, tests, and surveillance procedures ensuring the capability of the instrumentation and control system to support safe operation of the DTS and to mitigate those off-normal and accident situations.

4.5.6 Control Room and Control Areas

- The NRC staff has reviewed the description of the Control Room and Control Areas provided in Chapter 5, Operation Systems, of the TSAR. The NRC staff found that the descriptions of the portable control room and associated control panels provide reasonable assurance that a control room is not important to safety for short-term storage of SNF under nonoperational conditions. SNF can be stored safely while the control room is repaired or replaced in the event it is damaged. The control room and associated control panels are compliant with regulations described in 10 CFR 72.122(f), (g), (i), and (j) and 72.128(a).

The site-specific SAR must contain at least the following information to satisfy the requirements of 10 CFR 72.40(a)(8):

- Details of the security monitoring system.

4.5.7 Analytical Sampling

The results of the NRC staff evaluation findings for Analytical Sampling for the DTS is covered in Subsection 5.5.2.5 of this AR.

4.5.8 Shipping Cask Repair and Maintenance

This section does not pertain to the DTS review because no cask repair or maintenance will be performed at the DTS installation.

4.6 References

American Society of Mechanical Engineers. *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder).* ASME NOG–1–1995. New York: American Society of Mechanical Engineers. 1995.

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report*. Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

5 OPERATING PROCEDURES

5.1 Review Objective

The objective of the operating procedures review is to evaluate the descriptions related to development and implementation of operating and maintenance procedures as described in the TSAR (U.S. Department of Energy, (1996). This chapter of the TSAR should describe operations that will be used by the facility staff to ensure that routine operations will be conducted in a safe manner. Because the TSAR is not site-specific, a complete review of all operating procedures as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

5.2 Areas of Review

The following listing shows the areas of review addressed in Section 5.4, Conduct of Review:

Description of Operations

Identification of Subjects for Safety Analysis

Spent Nuclear Fuel Handling Subsystems
Other Operating Systems
Operation Support Systems
Control Room and Control Areas
Analytical Sampling
Preventive Maintenance

5.3 Regulatory Requirements

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

- 72.24(b), (e), and (k)
- 72.40(a)(5) and (13)(i)
- 72.104(b)
- 72.122(f), (j), and (l)
- 72.150

5.4 Conduct of Review

The NRC staff evaluated the operating descriptions by reviewing Chapter 5, Operation Systems, of the TSAR (U.S. Department of Energy, 1996), DOE responses to the NRC RAIs (Stewart, 1999a,b), and documents cited in the RAI responses and the TSAR. The descriptions of the operations and procedures planned to be used for SNF assembly transfers are part of this review and the NRC staff conducted the review based on the requirements of 10 CFR Part 72.

5.4.1 Description of Operations

The NRC staff has reviewed the proposed operation description in Section 5.1, Operation Description, of the TSAR to ensure DOE fully described the appropriate procedures, equipment operations involved, and operational personnel requirements. In addition, the review evaluated appropriate sections in Chapters 1, Introduction and General Description of Installation; 4, Installation Design; and 9, Conduct of Operations, in the TSAR. The NRC staff also examined the responses to round one RAIs 5-2, 5-3, and 5-10 (Stewart, 1999a).

Chapter 5, Operation Systems, in the TSAR describes the operations to be performed using the systems whose features are summarized in Chapter 1, Introduction and General Description of Installation, of the TSAR. The operations are described in Subsection 4.4.1 of this AR. The DTS transfer equipment and the planned systems and equipment will be used to accomplish these operations.

The descriptions of the operational systems functions are given in Chapter 4, Installation Design. Operating descriptions used for procedure development for the equipment to transfer the SNF are contained in Section 5.1, Operation Description, of the TSAR. The proposed SNF transfer between two casks is described by a series of nine major activities given in Subsections 5.1.1.1–5.1.1.9 of the TSAR. These nine major activities will be accomplished using step-by-step procedures. The procedures necessary to conduct the nine major activities are described in a series of clearly delineated steps. Ancillary activities are described in Subsection 5.1.1.10, Ancillary Activities. The functions, design bases, and the pertinent design features of the equipment involved in the transfer of the SNF between casks are presented in Section 5.2, Spent Fuel Waste Handling Systems, of the TSAR.

Chapter 9, Conduct of Operations, of the TSAR describes the organizational structure and general plans for operating the DTS. This includes a brief description of (i) the responsibilities of key personnel, (ii) the training program for the facility staff, (iii) standards and procedures that govern daily operations and the records developed as a result of those operations, and (iv) the program used to promote safety and ensure compliance with the regulations under which the facility will operate.

5.4.2 Identification of Subjects for Safety Analysis

5.4.2.1 Spent Nuclear Fuel Handling Subsystems

The NRC staff has reviewed the operating descriptions of the SNF handling subsystems given in Section 5.2, Spent Fuel Waste Handling Systems, and the waste handling descriptions given in Chapter 6, Site Generated Waste Confinement and Management, of the TSAR. The NRC staff also reviewed the responses to operating descriptions of remote, manually operated tools given in response to round one RAIs 5-1, 5-5, 5-6, 5-7, 5-8, and 5-9 (Stewart, 1999a). NRC staff also reviewed the responses to round two RAIs 5-1, 5-2, 5-3, 5-4, 5-5, 5-6, 5-7, 5-8, 5-10, 5-11, 5-12, 5-13, 5-14, and 5-16 (Stewart, 1999b).

The DTS is a modular system that provides for the dry transfer of SNF in a vertical orientation. The DTS is designed to be installed at a host nuclear power plant site or DOE nonreactor facility. It will utilize existing systems at the site for handling canisters and casks outside the DTS. Section 5.2, Spent Fuel Waste Handling Systems, in the TSAR describes the canister handling unique systems used during the unloading, closure, and transfer operations. The SNF assembly transfer system is described in Sections 4.7, Spent Fuel and Waste Handling

Operation System; and 5.2, Spent Fuel Waste Handling Systems, of the TSAR. These sections describe and illustrate the hardware and its specifications and limits of operation required for the DTS.

5.4.2.2 Other Operating Systems

The review of the Other Operating Systems is done under Subsection 4.4.4 of this AR.

5.4.2.3 Operation Support Systems

The NRC staff examined the proposed operating descriptions of the support systems provided in Section 5.4, Operation Support Systems, of the TSAR. The NRC staff has reviewed the responses to round two RAIs 4-1, 4-2, 5-1, and 5-17 (Stewart, 1999b).

Subsection 5.1.3.4, Instrumentation, of the TSAR identifies typical instruments that may be used to measure conditions or control the operations during SNF transfers.

The operating systems identified in the response to round one RAI 1-4 and round two RAI 1-1 (Stewart, 1999a,b) appear to be necessary to maintain the conditions required for safe operation of the DTS, handle SNF safely, or prevent damage to the SNF during handling and storage without undue risk to the health and safety of the public or DTS personnel. Table 3.4-1 (Stewart, 1999b) provides a compilation of the SSCs important to safety.

5.4.2.4 Control Room and Control Areas

The NRC staff examined the Control Room and Control Areas described in Section 5.5, Control Room and Control Areas, of the TSAR. In addition, the NRC staff evaluated sections pertaining to monitoring instruments, limits, and controls of the DTS from Chapters 1, 3–5, and 10 of the TSAR. The NRC staff also reviewed the responses to round one RAI 5-10 (Stewart, 1999a) and round two RAIs for Section 5, [i.e., RAIs 5-1 through 5-9 and 5-14 through 5-16 (Stewart, 1999b)].

The proposed DTS will not be a permanent facility. Auxiliary systems required to support loading and off-loading of SNF, periodic monitoring, and maintenance are designed to be portable systems. These systems, such as power for the sampling, loading, and off-loading systems, will be built into the equipment to support those functions.

During SNF handling, the DTS will be vented to maintain safe levels of radionuclides through HEPA filters and will accommodate periodic monitoring and control.

5.4.2.5 Analytical Sampling

The NRC staff examined the proposed Analytical Sampling operating system described in Subsection 7.3.4, Radiation Monitoring subsystem, and supplemented by additional discussions in Chapters 1, 3, 4, 6, and 10 of the TSAR. The NRC staff also reviewed the responses to round one RAI 7-19 (Stewart, 1999a).

Subsection 7.3.4, Radiation Monitoring Subsystem, of the TSAR asserts that continuous area surveys and air sampling will be performed for the DTS in accordance with the surveillance and monitoring specifications described in Chapter 10, Operating Controls and Limits, of the TSAR.

The actions to be taken if the specification limits are exceeded are also provided. The objective of the continuous area surveys and air sampling is to verify that radiation exposures remain at safe levels and the ventilation subsystem and HEPA filters function properly.

Described in Section 5.6, Analytical Sampling; and Subsection 7.3.4, Radiation Monitoring Subsystem, of the TSAR radiological monitoring and contamination control at the DTS will be maintained to verify radiation exposure and contamination limits are not exceeded. The DTS will also be integrated into an existing site monitoring and alarm program, which includes environmental and affluent monitoring to further verify HEPA filter functionality.

5.4.2.6 Preventive Maintenance

The NRC staff examined the preventive maintenance planned for the DTS, as presented in the new Section 5.7, Preventive Maintenance, in the responses to round one RAI 5-4 (Stewart, 1999a). Equipment maintenance is required by 10 CFR 72.122(f) and 72.150. The major components that move and could fail and cause damage to the SNF have been identified in the new TSAR Section 5.7. The preventive maintenance to be performed on this equipment on a periodic basis has also been described. The NRC staff has also reviewed the response to round two RAI 5-8 (Stewart, 1999b) for regulatory compliance.

5.5 Evaluation Findings

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

5.5.1 Description of Operations

- The NRC staff has reviewed the operation description provided in Chapter 5, Operation Systems, of the TSAR. The NRC staff found reasonable assurance that the generic operation description provides acceptable information and discussions of the projected DTS operating characteristics and concomitant safety considerations, in compliance with the general design criteria requirements of 10 CFR 72.122(f) and (l).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (e), and (k); 72.40(a)(5) and (13)(i); 72.104(b); and 72.150:

- Specific details of the DTS operating characteristics and concomitant safety considerations.

5.5.2 Identification of Subjects for Safety Analysis

5.5.2.1 Spent Nuclear Fuel Handling Subsystems

- The NRC staff has reviewed the description of the SNF handling subsystems provided in Chapter 5, Operation Systems, of the TSAR. The NRC staff found that the generic operational descriptions for the SNF handling subsystems provide reasonable assurance that the activities can be conducted without endangering the health and safety of the public and DTS personnel, in accordance with the general design criteria requirements of 10 CFR 72.122(f) and (l).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (e), and (k); 72.104(b); and 72.150:

- Specific operational details of the SNF handling subsystems.

5.5.2.2 Other Operating Systems

See Subsection 4.5.4 of this AR.

5.5.2.3 Operation Support System

- The NRC staff has reviewed the description of the operations of the support systems provided in Chapter 5, Operation Systems, of the TSAR. The NRC staff found that the generic descriptions for the operation of the support systems provide reasonable assurance that the proposed DTS does not require permanently installed auxiliary systems and meet the general design criteria requirements of 10 CFR 72.122(f) and (l).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (e), and (k) and 72.150:

- A detailed description of the operation of the support systems.

- Detailed descriptions of all auxiliary systems required to support the loading and off-loading of the SNF. These descriptions must include details pertaining to operation, monitoring, and maintenance of these systems.

5.5.2.4 Control Room and Control Areas

- The NRC staff has reviewed the description of the Control Room and Control Areas provided in Chapter 5, Operation Systems, of the TSAR. The NRC staff found that the generic descriptions of the Control Room and Control Areas provide reasonable assurance that a control room and control area can provide for safe handling of the SNF. The control room systems required to support the loading and off-loading of the SNF, periodic monitoring, and maintenance are in compliance and meet the general design criteria requirements of 10 CFR 72.122(j).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(l) and 72.150:

- Detailed descriptions of the Control Room and Control Areas. These descriptions must include details pertaining to operation, monitoring, and maintenance.

5.5.2.5 Analytical Sampling

- The NRC staff has reviewed the description of the analytical sampling provided in Subsection 7.3.4, Radiation Monitoring Subsystem, of the TSAR. The NRC staff found that the generic description of the analytical sampling procedures and methods provide reasonable assurance that the design and planned site-specific procedures for the DTS allow the capability to test and monitor components important to safety, and to measure exposures to radiation and is in compliance with the general design criteria requirements of 10 CFR 72.122(f) and (l).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (e), and (k) and 72.150:

- The details of the analytical sampling procedures and methods to be employed at the DTS facility for testing and monitoring components important to safety.

5.5.2.6 Preventive Maintenance

- The NRC staff has reviewed the generic Preventive Maintenance operations to be performed on the components of the DTS as provided in the response to round one RAI 5-4 (Stewart, 1999a), which consisted of a new Section 5.7, Preventive Maintenance, to be added to the TSAR. The NRC staff found that the description of the Preventive Maintenance program and its concomitant scheduling provide reasonable assurance that SNF transfers will be done without endangering the health and safety of the public and DTS personnel, in accordance with the general design criteria requirements of 10 CFR 72.122(f).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.150:

- The details of the Preventive Maintenance program to be implemented at the DTS facility.

5.6 References

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report.* Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy. 1996.

6 WASTE CONFINEMENT AND MANAGEMENT EVALUATION

6.1 Review Objective

The objective of the review of site-generated waste confinement and management is to ensure that the design and proposed operation of the DTS provide for safe confinement and management of any radioactive waste generated as a result of facility operations. This review specifically concerns radioactive wastes that are generated by site activities involving the handling and storage of SNF. These wastes include: (i) gaseous effluents from treatment and ventilation systems; (ii) liquid wastes from laboratory, cask washdown, and decontamination activities; and (iii) solid or solidified wastes. Neither the actual SNF being stored nor the waste generated by eventual decommissioning of the facility falls within the scope of this review. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete review of the waste confinement and management as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

6.2 Areas of Review

The following listing shows the areas of review addressed in Section 6.4, Conduct of Review:

Onsite Waste Sources

Offgas Treatment and Ventilation

Liquid Waste Treatment and Retention

Solid Wastes

Radiological Impact of Normal Operations

6.3 Regulatory Requirements

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

- 20.1101(d)
- 20.1301(a) and (d)
- 20.1302(b)
- 20.2001
- 20.2003(a)
- 20.2005
- 20.2007
- 72.40
- 72.104
- 72.122
- 72.126
- 72.128

- 72.24(f) and (l)

6.4 Conduct of Review

The NRC staff evaluated the site-generated confinement and management of waste by reviewing Chapter 6, Site Generated Waste Confinement and Management, of the TSAR (U.S. Department of Energy, 1996), DOE responses to the NRC RAIs (Stewart, 1999), and cited references. Chapter 6 of the TSAR describes the waste management systems of the DTS and provides information about the waste confinement and disposal. The review objectives for this section are to establish that the DTS provides safe confinement and management of radioactive waste generated at the facility, and that the generation of radioactive waste and release of the radioactive material to the environment meets the regulatory standards and is also ALARA.

6.4.1 Onsite Waste Sources

The review of Section 6.1, Onsite Waste Sources, of the TSAR and the response to round one RAI 6-1 (Stewart, 1999) included information about the onsite waste sources. The amount of waste cannot be readily quantified because it is dependent on the facility-specific conditions (e.g., crud levels on the fuel assemblies). According to the TSAR, the DTS will not accept damaged fuel; therefore, the waste generation and associated radiological impacts will be minimal. The expected waste sources are described in Table 6.1-1 of the TSAR. The dry solid waste produced at the DTS will be limited to decontamination swabs and HEPA filters. This solid waste will be packaged and incorporated in the collocated utility or DOE facility waste stream. Other potential sources include spalled material in the crud catcher and lubricants.

6.4.2 Offgas Treatment and Ventilation

The review of Section 6.2, Offgas, Treatment and Ventilation, of the TSAR included information on offgas treatment and ventilation subsystems. The HVAC subsystem at the DTS will use negative pressures to direct air flow from areas of lower contamination to areas of higher contamination. This system is equipped with pre-filters and HEPA filters to minimize the release of radioactive material to the environment.

6.4.3 Liquid Waste Treatment and Retention

The review of Section 6.3, Liquid Waste Treatment and Retention, of the TSAR and the response to round one RAI 6-2 (Stewart, 1999) included descriptions of the liquid waste treatment and retention subsystems. Radioactive liquid wastes generated at the DTS are limited to a small amount of liquid produced from the localized decontamination using standard swabbing techniques, HVAC condensation liquid, and contaminated lubricants. DTS has no water supply and no drain sumps. The moist swipes will be collected in 55-gallon drums, and the waste will be included in the radioactive waste stream for the collocated utility or DOE facility. The TSAR states that site-specific operations will be followed for proper disposal.

6.4.4 Solid Wastes

The review of Section 6.4, Solid Wastes, of the TSAR and the response to round one RAI 6-3 (Stewart, 1999) included descriptions of collection, packaging, and storage of solid wastes. The solid wastes at the DTS will be generated from decontamination activities and the HVAC subsystem. A small amount of solid waste will be generated in the form of protective clothing, swipes, vacuum bags, and other health physics materials.

6.4.5 Radiological Impact of Normal Operations

The review of Section 6.5, Radiological Impact of Normal Operations, of the TSAR and the response to round one RAI 6-4 (Stewart, 1999) included a summary of radiological impact of normal operations. According to the TSAR, the concentration, radiological content, and amount of waste generated from DTS during normal operation cannot be readily quantified. The waste generation is dependent on facility-specific conditions, however, the amount of solid and liquid waste generation will be minimal, and the radiological impact from normal operation is also expected to be minimal.

6.5 Evaluation Findings

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

6.5.1 Onsite Waste Sources

- The NRC staff has reviewed the information presented in Section 6.1, Onsite Waste Sources, of the TSAR and found reasonable assurance that it satisfies the requirements of 10 CFR 72.24(f), 72.104, 72.122, and 72.128, in that the onsite waste sources are adequately identified, and means for disposal, using proposed processes and procedures, are adequate to ensure that dose limits will be satisfied.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(l):

- Detailed information of the onsite waste sources and a listing of processes and procedures for disposal of the solid, liquid, and gaseous waste.

6.5.2 Offgas Treatment and Ventilation

- The NRC staff has reviewed information presented in Section 6.2, Offgas Treatment and Ventilation, of the TSAR and found reasonable assurance that it satisfies the requirements of 10 CFR 20.2001, 20.2005, 20.2007, 72.24(f), 72.104, 72.126, and 72.128, because the offgas treatment and ventilation are adequate to prevent radioactive particulate material from escaping to the environment.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(l) and 72.122(h)(3):

- Detailed information, including the expected amount of the gaseous waste, the offgas treatment, and the ventilation subsystem.

6.5.3 Liquid Waste Treatment and Retention

- The NRC staff has reviewed information presented in Section 6.3, Liquid Waste Treatment and Retention, of the TSAR and found reasonable assurance that it satisfies the requirements of 10 CFR 20.2001, 20.2003(a), 20.2005, 20.2007, 72.24(f), 72.104, 72.122, 72.126(a) and (b), and 72.128 because the liquid waste treatment and retention process is adequate to ensure dose limits will not be exceeded.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(l) and 72.126(c) and (d):

- Detailed information of the liquid waste treatment and retention subsystems,, including the expected amount of the liquid waste.

6.5.4 Solid Wastes

- The NRC staff has reviewed information presented in Section 6.4, Solid Wastes, of TSAR and found reasonable assurance that it satisfies the requirements of 72.24, 72.104, 72.122, and 72.128(a), because the solid wastes are adequately identified, and means of disposal using processes and procedures, are adequate to ensure that dose limits will not be exceeded.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.128(b):

- Detailed information, including the expected amounts of the solid waste and its means of disposal.

6.5.5 Radiological Impact of Normal Operations

- The NRC staff has reviewed information presented in Section 6.5, Radiological Impact of Normal Operations, of the TSAR and found reasonable assurance that it satisfies the requirements of 10 CFR 20.1101(d), 20.1301(a) and (d), 20.1302(b), and 72.40, because the analysis of radiological impact of normal operations is adequate to ensure that dose limits will be satisfied and ALARA considerations have been satisfied.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.126(a):

- Radiological impact of normal and off-normal operations based on estimated values of generated waste.

6.6 References

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities*. NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: Nuclear Regulatory Commission. 1999.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report*. Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

7 INSTALLATION DESIGN AND STRUCTURAL EVALUATION

7.1 Review Objective

The objective of the installation design review is to ensure compliance with required site features and to support other evaluation areas. The objective of the structural evaluation review is to ensure the structural integrity of SSCs, with emphasis on SSCs important to safety. These SSCs may provide confinement, subcriticality, radiation shielding, and retrievability of the stored materials and must be appropriately maintained under all credible loads for normal, off-normal, and design basis accident conditions. These conditions also include natural phenomena. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete review of the installation design and structural evaluation as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS application is identified.

7.2 Areas of Review

The following listing shows the areas of review addressed in Section 7.4, Conduct of Review:

Description of Structures, Systems, and Components

Confinement Structures, Systems, and Components

Pool and Pool Confinement Facilities

Reinforced Concrete Structures

Other Structures, Systems, and Components Important to Nuclear Safety

Other Structures, Systems, and Components Subject to NRC Approval

Within each area of review, details concerning description, design criteria, material properties, and structural analysis are included.

7.3 Regulatory Requirements

The applicable regulatory requirements from 10 CFR Part 72 for installation design and structural evaluation are:

- 72.24(a–d) and (i)
- 72.40(a)(1)
- 72.72(b)
- 72.82(c)(2)
- 72.106
- 72.122(a–d) and (f–l)
- 72.128
- 72.140
- 72.236

Note that a review of regulatory requirement 10 CFR 72.236 requires cask-specific information that is beyond the scope of the TSAR.

7.4 Conduct of Review

The NRC staff evaluated the installation design by reviewing Chapter 4, Installation Design, and Chapter 8, Accident Analysis, of the TSAR (U.S. Department of Energy, 1996), DOE responses to the NRC RAIs (Stewart, 1999a,b), and supporting documentation.

The NRC staff performed a review and some limited verifications of calculations to evaluate data provided in the TSAR. The design procedures identified by the DOE were compared to standard engineering practice identified in documents, including ANSI/ASCE 7-95 (American National Standards Institute and American Society of Civil Engineers, 1996); ACI 318 and 349 (American Concrete Institute, 1983, 1985); AISC N690 (American National Standards Institute and American Institute of Steel Construction, 1989); ASME N509, ASME AG–1, and ASME NOG–1 (American Society of Mechanical Engineers, 1996, 1994, 1995).

Details of the structural analysis of the DTS are contained in the appendices to Chapter 8 of the TSAR. As identified in the TSAR, the magnitudes of loads used in the analysis are consistent with the design criteria identified in Chapter 3, Principal Design Criteria, of the TSAR. Load combinations used in the analysis are consistent with the design criteria and standard engineering practice. Normal and off-normal conditions (Categories I and II) are covered in Section 8.1, Off-Normal Events, of the TSAR. These events must not result in radioactive releases to the DTS personnel, the public, or the environment that exceed regulatory allowable limits of 10 CFR Part 20. Category I are those events expected to occur regularly or frequently in the course of normal operations (Subsection 8.1.1 of the TSAR). Category II includes those events expected to occur with moderate frequency on the order of once per calendar year (Subsection 8.1.2 of the TSAR). The normal operation structural analysis is contained in Appendix 8A.1.5.

The analyses performed in the TSAR are consistent with basic strength of materials procedures. Checks were made of the calculations performed including correct use of the equations, accurate implementation of the calculations, and comparison to correct allowables for the development of margins of safety. The majority of analyses are based on bounding conservative assumptions and methodologies, with the objective of establishing upper bound values for the design basis events.

Reinforced concrete is designed and analyzed per the requirements of ACI 318 and 349 (American Concrete Institute, 1983, 1985). Structural steel components are designed and analyzed in accordance with the requirements of AISC N690 (American National Standards Institute and American Institute of Steel Construction, 1989). Mechanical systems are designed to representative industrial standards such as ASME NOG–1 (American Society of Mechanical Engineers, 1995).

The calculations for postulated accident conditions, Categories III and IV, are covered in Section 8.2, Accidents, of the TSAR. These are discussed in detail in Chapter 12 of this AR.

7.4.1 Description of Structures, Systems, and Components

Subsection 4.2.3, Individual Unit Description; and 4.3, Auxiliary Subsystems, of the TSAR provide descriptions of the individual unit and auxiliary subsystems. The generic description of SSCs provides sufficient detail to allow for determination of the overall acceptability of the design. Details of the design of the fuel assembly handling subsystem are missing. The design is identified in accordance with ASME NOG–1 (American Society of Mechanical Engineers, 1995) requirements, which when properly implemented will ensure an acceptable design.

Design details, such as location of openings for manual operation and rebar placement around openings, are left up to the site-specific SAR. Detailed specifications will be prepared for specific projects to establish the quality of the materials and workmanship for both the reinforced concrete and the structural steelwork. These specifications will be based on ACI 301 (American Concrete Institute, 1996) and AISC N690 (American National Standards Institute and American Institute of Steel Construction, 1989). The overall design of the reinforced concrete structure has been shown to withstand the bounding load combination. The final rebar arrangement within the geometry of the structure can be adjusted to enable the structure to withstand the effects of site-specific environmental and natural phenomena. The structural design, procurement, testing, construction, fabrication, and erection activities are important to safety and will be controlled under an overall QA Plan for the project and will be in accordance with the site-specific license requirements.

7.4.2 Confinement Structures, Systems, and Components

The components identified in Section 4.1, Summary Description, of the TSAR that function as the primary confinement boundary include:

- Reinforced concrete basemat
- Reinforced concrete superstructure
- Roof enclosure area
- Sliding door
- HVAC subsystem and HEPA filtration

The components identified in Section 4.1, Summary Description, of the TSAR that provide for structural support of SSCs and allow for maintenance of the differential air pressure include:

- Structural steel roof plate
- Mezzanine plate
- PA including roll-up door

The structural steel roof plate and mezzanine plate are considered important to safety; the PA is not.

As identified in the TSAR, both finite element analysis (FEA) and strength of materials analysis were used to verify the capability of the components to perform their functions under all loading conditions. Information on the types of analyses used for the various components is given in the following sections.

Description

The confinement system provides a physical barrier for the purpose of preventing release of radioactive particulate matter. Subsection 4.2.3, Individual Unit Description, of the TSAR provides descriptions of the individual unit. The generic description of the confinement SSCs provides sufficient detail to allow for determination of the overall acceptability of the design. The design of the reinforced concrete base pad and wall, protective cover, and sliding door provide the physical boundary. The filtration system has redundant exhaust fans that are housed in a protective enclosure and HEPA filters. The structural steel roof and mezzanine plates are not part of the physical boundary. They allow for proper function of the HVAC exhaust subsystem to ensure flow from regions of lowest potential contamination to regions of highest potential contamination. Although the PA is considered part of the confinement system, it is not classified as important to safety. The area is part of the differential air pressure system to ensure flow from regions of lowest potential contamination to regions of highest potential contamination. Loss of the PA will not impair the safety function of the confinement system. The upper shield port cover design includes a seismically designed locking pin to secure the upper shield port covers in the open and closed positions.

The HVAC exhaust system, including HEPA filters, is designed to maintain internal DTS pressures less than ambient as follows:

- 1-inch H_2O in TCA
- 0.5-inch H_2O in LAA
- 0.25-inch H_2O in PA.

The description of the ventilation of the offgas subsystem is provided in Section 4.3.1, Ventilation and Offgas Systems, of the TSAR. The HEPA filters provide a method to trap airborne particles in the air drawn through the facility prior to exhaust to the environment.

The safety evaluation of the confinement properties of the source and receiving cask, assumed to be the MPC in the TSAR, will be covered by a separate submittal and is not within the scope of this TSAR.

Design Criteria and Codes

The design criteria for the confinement SSCs are identified in Chapter 3, Principal Design Criteria, of this AR. The TSAR identified the following codes for reinforced concrete design:

- ACI 318 (American Concrete Institute, 1983)
- ACI 349 (American Concrete Institute, 1985)
- ACI 301 (American Concrete Institute, 1996)

The design of the structural steel is based on an allowable stress design. The TSAR identified ANSI/AISC N690 (American National Standards Institute and American Institute of Steel Construction, 1989), Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings, as the code for structural steel design.

The TSAR identified that the HVAC components will be designed in accordance with

- ASME N509, Nuclear Power Plant Air-Cleaning Units and Components (American Society of Mechanical Engineers, 1996)

- ASME AG-1, Code on Nuclear Air and Gas Treatment (American Society of Mechanical Engineers, 1994)

- 1997 ASHRAE Handbook-Fundamentals (American Society of Heating, Refrigeration, and Air-Conditioning Engineers, 1997)

The TSAR identifies that lifting and component handling equipment within the DTS is designed in accordance with ASME NOG–1(American Society of Mechanical Engineers, 1995). This includes fail-safe design of components used to handle the fuel assemblies.

Details of the design criteria for the television cameras and lighting system used to verify the transfer process were given in the response to round two RAI 5-9 (Stewart, 1999b). These provide sufficient information for identification of appropriate candidates.

The TSAR identified NFPA Code 780 (National Fire Protection Association, 1992) as the controlling document for the lightning protection subsystem.

Materials

Material properties are identified in Table 8A.1-2, with some updates provided in the responses to RAIs. The yield and ultimate strengths for steel components provided are consistent with published values. For design of steel components, $F_t = 0.60\ F_y$, $F_v = 0.40\ F_y$, and $F_b = 0.66\ F_y$. The materials used in the confinement SSCs steel components include:

- A36—Protective cover plate, protective cover beams, roof plate beams, mezzanine plate, mezzanine plate beams, sliding door shear pin
- A193–B7—Protective cover bolts, roof plate bolts, mezzanine plate bolts
- A105—Roof plate, sliding door
- A325—Roof plate corbel connection bolts, mezzanine plate corbel connection bolts
- A564 Type 630 H1100—Sliding door wheel axle
- A514—Axle bracket, axle bracket bearing, sliding door support bracket, sliding door rail
- Drop forged steel
- Sliding door wheels

The allowables identified in the TSAR for concrete materials are in conformance with American Concrete Institute specifications. The material properties for the concrete systems include:

- Foundation concrete, 4,000 psi Type II American Society for Testing and Materials (ASTM) C150
- Super-structure concrete, 5,000 psi Type II (ASTM C150)
- Aggregates conform to ASTM C33
- Reinforcing steel, identified as ASTM A615 Grade 60

As identified in Table 8A.1-2 of the TSAR, the 28-day compressive strength is 3,000 psi. This is less than that identified in other sections of the TSAR. Analysis of the response of the structure will be conservative for this lower compressive strength.

The specifications and codes for the HVAC components contain the necessary information on the material characteristics of these components.

Analysis

As identified in the TSAR, a combination of FEA and strength of materials analysis was used to verify the capability of the components to perform their functions under all loading conditions. The reinforced concrete structure forms a heavy rigid box structure with substantial stiff cross walls in both directions.

Normal operating loads are identified in Appendix 8A.1.5.1 and are consistent with the design criteria. Thermal analysis is given in Subsection 8.1.1, Evaluation of Normal Conditions, which covers normal operating conditions and is based on ensuring the differential temperature across the concrete is less than 70 °F. The DTS wall thickness is primarily dictated by shielding requirements. Resistance of concrete slab and walls, the protective cover, the roof and mezzanine plates and beams, and the sliding door was found to be controlled by the accident-loading conditions for DBT wind pressure, DBT missiles, and the DE (Appendix 8A.1.5 of the TSAR). Other loads are much smaller and, in general, loads that are clearly not limiting were not evaluated. Brief checks are provided in the TSAR for less obviously unimportant loads.

The seismic analysis performed in the TSAR is based on the dynamic response of the system resting on a hard rock site. As identified in Revision 0 of the TSAR, the seismic analysis of the reinforced concrete structure is based on an uncracked section FEA. In response to round one RAI 8-8 (Stewart, 1999a) and round two RAI 8-2 (Stewart, 1999b), checks of the residual capability of cracked sections were performed. The NRC staff agrees with the development of the seismic input response spectrum for the structure and secondary locations. A three-dimensional finite element model of reinforced concrete structure with roof and mezzanine plates and equipment idealized as beam structures was used for the dynamic analysis. The concrete elements were modeled using four-node shell elements located at the centerline of the walls. The vertical component of response of the steel plates is considered important and was included in the model. Analyses using fixed base modal procedures with defined input response spectra for three directions were performed. Results of the modal analysis were combined using the square root sum of squares method and the complete quadratic combination.

Resulting moments, shears, and axial stress in components provided in the TSAR and responses to the RAIs were checked against allowables. The factor of safety for some locations was less than 1.0. In this case, there would be local shear cracks but the structural integrity of the confinement barrier would be maintained. In other areas, additional shear steel will have to be added in the site-specific design to ensure adequate strength in critical areas. Structural analysis of the reinforced concrete is given in Appendix 8A.1.5.2 of the TSAR. Updated summary tables of the maximum stresses in the concrete members, Tables 8.16-1 and 8.16-2, were provided in response to round two RAI 8-5 (Stewart, 1999b). Information is also provided on the residual capacity of the major members following damage due to the tornado missiles. Based on the analysis of the structure, the TSAR determined that there was no structural damage that would result in release of radioactive material. Site-specific analysis to accommodate soil-structure interaction and design adjustments will have to be made. Additionally,

- The level of the mezzanine plate may be adjusted to accommodate the actual cask and fuel assemblies. If this is necessary, reanalysis of the structure will be required.

- The concrete basemat must be designed for the site-specific foundation requirements. Final reinforcement steel arrangement must be specified to accommodate local shear stress.

Determination of the response of the concrete structure to the DBT was also based on global stability resisting overturning and sliding, as well as local deformation due to missile impact. Overturning and sliding stability were determined to be acceptable based on static equilibrium, Appendix 8A1.6.1.1, of the TSAR.

The seismic analysis of the protective cover, plates, and doors is based on adding the dynamic loading to other load results, as appropriate. Protective cover normal loads include dead plus live loads, Appendix 8A.1.5.3, of the TSAR. Strength of materials analysis was used for the protective cover. Calculated stress due to dead and live load was based on formulas for flat plates with straight boundaries and constant thickness from Roark's Formulas for Stress and Strain (Young, 1989). The stresses in the steel components were found to be less than allowables (Tables 8.24-1 and 8.24-2 of the TSAR). Additional checks on the overall cover response were made in the TSAR and resulted in stress levels similar to the tertiary area plate structures.

FEA was performed for the roof plate assuming all loads were carried by beams. The DOE analysis demonstrated that it will not lift off the support beam and that the stress levels were less than allowables. Strength of materials analysis was used to check the adequacy of the attachment bolts. The same procedure was used for the mezzanine plate. Stress in beams and attachment bolts were shown to be less than allowable (Tables 8.24-1 and 8.24-2 of the TSAR). The attachment for the plates to the beams was checked against uplift and shear. Individual load cases on the attachment bolts were found to be acceptable. There was no check of the combined loads on the attachment bolts. Because the number of bolts required for the individual loads is small compared to those used, the ability of the structure to perform its function should not change.

The analysis of the LAA sliding door was performed using the strength of materials approach. The door was considered a rigid body and a factor applied to the overall weight to account for seismic loading. Global stress in plate material of the door was less than allowable (Tables 8.24-1 and 8.24-2 of the TSAR). Analysis was performed on the support brackets and wheels and the stress levels were found to be less than allowable (Tables 8.24-1 and 8.24-2 of the TSAR).

7.4.3 Pool and Pool Confinement Facilities

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

7.4.4 Reinforced Concrete Structures

No other reinforced concrete structures are identified in the TSAR beyond those considered as confinement SSCs.

7.4.5 Other Structures, Systems, and Components Important to Nuclear Safety

The components identified in the TSAR as other SSCs important to safety include

- CCTV and lighting subsystems
- CTS (Appendix 8A.2 of the TSAR)
- Overlid with gripping device
- TC port cover handling subsystem (Appendix 8A.4 of the TSAR)
- Receiving cask shield plug and source cask lid handling subsystem (Appendix 8A.4 of the TSAR)
- Fuel assembly handling subsystem (Appendix 8A.5 of the TSAR)
- Upper shield plug port cover
- HEPA filter pressure monitoring subsystem
- Exhaust temperature monitoring subsystem

As identified in the TSAR, both FEA and strength of materials analysis were used to verify the capability of the components to perform their function under all loading conditions. Information on the types of analyses used for the various components are given in the following sections.

Description

The CCTV and lighting subsystems for the DTS have been identified as important to safety in response to round one RAIs 3-21 and 3-22 (Stewart, 1999a) and round two RAI 1-1 (Stewart, 1999b). The TSAR must be updated to reflect the current classification, number, and locations of the cameras and lighting elements.

Description of the cask transfer, cask component handling, and fuel assembly handling subsystems are provided in the TSAR. As part of the site-specific application, it will be necessary to review these components to ensure they are adequate for the site-specific casks.

The condition of the HEPA filters is monitored by the HEPA filter pressure monitoring subsystem and is necessary to evaluate the status of the confinement function provided by the HEPA filters. Calibrated differential pressure sensors are provided across each HEPA filter module, which can be read at redundant locations and also by the control system. The readouts are mounted in seismically isolated housings.

The performance of the heating/cooling subsystem is monitored by the exhaust air temperature monitoring subsystem. It consists of a redundant pair of calibrated temperature gages mounted in seismically isolated housings.

Design Criteria and Codes

The TSAR identifies that the HVAC components will be designed in accordance with

- ASME N509, Nuclear Power Plant Air-Cleaning Units and Components (American Society of Mechanical Engineers, 1996)

- ASME AG-1, Code on Nuclear Air and Gas Treatment (American Society of Mechanical Engineers, 1994)

- 1997 ASHRAE Handbook-Fundamentals (American Society of Heating, Refrigeration, and Air-Conditioning Engineers, 1997)

The TSAR identifies that lifting and component handling equipment within the DTS is designed in accordance with ASME NOG–1(American Society of Mechanical Engineers, 1995). ASME NOG–1 covers electric overhead and gantry multiple girder cranes with top running bridge and trolley used at nuclear facilities and components of cranes at nuclear facilities. This includes a fail-safe design of components used to handle the fuel assemblies.

Details on the design criteria for the television cameras and lighting subsystem used to verify the transfer process were given in the response to round two RAI 5-9 (Stewart, 1999b). These provide sufficient information for identification of appropriate candidates that will satisfy the design criteria for the CCTV cameras and lighting subsystem.

Materials

The specifications and codes for the HVAC components contain the necessary information on the material characteristics of these components.

The operating limits identified for the television cameras and lighting subsystem contain the necessary information to identify appropriate material characteristics of these components.

Materials used in the construction of the lifting components are identified in the appendices to Chapter 8 of the TSAR.

The lubrication systems used on moving parts will be radiation resistant. In addition, maintenance procedures will have to be developed in the site-specific application to inspect and replace them when necessary.

Analysis

The CTS analysis is given in Appendix 8A.2 of the TSAR. Additional information was provided in the response to round one RAI 8-32 (Stewart, 1999a). Details of the locking pins, transmission cradles, anti-derailing devices, and guidance rollers and wheels were provided. The strength of materials procedures used are in accordance with standard engineering practice. Under seismic loading, the cask transfer equipment will not tip over or derail. The locking pin, transmission cradles, anti-derailing devices, guidance rollers, and wheels are sized properly.

The fuel assembly handling crane analysis is contained in Appendix 8A.5 of the TSAR. As identified in the definition of important to safety in 10 CFR Part 72, this system is designed to prevent damage to the SNF during handling. Analysis was based on both FEA and strength of materials calculations, in accordance with the requirements of ASME NOG-1 (American Society of Mechanical Engineers, 1995). This included calculation of the stresses in beams, bolts, and cables as well as deflections. These loads were based on secondary response spectra. As identified in the TSAR, these do not correspond to the spectra identified in the analysis of the reinforced concrete structure (Appendix 8A.1 of the TSAR). The analysis must be redone for the site-specific application. The stiffness of the cable in the FEA model was set to produce a natural frequency of 10 Hz, which is in the elevated region of the secondary response spectra used. When combined with the stiffness of the other components of the model, the calculated frequency is less than 10 Hz. The calculated stresses and deformations were compared to allowables and shown to be acceptable. The definition of the allowables is in conformance with standard engineering practice.

The shield plug and source cask lid handling subsystem analysis is contained in Appendix 8A.4 of the TSAR. In the analysis, the roof plate structure was assumed to be 4-inches thick. This has been increased to 7 inches for shielding purposes with the assumption that the analysis performed is conservative. Level of the secondary response spectra is given in Figures 8A.4-14 and 8A.4-15 of the TSAR. Again the levels are not consistent with the spectra identified in the analysis of the reinforced concrete structure in Appendix 8A.1 of the TSAR. The analysis must be redone for the site-specific application. The resulting stresses in the components are shown to be acceptable.

Refer to the fuel assembly handling crane system analysis provided in the TSAR for additional details.

7.4.6 Other Structures, Systems, and Components Subject to Nuclear Regulatory Commission Approval

The components identified in the TSAR as other SSCs subject to NRC approval include:

- Protective enclosure to house the fans and PLC
- HVAC heating and cooling subsystems
- Electrical subsystem
- Air supply subsystem for the sliding door seal
- Radiation monitoring subsystem
- Fire protection subsystem
- Decontamination subsystem
- Control subsystem and PLC
- Cask transport and lifting subsystem
- Cask vacuum/inerting/leak test subsystems
- Canister welding subsystem

Collocated, existing services at a nuclear facility include:

- Electrical power
- Access to transportation
- Security system
- Waste disposal system
- Health physics organization
- Trained operations personnel

Description

A description of the protective enclosure used to house the fans and PLC bench is provided in the response to round one RAI 8-5 (Stewart, 1999a). It is constructed of steel plates and structural steel members. Although it is not considered important to safety, it is designed to protect its contents from the effects of the design basis events. Loss of the exhaust fans and/or PLC bench could have a significant influence on the operation of the DTS.

The description of the heating and cooling function of the HVAC subsystem is provided in Subsections 4.3.1, Ventilation and Offgas Systems, and 5.3.1, HVAC Subsystems, of the TSAR.

A description of the electrical subsystems in the DTS is given in Subsection 4.3.2, Electrical Systems, of the TSAR.

The air supply subsystem for the sliding door seal, Subsection 4.3.3, Air Supply Systems, of the TSAR, includes an air tank that is to be stored in the tank storage area outside the PA.

Radiation monitoring subsystems, Subsections 4.3.7.2, Alarms, and 7.3.1, Installation Design Features, of the TSAR, are located in the PA, LAA, TCA, and REA. Battery backup is provided in case primary electrical power is disrupted.

A description of the fire protection subsystem in the DTS is given in Subsection 4.3.8 of the TSAR. Fire alarm and protection are provided in the PA, LAA, TCA, and REA. Within the confinement boundary, a carbon dioxide fire suppression system is used.

As identified in Section 4.4, Decontamination Systems, of the TSAR there are no built-in decontamination facilities in the DTS. All the decontamination equipment will be portable and associated with the collocated nuclear facility.

The control subsystem and associated PLC are described in Section 5.5, Control Room and Control Area, of the TSAR.

A general description of the CMS is provided in the TSAR. It is noted that this subsystem may have to be modified based on the characteristics of the site-specific source and receiving casks.

The basic characteristics of the cast transport and lifting, cask vacuum/inerting/leak test, and canister welding subsystems are identified in Subsection 1.2.5, Other Subsystems. The details of these subsystems will be based on the characteristics of the site-specific source and receiving casks and will be included in the site-specific application.

Information on the description of the collocated services and other SSCs will be provided in the site-specific application.

Design Criteria and Codes

The TSAR identifies that the HVAC components will be designed in accordance with

- ASME N509, *Nuclear Power Plant Air-Cleaning Units and Components* (American Society of Mechanical Engineers, 1996)

- ASME AG-1, *Code on Nuclear Air and Gas Treatment* (American Society of Mechanical Engineers, 1984)

As described in Subsection 4.3.2 of the TSAR, the electrical subsystems in the DTS are designed to meet the requirements of ANSI/ANS 57.9 (American National Standards Institute and American Nuclear Society, 1984).

All fire protection features will be provided per NFPA Standard 72D (National Fire Protection Association, 1999) and ANSI/NFPA 12 (American National Standards Institute and National Fire Protection Association, 1998).

Information on the design criteria and associated codes for the collocated services will be provided in the site-specific application.

Materials

The majority of components in this section are commercial items. No special materials are identified in the TSAR.

Analysis

DTS heating/cooling loads are calculated using a commercially available HVAC loads program, Full Commercial HVAC Loads, by Elite Software Development, Inc. No analysis is provided on the structural integrity or susceptibility of these components to the normal operation, natural phenomena, and accident conditions. Selection of components that conform to the specified codes and standards will provide assurance that they will operate as required.

Analysis of the protective enclosure housing the exhaust fans and PLC was based on a strength of materials approach including dead, live, wind, tornado wind, tornado wind differential pressure, and seismic loads. Resistance was found to be controlled by the accident loading conditions for DBT wind pressure, DBT missiles, and the DE. The maximum stresses in the steel plate roof, roof beams, wall plates, and columns were found to have acceptable factors of safety, based on the round two RAI 3-6 (Stewart, 1999b) response.

No analysis of the structural integrity of other SSCs subject to NRC approval is given in the TSAR. Information on the analysis of the other SSCs and the ability of the collocated services to provide the required services to the DTS must be provided in the site-specific application.

7.5 Evaluation Findings

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

7.5.1 Description of Structures, Systems, and Components

- The NRC staff has reviewed the information in Chapters 1, Introduction and General Description of Installation, and 4, Installation Design, of the TSAR and associated documentation and did not find reasonable assurance that the drawings and dimensions represent the conceptual design and provide sufficient detail to support the requirements of 10 CFR 72.40(a)(1), in accordance with the requirements of 10 CFR 72.24(b) and (c).

The site-specific SAR for the DTS must include at least the following information to satisfy the requirements of 10 CFR 72.24(b)(c), 72.40(a)(1), and 72.140:

- An evaluation of the DTS design, including updated design analyses, in the event that design changes must be made to accommodate any differences in the cask design parameters. This will require consideration of the cask related design criteria presented in Chapter 3, Principal Design Criteria, of the TSAR and the bounding conditions analyzed in Chapter 8, Accident Analyses, of the TSAR.

- Detailed description of the design of the fuel assembly handling subsystem which may be changed based on the source and receiving cask design. The drawings presented in Chapter 1, Introduction and General Description of Installation, and the description given in Section 4.3, Auxiliary Subsystems, of the TSAR provide a basis for the design. Sufficient information is not provided, however, to determine the adequacy of the SSC to perform its safety function.

- Detailed description of the design provisions and procedures for installation of the pintle to the cask lid and shield plug. Sufficient information is not provided to determine the adequacy of the SSC to perform its safety function.

- Site-specific analysis to accommodate soil-structure interaction and design adjustments. This analysis will have to be made and should include

  — Level of the mezzanine plate if adjusted to accommodate the actual cask and fuel assemblies. This will require reanalysis of the structure.

  — The concrete base mat must be designed for the site-specific foundation requirements.

  — Final reinforcement steel arrangement must be specified to accommodate local shear stress.

- Detailed specifications to establish the quality of the materials and workmanship for both the reinforced concrete and the structural steelwork. These specifications will be based on ACI 301 (American Concrete Institute, 1996) and ANSI/AISC N690 (American National Standards Institute and American Institute of Steel Construction, 1989).

- Structural design, procurement, testing, construction, fabrication, and erection activities important to safety. These items will be controlled under the overall QA Plan for the project and will be in accordance with the site-specific license requirements.

7.5.2 Confinement Structures, Systems, and Components

- The NRC staff has reviewed the information presented in Section 4.2, Confinement Structures, of the TSAR and found reasonable assurance that the generic description of confinement SSCs, including reinforced concrete components, meets the requirements of 10 CFR 72.24(a) and (b), 72.82(c)(2), and 72.106.

- The NRC staff has reviewed the information presented in Section 4.2, Confinement Structures, of the TSAR and found reasonable assurance that the design criteria, including applicable codes and standards, meet the requirements of 10 CFR 72.24(c)(1, 2, and 4), 72.40(a)(1), and 72.128.

- The NRC staff has reviewed the information presented in Section 4.2, Confinement Structures, of the TSAR and found reasonable assurance that the structural analysis procedures identified are in conformance with standard engineering practice and the applicable codes and standards identified. The NRC staff also found reasonable assurance that the analytical reports, test reports, or both ensure structural integrity of the SSCs and meet the requirements of 10 CFR 72.24(d)(1 and 2) and (i), and 72.122(b)(1–3), (c), (d), and (f–l).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(c)(3).

- The design details, including the material properties used in the design and construction of all SSCs important to safety.

7.5.3 Pool and Pool Confinement Facilities

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

7.5.4 Reinforced Concrete Structures

No other reinforced concrete structures are identified in the TSAR beyond those considered as confinement SSCs.

7.5.5 Other Structures, Systems, and Components Important to Nuclear Safety

- The NRC staff has reviewed the information in the TSAR regarding the description of other SSCs important to safety. Based on information in the TSAR and supporting materials, the NRC staff has found reasonable assurance that the description of some of the other SSCs important to safety meets the requirements of 10 CFR 72.24(a) and (b), 72.82(c)(2), and 72.106.

- The NRC staff has reviewed the design criteria identified for other SSCs important to safety provided in the TSAR. Based on this information and supporting materials, the NRC staff has found reasonable assurance that the design criteria, including applicable codes and standards, meet the requirements of 10 CFR 72.24(c)(1, 2, and 4), 72.40(a)(1), and 72.128.

- The NRC staff has reviewed the information in the TSAR and supporting materials and found reasonable assurance that the material properties used in the design and construction of the lifting component SSCs meet the requirements of 10 CFR 72.24(c)(3).

- The NRC staff reviewed the information in the TSAR and supporting materials and found reasonable assurance that the analytical reports, test reports, or both ensure structural integrity of the SSCs and meet the requirements of 10 CFR 72.24(d)(1 and 2) and (i), and 72.122(d), (f), and (h).

The site-specific SAR must include at least the following information to satisfy the requirements of 10 CFR 72.122(a–c), (i), and (l):

- The current classification, number, and locations of the cameras and lighting elements. The structural integrity and susceptibility of these components to the environment, including temperature and radiation levels, and accident conditions will be reviewed under the site-specific application.

- A description of the cask transfer, cask component handling, and fuel assembly handling subsystems to ensure they are adequate for the site-specific casks. As identified in the TSAR, the secondary response spectra do not correspond to the spectra identified in the analysis of the reinforced concrete structure (Appendix 8A.1 of the TSAR). The analysis will be redone for the site-specific application.

7.5.6 Other Structures, Systems, and Components Subject to Nuclear Regulatory Commission Approval

- The NRC staff has reviewed the description of other SSCs in the TSAR paying special attention to design characteristics. Based on information in the TSAR and supporting materials, the NRC staff found reasonable assurance that the description of other SSCs, subject to NRC approval, meets the requirements of 10 CFR 72.82(c)(2) and 72.106.

- The NRC staff has reviewed the information provided in the TSAR and supporting materials and determined that the DOE intends to use standard engineering practice to design other SSCs subject to NRC approval. The NRC staff found reasonable assurance that the design criteria, including applicable codes and standards, meet the requirements of 10 CFR 72.24(c)(1, 2, and 4), 72.40(a)(1), 72.122(a–d) and (f–l), and 72.128.

The site-specific SAR must include at least the following information to satisfy the requirements of 10 CFR 72.24(a) and (b), and 72.72(b):

- A general description of the CMS based on the characteristics of the site-specific source and receiving casks.

- Information on the inventory and characteristics of the nuclear materials of the collocated services.

- Information on the analysis of the other SSCs and the ability of the collocated services to provide the required services to the DTS.

- A detailed description of the design and testing of the control system. The description should include applicable code and standards that are applied to the control subsystem during design and operation.

7.6 References

American Concrete Institute. *Building Code Requirements for Reinforced Concrete*. ACI 318-83. Detroit, MI: American Concrete Institute. 1983.

American Concrete Institute. *Code Requirements for Nuclear Safety Related Concrete Structures and Commentary*. ACI 349-85 and ACI 349R–85. Detroit, MI: American Concrete Institute. 1985.

American Concrete Institute. *Specification for Structural Concrete for Building.* ACI 301-96. Detroit, MI: American Concrete Institute. 1996.

American National Standards Institute and American Institute of Steel Construction. *Nuclear Facilities-Steel Safety and Related Structures for Design Fabrication and Erection.* ANSI/AISC N690. New York: American National Standards Institute and American Institute of Steel Construction. 1989.

American National Standards Institute and American Nuclear Society. *Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type).* ANSI/ANS 57.9–1984. La Grange Park, IL: American National Standards Institute and American Nuclear Society. 1984.

American National Standards Institute and American Society of Civil Engineers. *Minimum Design Loads for Buildings and Other Structures*. ANSI/ASCE 7-95. New York: American National Standards Institute and American Society of Civil Engineers. 1996.

American National Standards Institute and National Fire Protection Association. *Standard or Carbon Dioxide Extinguishing Systems.* ANSI/NFPA 12. Quincy, MA: National Fire Protection Association. 1998.

American Society of Heating, Refrigeration, and Air-Conditioning Engineers. *1997 ASHRAE Handbook-Fundamentals*. New York: American Society of Heating, Refrigeration, and Air-Conditioning Engineers. 1997.

American Society of Mechanical Engineers. *Code on Nuclear Air and Gas Treatment*. ASME AG–1. New York: American Society of Mechanical Engineers. 1994.

American Society of Mechanical Engineers. *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder).* ASME NOG–1–1995. New York: American Society of Mechanical Engineers. 1995.

American Society of Mechanical Engineers. *Nuclear Power Plant Air-Cleaning Units and Components.* ASME N509. New York: American Society of Mechanical Engineers. 1996.

National Fire Protection Association. *Standard for the Installation of Lightning Protection Systems*. NFPA 780. Quincy, MA: National Fire Protection Association. 1992.

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

Nuclear Regulatory Commission. Standard Review Plan for Spent Fuel Dry Storage Facilities. NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report*. Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

Young, W.C. *Roark's Formulas for Stress and Strain*. 6th Edition. New York: McGraw Hill. 1989.

8 THERMAL EVALUATION

8.1 Review Objective

The objective of the thermal review is to ensure that the SSCs important to safety and fuel material temperatures remain within the allowable values or criteria for normal, off-normal, and accident conditions. This review includes confirmation that the fuel-cladding temperatures (fission product barrier) are maintained throughout the SNF assembly transfer process and protects the cladding against degradation. The DTS is evaluated for adequate DHR under normal, off-normal, and accident conditions. A fire-hazard analysis and fire-protection measures for the DTS are also evaluated. The review also confirms that the thermal design of the DTS has been analyzed with acceptable analytical and/or test methods. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete review of the installation design and thermal evaluation as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

8.2 Areas of Review

The following listing shows the areas addressed in Section 8.4, Conduct of Review:

Material Temperature Limits

Decay Heat Removal Systems

Thermal Loads and Environmental Conditions

Analytical Methods, Models, and Computations

Fire and Explosion Protection

8.3 Regulatory Requirements

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

- 72.122(c), (h)(1 and 3), and (j)
- 72.236(f)
- 72.128(a)(4)

Note that a review of regulatory requirement 10 CFR 72.236(f) requires cask-specific information beyond the scope of the TSAR.

8.4 Conduct of Review

The NRC staff performed the thermal evaluation by reviewing Chapter 3, Principal Design Criteria; Chapter 4, Installation Design; and Chapter 8, Accident Analyses; of the TSAR, with supporting information contained in Chapter 1, Introduction and General Description of Installation; and Chapter 2, Site Characteristics; of the TSAR (US Department of Energy, 1996), DOE responses to the NRC RAIs (Stewart, 1999a,b), and documents cited in the RAI responses.

The findings for relevant portions of the chapter are contained in the following subsections. Note that the analysis review is based on Revision 0 of the TSAR and proposed changes.

The HVAC subsystem and components are designed and will be fabricated using the following applicable documents for guidance: (i) ASME N509 (American National Standards Institute and American Society of Mechanical Engineers, 1996) and (ii) ASME AG–1 (American Society of Mechanical Engineers, 1994).

The DTS installation design specifications pertaining to thermal parameters were provided in Subsection 4.3.1, Ventilation and Offgas Systems, of the TSAR. Details of the thermal analysis of the DTS are contained in the appendices to Chapter 4, Installation Design, of the TSAR. Specific information provided includes the input and output data for the computer program used to calculate the heating and cooling loads for the PA. The analysis program that was used, entitled CHVAC, Full Commercial HVAC Loads, is designed to calculate the maximum heating and cooling loads for buildings with multiple zones and systems. This program is maintained and distributed by Elite Software Development, Inc. CHVAC uses the procedures and methods described in the 1989 ASHRAE Handbook-Fundamentals (American Society of Heating, Refrigeration, and Air-Conditioning Engineers, 1989).

The results obtained from a bounding thermal analysis of the DTS during off-normal and accident conditions are presented in the round two response to RAI 8-1 (Stewart, 1999b). The evaluation of the off-normal and accident conditions is contained in Chapter 12 of this AR. The evaluation presented here pertains to normal operating conditions only.

8.4.1 Material Temperature Limits

Based on a study by Einzinger (cited in the TSAR text but not provided), the following fuel temperature limits were adopted for the DTS: 464°F (240°C) for a 2-week period (before the receiving cask is inerted); 441°F (227°C) for a 1-month period; and 347°F (175°C) for a 2-year period.

The allowable temperature gradient across the DTS structure wall should not exceed 70°F (39°C).

The important to safety CCTV temperature limit is 130°F (54°C).

The bellows material of the CMS is made of silicon coated polyester fabric, which has a maximum operating temperature of 240°F (115°C).

8.4.2 Decay Heat Removal Systems

Each area of the DTS—the PA, LAA, and TCA—is supported by its own heating/cooling subsystem. The cooling units for the PA, LAA, and TCA are located outside of the DTS and are susceptible to seismic and tornado damage. An important aspect of the DTS HVAC subsystem is that the heating and air conditioning subsystem components are separate from the ventilation subsystem. The air handling unit (AHU) for the PA is located within the PA. The AHUs for the LAA and TCA and the redundant ventilation HEPA filter banks are located in the LAA. The ventilation subsystem also employs redundant exhaust fans, primary and secondary units, that are located in a protective enclosure outside the DTS. A 20-inch (0.508-meter) diameter exhaust stack for the HVAC ventilation subsystem extends 10 feet (3 meters) above the DTS structure. Failure of the exhaust stack would not result in an unanalyzed condition; therefore, it was not designed for seismic or tornado loads.

8.4.3 Thermal Loads and Environmental Conditions

Under normal conditions, the temperatures within the DTS are to be maintained at 70°F (21°C) and a setpoint relative humidity of 50 percent. If the ambient temperature outside the DTS drops below 0°F (−18°C), then the temperature setpoint within the DTS will be lowered to 50°F (10°C). This decrease in temperature is to ensure that the temperature gradient across the DTS concrete walls does not exceed the 70°F (39°C) limit. The interior of the DTS is designed to remain within a temperature range of 40–130°F (4–54°C) with an ambient temperature range of −20–115°F (−29–46°C).

The design basis for heat dissipation during normal conditions corresponds to 21–intact 10-year cooled SNF assemblies. The estimated decay heat load for this type and number of SNF assemblies is 15.5 kW. This decay heat load will potentially have to be dissipated within the PA, LAA, or TCA, depending on the location of the filled receiving cask at any given time or the operation being performed for the SNF assembly transfer process.

In addition to the 15.5 kW SNF DHR requirement just discussed, equipment heat loads that were also accounted for in the thermal analysis for the different areas of the DTS are: (i) 1.5 kW for the TCA, (ii) 0.5 kW for the LAA, (iii) 20 kW for the PA, and (iv) 3.0 kW for the REA. The high equipment heat load for the PA is attributable to the welding operations to be performed in this area and the concomitant welding equipment.

8.4.4 Analytical Methods, Models, and Computations

The analysis program that was used, entitled CHVAC, Full Commercial HVAC Loads is designed to calculate the maximum heating and cooling loads for buildings with multiple zones and systems. This program is maintained and distributed by Elite Software Development, Inc. CHVAC uses the procedures and methods described in the 1989 ASHRAE Handbook-Fundamentals (American Society of Heating, Refrigeration, and Air-Conditioning Engineers, 1989).

Although the input and output data for the thermal analysis of the PA was provided in the TSAR, this information did not convey the various assumptions and techniques employed in constructing the mathematical abstraction. In addition, the relevant parameters typically associated with a thermal analysis were not provided. In particular, the various convective heat transfer coefficients, radiation emissivities and view factors, and material thermal conductivities, were not provided for review.

8.4.5 Fire and Explosion Protection

A review of the fire protection facilities for the DTS can be found in Subsection 12.4.2.6 of this AR. The explosion protection evaluation was conducted as part of the tornado, hurricanes, and high wind review in Subsection 12.4.2.5 and the electrical surges and explosions review in Subsection 12.4.2.10. Note that Subsection 12.4.2.5 of this AR is applicable to this evaluation because these natural events bound the design basis loads for explosions.

8.5 Evaluation Findings

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

8.5.1 Material Temperature Limits

- The NRC staff has reviewed the information provided in the TSAR and found reasonable assurance that the requirements for the cladding material temperature limits under 10 CFR 72.128(a)(4) are satisfied.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of these regulations:

- Description of the strength and temperature characteristics of the concrete to be used for the DTS SSCs. Identify all applicable codes and technical specification requirements.

8.5.2 Decay Heat Removal Systems

- The NRC staff has reviewed the information provided in the TSAR and found reasonable assurance that the requirements for maintaining the cladding material temperature within acceptable limits for normal operating conditions under 10 CFR 72.122(h)(1 and 3) and (j), and 72.128(a)(4) are satisfied.

8.5.3 Thermal Loads and Environmental Conditions

- The NRC staff has reviewed the information provided in the TSAR and found reasonable assurance that the requirements for the thermal loads and environmental specifications for normal operating conditions under 10 CFR 72.122 (h)(1 and 3) and (j) are satisfied.

8.5.4 Analytical Methods, Models, and Computations

- The NRC staff has reviewed the information in the TSAR and found that the requirements for the methods, models, and calculations under 10 CFR 72.122(h)(1 and 3) and (j), and 72.128(a)(4) were not satisfied.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of these regulations:

- The various assumptions and techniques employed in constructing the mathematical abstraction for all relevant thermal analyses. In addition, the parameters typically associated with a thermal analysis must be provided. Specifically, provide the various convective heat transfer coefficients, radiation emissivities and view factors, material thermal conductivities and insolation values that were used for the thermal analyses. If commercial software packages are used to perform the analyses, the licensee must provide the necessary documentation for the NRC staff to aid in interpreting the relevant input and output data formats.

8.5.5 Fire and Explosion Protection

- See Subsections 12.5.2.6 and 12.5.2.10 of this AR for the evaluation findings pertaining to the applicable bounding analyses.

8.6 References

American National Standards Institute and American Society of Mechanical Engineers. *Nuclear Power Plant Air-Cleaning Units and Components.* ASME N509. New York: American Society of Mechanical Engineers. 1996.

American Society of Heating, Refrigeration, and Air-Conditioning Engineers. *1989 ASHRAE Handbook-Fundamentals*. New York: American Society of Heating, Refrigeration, and Air-Conditioning Engineers. 1989.

American Society of Mechanical Engineers. *Code on Nuclear Air and Gas Treatment.* ASME AG–1. New York: American Society of Mechanical Engineers. 1994.

Nuclear Regulatory Commission. *Standard Review Plan for Spent Dry Storage Facilities*. NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report.* Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

9 RADIATION PROTECTION EVALUATION

9.1 Review Objective

The objective of this radiation protection evaluation is to determine whether: (i) the design features of the facility meet the NRC design criteria for direct radiation, (ii) the facility radiation protection program for occupational exposures to workers is consistent with the NRC's radiation protection standards, (iii) the radiation doses to the general public will meet regulatory standards during both normal and off-normal situations, and (iv) doses to the workers and members of the public will be maintained ALARA. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete review of the radiation protection program as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

9.2 Areas of Review

The following listing shows the areas of review addressed in Section 9.4, Conduct of Review:

Ensuring that Occupational Radiation Exposures Are As Low As Reasonably Achievable

Applicant Policy
Design Considerations
Operational Considerations

Radiation Sources

Gamma Sources
Neutron Sources

Radiation Protection Design Features

Installation Design Features
Access Control
Shielding Design, Use, and Effectiveness
Ventilation
Area Radiation and Airborne Radioactivity Monitoring Instrumentation

Estimated Onsite Collective Dose Assessment

Direct Radiation Dose Rate at the Perimeter of the Controlled Area
Doses to Workers

Health Physics Program

Organization
Equipment, Instrumentation, and Facilities
Procedures

Direct Dose to the Offsite Public

9.3 Regulatory Requirements

This section identifies and presents a summary of 10 CFR Part 20 and Part 72 sections relevant to the review areas addressed by this chapter. The applicable regulatory requirements from 10 CFR Parts 19, 20, and 72 to radiation protection evaluation are:

- 19.12
- 20.1101
- 20.1201
- 20.1202
- 20.1207
- 20.1208
- 20.1301
- 20.1302
- 20.1406
- 20.1501
- 20.1502
- 20.1601(a–e)
- 20.1602
- 20.1701
- 20.1702
- 20.1703
- 20.1801
- 20.1802
- 20.2101
- 20.2102
- 20.2103
- 20.2106
- 72.24(e)
- 72.40(a)(13)
- 72.104
- 72.106(b)
- 72.122(e)
- 72.126
- 72.128(a)(2)
- 72.130

9.4 Conduct of Review

This review was based on the radiation protection program described in the TSAR (U.S. Department of Energy, 1996) and responses to RAIs (Stewart, 1999a,b). Information for this review included Chapter 7, Radiation Protection; and Section 3.3, Safety Protection Systems, of the TSAR. Chapter 7 describes the radiation protection features of the DTS designed to ensure that the radiation exposures to the personnel meet the NRC regulatory criteria (10 CFR Part 20, Subpart B). Chapter 7 demonstrates that the dose rates to personnel on site are maintained ALARA. In addition to the site doses being ALARA, the doses to the general public are evaluated in this chapter. The occupational dose limits specified in 10 CFR Part 20, Subpart C, are also reviewed for this AR.

9.4.1 Ensuring That Occupational Radiation Exposures Are as Low as Reasonably Achievable

Section 7.1 of the TSAR describes the policy considerations, facility design, and facility operations to ensure that radiation doses at the site will be ALARA. DTS operations at the nuclear facility or DOE nonreactor site are intended to minimize the radiation doses to the workers. A radiological protection program will be implemented at the DTS site in accordance with 10 CFR Part 20, and plant personnel will be trained in the proper operations of the DTS.

The DTS will be designed to ensure that doses to workers are ALARA by incorporating the principles of Regulatory Position 2 of Regulatory Guide 8.8, Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be ALARA (Nuclear Regulatory Commission,1978). The principal design feature to ensure that worker doses will be ALARA is the heavy shielding used to reduce personnel exposures. To minimize worker exposure from airborne radioactivity, sufficient filters are set up in series to minimize the concentration of particulate materials in work areas. To minimize releases to the environs, the HVAC is maintained under a negative pressure.

The DTS will be operated to maintain worker doses ALARA. Site-specific operations will be addressed in the site-specific LA, but several operational considerations will be maintained across all uses of the DTS. The DTS equipment is placed such that it can be easily removed and maintained and is designed such that it can be dismantled and transported to another utility. The DTS structure and operation will be similar from site to site so that personnel can be appropriately trained and qualified in operation.

9.4.2 Radiation Sources

This section of the AR evaluates the applicant's description of the contained radiation sources at the proposed DTS to determine whether sufficient information has been provided to support the licensee's analysis of the effectiveness of the shielding. Subsections 3.1.1, Materials to be Transferred; and 7.2.1, Characterization of Sources; of the TSAR contain information on the radiation sources present at the proposed DTS. The radiation sources at the proposed DTS will consist of both PWR and boiling water reactor (BWR) SNF.

9.4.2.1 Gamma Sources

Gamma sources that will be located at the proposed DTS include the SNF and activated assembly hardware from PWR and BWR nuclear reactors. The fuel is conservatively modeled as the most radioactive fuel that will be used on the site. The fuel is modeled as B&W 15×15 PWR fuel assemblies, with an enrichment of 3.75-percent, a burnup of 40,000 MWd/MTU, and a decay time of 5 years. It is important to recognize that the design basis SNF must be cooled for at least 5 years because of radiation shielding limitations. From a thermal perspective, the maximum decay heat load that the DTS can accommodate is 15.5 kW, which is equivalent to 21 10-year cooled SNF assemblies. As a consequence, 5-year cooled fuel can be mixed with longer then 10-year cooled fuel to achieve a net decay heat load below the 15.5 kW limitation.

The TSAR calculated the gamma source term using the ORIGEN 2.1 computer code (Oak Ridge National Laboratories, 1991). The magnitude of the nonfuel region gamma source, consisting primarily of Co-60 in activated metal components, was calculated using the ORIGEN 2.1 computer code.

9.4.2.2 Neutron Sources

The neutron source term was calculated using the same fuel characteristics, methodology, and assumptions as the fuel generated gamma source term. This method is acceptable for calculating the neutron source term and energy structure, and there is reasonable assurance that the neutron sources at the proposed DTS will not exceed the quantity used by the licensee for the shielding evaluation in the SAR.

9.4.3 Radiation Protection Design Features

The design features of the DTS are described in Subsections 3.3.5, Radiological Protection, and 7.3, Radiation Protection Design Features, of the TSAR.

9.4.3.1 Installation Design Features

The installation design features of the DTS are described in Subsection 7.3.1, Installation Design Features, and in Figures 7.3-1 to 7.3-3 of the TSAR. These design features have been reviewed, and it was found that they comply with the ALARA goals. The site drawing contains and clearly shows these features. The DTS structure must be located no less than 200 meters from the site boundary to comply with the offsite dose limits in 10 CFR 72.104. Radiation zones will be identified based on potential dose rates in order to control access to areas of high dose rates. The TCA may be accessed only via the REA and the LAA. These limited access points provide an additional barrier to the areas of higher dose rates.

9.4.3.2 Access Control

Subsection 7.3.1.1, Access Control of Radiation Areas, of the TSAR contains information on the control of access to areas of the DTS facility. The first barrier to the controlled area is a fence with a locked gate that surrounds the DTS and prevents unauthorized access. Access to the DTS is through a normally locked gate. The radiation zone designations are specified in the DTS, Subsection 7.3.1.1. Inside the first barrier are additional points of entrance and exit. These access control areas comply with the ALARA procedures and structures at the site. The potential dose rates are tabulated, and they are in compliance with the dose limits in 10 CFR Part 20. Access control provisions include a stairway mounted to the outside of the DTS to access the roof and the REA. The access controls specified are in compliance with NUREG–0800, Sections 12.3 and 12.4, Radiation Protection Design Features (Nuclear Regulatory Commission, 1981).

9.4.3.3 Shielding Design, Use, and Effectiveness

The radiation shield designs, use, and effectiveness are described in Subsections 7.3.1.2, Radiation Shields and Geometry, and 7.3.2, Shielding, of the TSAR. The shielding is designed to maintain dose rates around the DTS structure ALARA. The design of these shields also minimizes the doses absorbed by personnel in the area. Both gamma and neutron doses were considered in the ALARA design of these areas.

A thick-walled cask body provides the gamma shielding for fuel assemblies in the source and receiving casks. Neutron shielding for the fuel assemblies is provided by a borated (high-absorption cross section for neutrons) polyester resin surrounding the cask body. In addition to the thick-walled cask and neutron shield, a steel shell surrounds the resin layer, increasing the design safety of the casks. The source and receiving casks were not evaluated as part of this AR.

The most significant shielding design features of the DTS are the 3-foot concrete walls, the steel sliding door, and the steel roof with a steel weather protective cover. During fuel transfer, the fuel assembly will be shielded by the 0.8-inch steel fuel transfer tube in addition to the structural materials. The steel rebar in the concrete walls of the DTS is conservatively neglected in the shielding evaluations, as is the steel and aluminum structure of the basket within the source and receiving casks. Additionally, no credit is taken for the steel PA building.

The compositions and densities of all materials considered in the shielding evaluation are included in Appendix 7A of the TSAR. The fuel and internal materials of the casks are averaged over the entire volume of the cask interior to simplify modeling for the shielding calculations. This method is considered acceptable by NRC reviewers because it is not likely to significantly alter the dose rates at long distances from the radioactive materials.

The primary gamma dose rates are determined using the point kernel computer code QADS, which is a module of the SCALE 4.3 code (Oak Ridge National Laboratory, 1996). QADS is a three-dimensional shielding code commonly utilized for shielding calculations in the nuclear industry and is considered acceptable to use for shielding calculations by NRC reviewers. ANSI/ANS 6.1.1 (American National Standards Institute and American Nuclear Society, 1977) standard flux-to-dose conversion factors were used to convert radiation fluxes-to-dose rates.

Additionally, the computer code SKYSHINE II (Lampley, 1979) was used to calculate the skyshine dose contribution. The dose rates near the source and receiving casks are calculated using the one-dimensional (1D) SAS1 module of the SCALE 4.3 code (Oak Ridge National Laboratory, 1996). The use of a 1D code to assess dose rates is acceptable as long as there are no significant penetrations or voids in the shielding materials.

The offsite dose rate calculations assess the radiation dose associated with filling a single receiving cask with fuel assemblies and multiplies this value by the maximum number of receiving casks that will be filled in a year. The TSAR calculates that the maximum offsite dose rate from direct radiation from the DTS will be 46.5 mrem/yr at a distance of 100 meters from the DTS structure and 15.4 mrem/yr at a distance of 200 meters from the DTS structure.

The TSAR has a description of the shielding composition and its locations. The radiation shielding evaluation provides sufficient information to determine whether the dose rates from all sources will meet all regulatory requirements. The description of the shielding composition and details in Subsection 7.3.2, Shielding, of the TSAR support the evaluation of compliance with the requirements of 10 CFR 72.126 by describing the radiation protection systems that will shield onsite personnel from excessive radiation exposure.

9.4.3.4 Ventilation

The HVAC ventilation subsystem provides an additional level of confinement of the radioactive materials associated with the transfer of SNF assemblies. This subsystem directs airflow from areas of low levels of potential contamination to areas of higher levels of potential contamination. The HVAC ventilation subsystem is designed to maintain negative pressures relative to atmospheric pressure in areas possibly containing radioactive materials. The HVAC helps to maintain radiation exposures ALARA as the use of negative pressure minimizes the spread of radioactive materials.

Only the filtration system of the HVAC was considered to be important to safety. Redundant exhaust fans and HEPA filters have been arranged in parallel along the piping as an extra measure of safety. In addition, the fans are supported by the main and secondary power supplies to ensure that the containment is maintained under control during a loss of power at the site. Pressure sensors in the HVAC subsystem monitor the effectiveness of the filters. The system has been designed so that filters containing radioactivity can be easily maintained and will not create any additional radiation hazards to maintenance personnel or those in adjacent occupied areas.

A detailed evaluation of the confinement and ventilation subsystems is provided in Chapter 11 of this AR, Confinement Evaluation.

9.4.3.5 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

The principal protection against the intake of radioactive materials is provided by engineering controls at the site. The radiation monitoring subsystem is used to monitor personnel areas and the environment during normal, off-normal, and accident conditions. Each radiation monitor will display and alarm at several locations at the site: the detector, the PA, and the control room. Gamma radiation monitors are located in several areas of the DTS. Two neutron monitors are in the PA, one neutron monitor each is posted in the LAA, the TCA, the REA, and the exhaust stack. Portable detectors may be used to monitor neutron exposure levels in other areas as required. These portable detectors are located in those areas that may be normally occupied during transfer operations.

The exhaust stack is equipped with a continuous air monitor. The stack monitor samples the air and monitors airborne particulates, iodine, and noble gases. The data are sent to the control center. All monitors have emergency power sources in the event of a power loss, and alarms are located in both the PA and the control room.

9.4.4 Estimated Onsite Collective Dose Assessment

The dose assessment for the DTS is contained in Sections 7.4, Estimated Onsite Collective Dose Assessment; and 7.6, Estimated Offsite Collective Dose Assessment, of the TSAR and in the response to round two RAI 7-2 (Stewart, 1999b).

Conservative methods are used to estimate the dose rates both on contact and 1 meter from the source. The dose rates at the perimeter of the controlled area are summarized in Subsection 9.4.6 of this AR. The TSAR contains estimates of the dose rates, exposure times, and number of people exposed during transfer operations. The time-integrated doses were summed for the number of people in the areas, and the consequential person-rem values were summed. The greatest personnel exposure rate (220 mrem/hr) occurs during the removal of inerting equipment, which takes 12 minutes for a single worker to accomplish. The collective worker dose for all the tasks is about 0.55 person-rem per receiving cask filled. The DOE expects the dose rates to be even lower when the design of the source cask is finalized.

9.4.5 Health Physics Program

The Health Physics program for the DTS will be dependent on the collocated nuclear facility or DOE nonreactor site. As a consequence, the program will be addressed in the site-specific LA at each site.

9.4.6 Direct Dose to the Offsite Public

The TSAR presents the dose rates for a direct exposure offsite as a function of distance from the face of the DTS building. In review of Section 7.6, Estimated Offsite Collective Dose Assessment of the TSAR, it was found that the codes used were acceptable to the NRC and had been validated. The direct exposure dose to offsite people was calculated with these approved codes.

The TSAR also displays the calculated dose rates from direct radiation at various distances from the DTS facility. The dose rates offsite range from about 44 mrem/yr at 100 meters from the DTS to about 2 mrem/yr at 500 meters. Additionally, the dose to members of the public from airborne releases during normal and off-normal conditions is 3.3 mrem/yr at a distance of 100 meters from the DTS structure and 0.25 mrem/yr at a distance of 500 meters. The annual dose equivalent at 100 meters from the DTS exceeds the maximum permissible 25 mrem over the 1-year time period. At 200 meters from the DTS, the controlled area boundary dose rate from all sources of radiation meets the annual dose limits as specified in 10 CFR 72.104.

9.5 Evaluation Findings

Based on review of the information presented in Chapter 7, Radiation Protection, of the TSAR, responses to the NRC RAIs and accompanying regulatory guides, the following evaluation findings can be made about the TSAR.

9.5.1 Ensuring that Occupational Radiation Exposures Are as Low as Reasonably Achievable

- The NRC staff has reviewed the information presented in the TSAR and found that the design and operating procedures of the DTS provide acceptable means for controlling and limiting occupational radiation exposures and meeting the objective of maintaining radiation exposures ALARA, in compliance with 10 CFR 72.24(e), 72.104, and 72.126. The NRC staff found that doses will be maintained ALARA by acceptable means of minimizing the contamination in accordance with 10 CFR 20.1406, using proper surveys in accordance with 10 CFR 20.1501, using process or other engineering controls in accordance with 10 CFR 20.1701, using other controls in accordance with 10 CFR 20.1702, and using individual respiratory protection equipment in accordance with 10 CFR 20.1703.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of the regulations:

- A description of the ALARA policy of the DTS facility to demonstrate compliance with 10 CFR 20.1101(b).

- Procedures used for summation of external and internal doses as required by 10 CFR 20.1202 and 10 CFR 72.122(e).

- A description of the storage and control of licensed materials as required by 10 CFR 20.1801 and 20.1802.

9.5.2 Radiation Sources

- The NRC staff has reviewed the information presented in the TSAR and found that the description of both the gamma and neutron radiation sources located at the DTS facility is sufficient to provide reasonable assurance that the facility will satisfy the criteria for radiological protection in 10 CFR 72.126(a)(6).

9.5.3 Radiation Protection Design Features

- The NRC staff has reviewed the information presented in the TSAR and found that the generic design of the DTS provides reasonable assurance that doses will be maintained ALARA in accordance with 10 CFR 20.1101(b) and that the DTS will contain suitable shielding for radioactive protection under normal and accident conditions, in compliance with 10 CFR 72.24(e), 72.104, 72.126, and 72.128(a)(2). The NRC staff also found that the design of the DTS provides reasonable assurance that contamination of the facility and the environment will be minimized in accordance with 10 CFR 20.1406 and 10 CFR 72.130 and that adequate controls will be used to limit the concentrations of radioactive material in the air in accordance with 10 CFR 20.1701 and 20.1702.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of the regulations:

- The site of the facility with respect to population centers and a description of the attempts made to locate the site away from population centers to the extent feasible to demonstrate compliance with 10 CFR 72.40(a)(13).

- The areas of the facility that will be designated as radiation areas, high radiation areas, and very high radiation areas and controlled access as required by 10 CFR 20.1601(a–e) and 20.1602.

9.5.4 Estimated Onsite Collective Dose Assessment

- The NRC staff has reviewed the information presented in the TSAR and found that the onsite dose assessment in the TSAR provides reasonable assurance that doses to workers will be ALARA in accordance with 10 CFR 20.1101(b) and will be calculated in accordance with 10 CFR 20.1202.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of the regulations:

- Estimates of annual doses to individual workers involved in the transfer of spent fuel to demonstrate these doses do not exceed the limits defined in 10 CFR 20.1201.

- A description of the administrative procedures that will be required to ensure that the annual dose to any individual worker does not exceed the 10 CFR 20.1201 total effective dose equivalent limit of 5 rem.

9.5.5 Health Physics Program

No findings can be made about the health physics program for the DTS because no information was provided in the TSAR pertaining to this particular program. Because the DTS will be collocated at an existing nuclear facility or DOE nonreactor site, the health physics program will be evaluated during NRC’s review of the site-specific SAR.

The site-specific SAR must contain at least the following information to satisfy the requirements of the regulations:

- A description of the organization of the health physics program to meet the requirements of 10 CFR 20.1101(a).

- A description of the equipment, instrumentation, and facilities that will be available at the DTS and collocated nuclear facility to support the health physics program to meet the requirements of 10 CFR 20.1101(a).

- A description of the procedures used to implement the health physics program to meet the requirements of 10 CFR 20.1101(a).

- An indication that workers will be trained in accordance with 10 CFR 19.12.

- Documentation that doses to a minor and an embryo/fetus will be in accordance with 10 CFR 20.1207 and 20.1208.

- A description of the records required to satisfy the requirements of 10 CFR 20.2101, 20.2102, 20.2103, and 20.2106.

- A description of the conditions requiring individual radiation monitoring to satisfy 10 CFR 20.1502.

9.5.6 Direct Dose to the Offsite Public

- The NRC staff has reviewed the information presented in the TSAR and found that the offsite dose assessment in the TSAR provides reasonable assurance that direct doses to members of the public and doses to members of the public from releases to the general environment during normal operations and anticipated occurrences will be within the limits in 10 CFR 72.104 as long as the uncontrolled area is at least 200 meters from the DTS structure. This distance will ensure compliance with the dose limits in 10 CFR 20.1301 and 10 CFR 20.1302 and the requirement in 10 CFR 72.106 that the nearest boundary of the controlled area must be at least 100 meters from the SNF handling and storage facilities.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of the regulations:

- A demonstration that the annual dose equivalent at the fence from all sources of radiation exposure will not exceed the limits defined in 10 CFR 72.104.

9.6 References

American National Standards Institute and American Nuclear Society. *Neutron and Gamma-Ray Fluence-to-Dose Factors.* ANSI/ANS 6.1.1. New York: American National Standards Institute. 1977.

Lampley, C.M. *The SKYSHINE-2 Procedure—Calculation of the Effects of Structure Design on Neutron, Primary Gamma-Ray Dose Rates in Air*. NUREG/CR–0781 (RRA–T7901). Washington, DC: Nuclear Regulatory Commission. 1979.

Nuclear Regulatory Commission. *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be As Low As Is Reasonably Achievable.* Regulatory Guide 8.8. Revision 3. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1978.

Nuclear Regulatory Commission. *Assuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable.* NUREG–0800. Revision 2. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1981.

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Oak Ridge National Laboratory. *ORIGEN 2: Isotope Generation and Depletion Code-Matrix Exponential Method.* CCC–371. Oak Ridge, TN: Oak Ridge National Laboratory. 1991.

Oak Ridge National Laboratory. *SCALE-4.3: Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation for Workstations and Personal Computers.* RSIC Computer Codes Collection: Volumes 1, 2, and 3. CCC–545. Oak Ridge, TN: Oak Ridge National Laboratory. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report*. Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

10 CRITICALITY EVALUATION

10.1 Review Objective

The objective of this criticality evaluation is to ensure that the stored materials remain subcritical under normal, off-normal, and accident-level conditions during all operations, transfers, and storage of fissile materials at the site. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete criticality evaluation as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible.

10.2 Areas of Review

The following listing shows the areas of review addressed in Section 10.4, Conduct of Review:

Criticality Design Criteria and Features

Criteria
Features

Stored Material Specifications

Analytical Means

Model Configuration
Material Properties

Applicant Criticality Analysis

Computer Program
Multiplication Factor
Benchmark Comparisons

As discussed in Subsection 10.4.1 of this AR, no independent staff criticality calculation was conducted for this review.

10.3 Regulatory Requirements

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

- 72.40(a)(13)
- 72.124

10.4 Conduct of Review

The review of the criticality evaluation of the DTS consisted of an examination of the TSAR (U.S. Department of Energy, 1996); Subsections 3.3.4, Nuclear Criticality Safety; and 5.1.3.1, Criticality Prevention. Subsection 3.3.4 of the TSAR describes the criticality analysis performed by the licensee and discusses the maximum credible neutron multiplication factor (K_{eff}). Subsection 5.1.3.1 discusses the design and materials used to provide criticality safety.

10.4.1 Criticality Design Criteria and Features

The criticality safety design criteria are found in Subsection 3.3.4, Nuclear Criticality Safety, of the TSAR. All source casks and receiving casks used at the DTS will be licensed by the NRC. The criticality evaluation for these casks will be conducted during the licensing of these casks and therefore will not be repeated in this AR. The source cask and the receiving cask each contain a fuel basket that has been prepared to provide for criticality safety. The fuel baskets may contain both neutron poison materials and neutron flux traps to control the reactivity of the fuel basket configuration. Because only a single assembly will be outside the casks at any time, there are no conditions that could exist within the installation that would not be bounded by the criticality licensing evaluations performed for the casks. Therefore, no additional criticality calculations were performed in the TSAR. The TSAR has not discussed how the criticality monitoring requirements of 10 CFR 72.124(c) have been met.

10.4.2 Stored Material Specifications

The system is a DTS, which has only a single fuel assembly out of a cask at any one time. No specific methods are utilized or necessary for criticality control within the DTS because no condition can exist within the installation that is not bounded by the criticality licensing evaluation performed for the casks.

10.4.3 Analytical Means

No review was conducted of the analytical means of the criticality evaluation because no condition can exist within the DTS that is not bounded by the criticality licensing evaluation performed for the casks.

10.4.4 Applicant Criticality Analysis

No review was conducted of the applicant criticality analysis because no condition can exist within the DTS that is not bounded by the criticality licensing evaluation performed for the casks.

10.5 Evaluation Findings

Based on review of the information presented in Subsection 3.3.4, Nuclear Criticality Safety, of the TSAR, the following evaluation findings can be made about the TSAR.

10.5.1 Criticality Design Criteria and Features

- The NRC staff has reviewed the information presented in the TSAR and found that the design, procedures, and materials to be stored for the proposed DTS provide reasonable assurance that the activities authorized by the license can be conducted without endangering the health and safety of the public, in compliance with 10 CFR 72.40(a)(13). The NRC staff also found that the designs and proposed use of the DTS handling, packaging, and transfer systems for the radioactive materials to be stored acceptably 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 in compliance with 10 CFR 72.124(a).

10.5.2 Stored Material Specifications

- The NRC staff has reviewed the information presented in the TSAR and found that the description of the stored material specifications is sufficient to provide reasonable assurance that the facility is in compliance with the criticality safety requirements in 10 CFR 72.40(a)(13) and 72.124(a) and (b).

10.5.3 Analytical Means

- The NRC staff has reviewed the information presented in the TSAR and found that the analytical means used by the applicant to demonstrate criticality safety is sufficient to provide reasonable assurance that the facility is in compliance with the criticality safety requirements in 10 CFR 72.40(a)(13) and 72.124(a) and (b).

10.5.4 Applicant Criticality Analysis

- The NRC staff has reviewed the information presented in the TSAR and found that the applicant criticality analysis is sufficient to provide reasonable assurance that the facility is in compliance with the criticality safety requirements in 10 CFR 72.40(a)(13) and 72.124(a) and (b).

10.6 References

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report.* Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

11 CONFINEMENT EVALUATION

11.1 Review Objective

The objective of the confinement review and evaluation is to determine whether: (i) radiological releases to the environment are within the limits established by the regulations, (ii) the public exposures to radiation released from the installation are within regulatory limits for normal and accident-level events and conditions, and (iii) the SNF cladding and fuel assemblies are acceptably protected during storage against degradation caused by the environment that could result in gross rupture of the materials, releasing radiation to the environment. Because the TSAR (U. S. Department of Energy, 1996) is not site-specific, a complete review of confinement as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

11.2 Areas of Review

The following listing shows the areas of review addressed in Section 11.4, Conduct of Review:

Confinement Design Characteristics

Storage Confinement Casks
Pool and Waste Treatment Facility Confinement
Ventilation-Offgas System Design Features

Confinement Monitoring Capability

Monitoring Sealing of Storage Confinement Casks
Monitoring Pool Facility Confinement
Monitoring Waste Management Facility Confinement

Nuclides with Potential for Release

Confinement Analyses

General
Failure of Spent Fuel Rods
Normal Conditions
Off-Normal Conditions
Accident-Level Conditions

Estimated Offsite Collective Dose Assessment

Protection of Stored Materials from Degradation

11.3 Regulatory Requirements

This section identifies and presents a summary of 10 CFR Part 20 and Part 72 sections relevant to the review areas addressed by this chapter. The applicable regulatory requirements for 10 CFR Parts 20 and 72 for confinement evaluation are:

- 20.1101(d)
- 20.1201

- 20.1202
- 20.1203
- 20.1204
- 20.1301
- 20.1302
- 72.24(c), (d), (f) and (l)(1)
- 72.44(c)(1) and (i)
- 72.90(e)
- 72.98(b)
- 72.100(a)
- 72.104
- 72.106
- 72.122(h)(1, 3, and 4)
- 72.126(c) and (d)
- 72.128(a)(1 and 3)

11.4 Conduct of Review

The description of the confinement capability of the DTS is located in Subsection 3.3.2, Multiple Confinement Barriers and Systems, of the TSAR (U.S. Department of Energy, 1996), DOE responses to the NRC RAIs (Stewart, 1999a,b), and documents cited in the TSAR and RAI responses. Confinement areas within the DTS will include the LAA and the TCA, but not the cask PA.

11.4.1 Confinement Design Characteristics

The DTS provides a barrier to prevent an accidental release of radioactive particulate matter into the environment and to keep doses from exceeding radiological protection limits. The particulate materials are confined in a series of two barriers—cladding on the fuels and the storage cask while the casks are sealed or the building structure while transfers are occurring. It would take the simultaneous failure of both barriers before any particulate materials could be released. The HVAC ventilation subsystem controls and confines potential releases of contaminants that could be released to the environment. Additionally, the HVAC maintains pressure differentials such that air flows from areas of lower levels of potential contamination to areas of higher levels of potential contamination during abnormal occurrences.

While the fuel is being transferred, the building will be a confinement barrier to the release of radioactive materials. This barrier will consist of the sliding door equipped with inflatable seals, the concrete structure, the protective cover with the gasket seals between the cover and the concrete structure, and the HVAC filters. The receiving and source casks will be mated with the mezzanine floor of the TCA during transfers through the use of bellows and seals. After the sliding door is closed, a seal around the door will be maintained as an additional safety shield for the postulated accidents. This confinement barrier will not allow the release of particulate material to the outside environment during normal operating conditions.

Normal access to the DTS restricted area is through a single guarded access point. Access to the potentially contaminated area is controlled through the control system. Only personnel with special access privileges will be allowed to enter the area. Health physics personnel will monitor the entrance point. There is also a sliding door, interlocked with the radiation monitoring subsystem. The sliding door prevents access to the LAA during fuel transfer procedures, or when a loaded cask is open. Before opening the access point, the radiation levels are checked by the PLC. If the radiation levels are acceptable and access is authorized, the sliding door will open. However, if radiation levels are above the acceptable limit, the authorization to enter is denied and the door will not open.

NRC staff finds that the confinement design of the DTS is acceptable and provides reasonable assurance that doses to workers and members of the public will be within regulatory limits.

11.4.2 Confinement Monitoring Capability

The exhaust stack of the DTS is equipped with a continuous air monitor. This monitor samples and monitors airborne particulates, iodine, and noble gases. It allows monitoring of radiation levels throughout operations and permits prompt personnel actions if an alarm situation occurs. The following features are included in the system:

- Display at each detector location and remote display at the PA and the Control Center
- Warning for low-level detection
- Alarms for high-level detection, detector failure, and low battery
- Audible and visible alarms at each detector, the PA, and the control room
- Battery backup of monitoring equipment
- Remotely operated check source
- Associated electronic equipment and cabling

11.4.3 Nuclides with Potential for Release

During normal operations, it is assumed that all fuel rods are intact because any damaged fuel rods will not be accepted for transfer at the DTS. Therefore, the only material that may be released during normal operations is the crud that accumulates on the exterior of the fuel rods. This material is primarily composed of Co-60.

During off-normal conditions, the fuel cladding of 10 percent of the fuel rods could be breached, making more radionuclides available for release. The analysis considered a 30 percent release of fission gases, Kr-85, noble gases, tritium, and iodine (which is treated as a gas). Cs-134, Cs-137, Sr-90, and Ru-106 are volatile materials that could be released. Also, as documented in the response to round two RAI 7-2 (Stewart, 1999b), a small fraction of the particulate material within the fuel rods may be released. The off-normal condition table also provided in the response to round two RAI 7-2, shows that tritium has the largest dose contribution of these potential releases from the fuel assemblies at the 100-meter point offsite. During accident conditions, the radionuclide release fraction assumed is the same as for off-normal conditions, but it is assumed that all fuel rods have cladding breaches and the ventilation subsystem is failed. The TSAR calculates the impacts of the release of gaseous radionuclides, but does not calculate the dose from particulate and volatile radionuclides.

NRC staff finds that the calculation of airborne releases of radioactive material from the DTS facility sufficiently bounds conditions such that the potential inputs of normal and off-normal conditions will not be significantly underestimated.

11.4.4 Confinement Analyses

The design of the DTS is such that, during normal operations, a small amount of material could become airborne in the DTS. Material that may spill from the fuel assemblies during the fuel transfer process is expected to be retained by a crud catcher and dropped into the receiving cask. Small amounts of airborne material will be carried to the HEPA filtration unit. All releases from the DTS will pass through the exhaust stack and be filtered by a HEPA filtration unit.

During off-normal conditions, it is assumed that two fuel assemblies fail during transfer such that their contents, including fission gases, volatiles, and particulate, are released to the exhaust stack and the HEPA filter.

During accident conditions, it is assumed that one fuel assembly fails during transfer such that its contents are released and that the release is unfiltered. The TSAR calculates the impacts of the release of gaseous radionuclides during accident conditions only. Doses to workers from airborne radionuclides are expected to be minor in comparison with doses from direct exposures and will not significantly impact the collective exposure to workers as reviewed in Chapter 9 of this AR. NRC staff finds that the confinement analysis under normal and off-normal conditions for the DTS facility is sufficient such that the potential impacts will not be significantly underestimated.

11.4.5 Estimated Offsite Collective Dose Assessment

Doses to members of the public resulting from an airborne release were calculated for receptors located at 100 and 500 meters from the transfer building. The results for normal, off-normal, and accident conditions are shown in Table 11-1.

These annual doses are substantially less than the dose limit of 25 mrem/yr in 10 CFR 72.104 and the airborne pathway dose limit of 10 mrem/yr in 10 CFR 20.1101(d) and, therefore, are considered acceptable. However, because the accident dose does not include volatile or particulate radionuclides, it has not been demonstrated that the dose limits in 10 CFR 72.106 have been met.

Table 11-1. Dose rates from postulated airborne releases at the Dry Transfer System

Location	Normal Conditions (mrem/yr)	Off-Normal Conditions (mrem/yr)	Accident Conditions (Gaseous Radionuclides Only) (mrem/accident)
100-meter receptor	2.72	0.58	721
500-meter receptor	0.21	0.044	39.6

11.4.6 Protection of Stored Materials from Degradation

The source cask and the receiving cask will be licensed by the NRC prior to use at the DTS. The LA for these casks will address the degradation of the fuel while it is inside the casks. Therefore, the degradation of the fuel within the casks was not evaluated for this AR.

Because fuel is transferred in air, the temperature of the fuel assemblies must be maintained at a temperature within design limits during the temporary storage and transfer time within the DTS. The licensee has demonstrated that the integrity of the design basis fuel for the DTS will not be threatened by the temperature increase during transfer. The limited transfer times and the maximum temperature of the fuel reached during transfer ensure that the fuel assembly will not degrade substantially due to oxidation.

11.5 Evaluation Findings

Based on review of the information in the TSAR and RAIs, the following evaluation findings can be made about the DTS release.

11.5.1 Confinement Design Characteristics

- The NRC staff has reviewed the information presented in the TSAR and found that the generic design of the DTS provides reasonable assurance that the ventilation and offgas subsystems will ensure the confinement of airborne radioactive particulate materials during normal or off-normal conditions, in compliance with 10 CFR 72.126(d) and 72.128(a)(3).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.122(h)(3):

- The design details of the ventilation and offgas subsystems.

11.5.2 Confinement Monitoring Capability

- The NRC staff has reviewed the information presented in the TSAR and has reasonable assurance that the generic design of the DTS provides for continuous monitoring of the effectiveness of confinement, in compliance with 10 CFR 72.44(c)(1)(i), 72.126(c), and 72.128(a)(1).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.122(h)(4):

- The details of the confinement monitoring equipment and related procedures to be employed at the DTS facility.

11.5.3 Nuclides with Potential for Release

- The NRC staff has reviewed the information presented in the TSAR and has reasonable assurance that the nuclides with potential for release have been described in accordance with 10 CFR 72.24(l)(1) such that offsite doses from airborne releases can be calculated.

11.5.4 Confinement Analyses

- The NRC staff has reviewed the information presented in the TSAR and found that the confinement analysis by the applicant provides reasonable assurance that radioactive materials released to the atmosphere during normal or off-normal conditions, which will ensure compliance with 10 CFR 20.1301 and 20.1302, will not cause a dose to a worker that exceeds the limits of 10 CFR 20.1201 as calculated in accordance with 10 CFR 20.1202 and 20.1203 or cause a dose to a member of the public to exceed the limits of 10 CFR 72.104.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of the regulations:

- A description of how internal exposures will satisfy the requirements of 10 CFR 20.1204.

11.5.5 Estimated Offsite Collective Dose Assessment

- The NRC staff has reviewed the information presented in the TSAR and found that the estimated offsite dose assessment by the applicant provides reasonable assurance that radioactive materials released to the atmosphere during normal and off-normal conditions will not cause a dose to a member of the public to exceed the limits of 10 CFR 72.104 in accordance with 10 CFR 20.1101(d), 72.90(e), 72.98(b), and 72.100(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of the regulations:

- A demonstration that radioactive materials released to the atmosphere during accident conditions will not cause a dose to a member of the public that exceeds the limits of 10 CFR 72.106.

11.5.6 Protection of Stored Materials from Degradation

- The NRC staff has reviewed the information presented in the TSAR and found that the design of the DTS provides reasonable assurance that the stored materials will be protected from degradation, in compliance with 10 CFR 72.24(c), (d), (f), and (l)(1), and 72.122(h)(1).

11.6 References

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report.* Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

12 ACCIDENT ANALYSIS

12.1 Review Objective

The objectives of the accident analysis review are to ensure that all credible off-normal and accident events have been identified and that all of the potential consequences with safety implications have been acceptably considered. Off-normal events are defined as those events that are expected to occur with moderate frequency or once per calendar year. ANSI/ANS 57.9-1992 (American National Standards Institute and American Nuclear Society, 1992) refers to these events as Design Events I or II. Accident events are considered to occur infrequently, if ever, during the lifetime of the facility. ANSI/ANS 57.9-1992 subdivides this class of accidents into Design Event III, a set of infrequent events that could be expected to occur during the lifetime of the DTS, and Design Event IV, events that have been postulated because they establish a conservative design basis for SSCs important to safety. Chapter 8, Accident Analyses, of the TSAR made no distinction between Design Events I and II or Design Events III and IV. The effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches are considered accident events. However, floods, tsunami, and seiches were not addressed in the TSAR (U.S. Department of Energy, 1996) because the DTS is to be located at a site where the probability of occurrence is sufficiently low to consider them noncredible events. Because the TSAR is not site-specific, a complete accident evaluation as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

12.2 Areas of Review

The following listing shows the areas of review addressed in Section 12.4, Conduct of Review. The subheadings correspond to those identified in the TSAR and DOE responses to NRC RAIs (Stewart, 1999a,b,c).

Off-Normal Events

Failure of the Cask Transfer Subsystem
Failure of the Cask Mating Subsystem
Failure of the Transfer Confinement Port Covers and Related Instrumentation
Failure of the Upper Shield Port Covers and Related Instrumentation
Failure of the Upper Crane and Related Instrumentation
Failure of the Fuel Assembly Handling Equipment
Failure of the HVAC Subsystem Components
Failure of the Control Subsystem Components
Failure of the Radiation Monitoring Equipment
Failure of Equipment in the PA
Loss of External Power Supply for up to 24 Hours
Off-Normal Thermal Loads
Heavy Snow Storm
Lightning

Accidents

Loss of the External Power Supply for an Extended Interval
Stuck Fuel Assembly or Inability to Insert a Fuel Assembly into a Cask
Failure of the Fuel Grapple to Disengage
Seismic Loading
Tornado Missiles, Hurricanes, and High Winds
Fire
Major Mechanical Malfunction Involving the Spent Fuel Handling System During Operation Resulting in Dropping of a Fuel Assembly
Complete Loss of HEPA Filters and Loss of Pressure Differential
Loss of a Shield Plug or Source Cask Lid
Electrical Surges and Explosions

Site Characteristics Affecting Safety Analysis

12.3 Regulatory Requirements

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

- 20.1201
- 72.11
- 72.24
- 72.26
- 72.40(a)(1 and 13)
- 72.44(c)
- 72.90
- 72.92
- 72.94
- 72.102(f)
- 72.104
- 72.106
- 72.120(a)
- 72.122
- 72.124
- 72.128(a)

12.4 Conduct of Review

The NRC staff evaluated the accident analyses by reviewing Chapter 8, Accident Analyses, and other relevant chapters of the TSAR (U.S. Department of Energy, 1996), DOE responses to the NRC RAIs (Stewart, 1999a,b,c), and documents cited in the TSAR and RAI responses.

The review varied in complexity within each evaluation. In general, the evaluations reviewed the environment, physical parameters, methodology used, actual analysis, and results and interpretation performed by the DOE.

Dead-weight loads are incorporated into the analysis of all normal, off-normal, and accident conditions that may challenge the structural integrity of the DTS. The DTS structure is comprised of a reinforced concrete foundation mat and walls, with concomitant structural steel support systems for the protective cover, roof plate, and mezzanine floor. The dead weight of each component was calculated using their respective nominal dimensions and the results listed in Tables corresponding to the specific responses given for round one RAIs 8-16 and 8-24 (Stewart, 1999a) and round two RAIs 3-6, 8-2, 8-5, and 8-7 (Stewart, 1999b). These loads were combined with other relevant loads to evaluate normal, off-normal, and accident conditions per the recommendations of ACI 349-95 (American Concrete Institute, 1995).

12.4.1 Off-Normal Events

The off-normal events are described in Section 8.1, Off-Normal Events, of the TSAR. The TSAR distinguishes off-normal events from accident events by using the criteria of ANSI/ANS 57.9-1992 (American National Standards Institute and American Nuclear Society, 1992). That is, using the definitions of ANSI/ANS 57.9-1992, off-normal events are analogous to Design Events I or II. These events are expected to occur regularly or frequently in the course of normal operation or can be expected to occur with moderate frequency or on the order of once during a calender year of operation.

This section discusses the results from the review of the postulated SSC failures and off-normal operating loads that meet the Design Events I or II criteria, (i.e., off-normal events for which the DTS safety-related SSCs are designed). In addition to providing descriptions of the SSC failures and off-normal design basis accidents for the DTS that meet the off-normal event criteria, the TSAR also includes analyses that demonstrate the adequacy of the design safety features of the DTS to mitigate the effects of these events. The SSC failures and loads that are considered to be off-normal events include: (i) failure of the CTS, (ii) failure of the CMS, (iii) failure of the TC port covers and related instrumentation, (iv) failure of the upper shield port covers and related instrumentation, (v) failure of the upper crane and related instrumentation, (vi) failure of the fuel assembly handling equipment, (vii) failure of the HVAC subsystem components, (viii) failure of the control subsystem components, (ix) failure of the radiation monitoring equipment, (x) failure of equipment in the PA, (xi) loss of external power supply for up to 24 hours, (xii) off-normal thermal loads, (xiii) heavy snow storm, and (xiv) lightning. The review of each of these events includes (i) a discussion of the cause of the event, (ii) the means of detection of the event, (iii) an analysis of the effects and consequences, and (iv) the actions required to return the system to a normal situation. Radiological impact from each of the off-normal events is assessed.

12.4.1.1 Failure of the Cask Transfer Subsystem

Reviews of the potential impact of a CTS failure included Subsections 1.2.3.1, 1.3, 3.1.2, 3.3.3.1, 3.4, 3.6, 4.1, 4.3.7.2, 5.1, 5.2.1, 5.4.1.1, 5.4.1.2, 5.5, 5A.5.2.1, 5A.7, 8.1.2.1.1, 9.2, 10.1, and 10.2 of the TSAR (U.S. Department of Energy, 1996); the responses to round one RAIs 3-18, 3-21, 3-22, 4-1, 5-1, 5-2, 5-3, 5-4, 5-9, 8-2, 8-3, 8-4, 8-5, 8-6, 8-12, 8-13, 8-24, 8-32, 9-2, 10-3, 10-4, and 10-6 (Stewart, 1999a); and responses to round two RAIs 1-1, 3-5, 5-1 through 5-4, 5-6, 5-7, 5-9, 5-10, 8-3, and 8-6, as well as Table 4 of the attachment (Stewart, 1999b).

The CTS consists of two trolleys mounted on one set of rails. The receiving and source casks are mounted in a vertical orientation on their respective trolleys in the cask receipt area. The casks are subsequently repositioned to the PA and the LAA of the DTS via the trolley-rail CTS. Each trolley is motor driven and operated using the local control panels outside and inside the PA and LAA. The trolleys support their respective casks during all operations within the DTS. The trolleys are locked into place manually once they are positioned properly. The CTS has been designated as an SSC important to safety.

The trolleys are moved into and out of the LAA using the LAA control panel that has the same functions as the PA control panel. The two control panels are key operated so that only one can be activated at any given time. When the cask trolley is moved to the LAA, the CMS cannot be lowered into place if the trolley locking pin sensor does not verify that the locking pin is engaged. Table 5.4-2 of the TSAR lists the required instrumentation for the CTS.

The following off-normal events associated with the CTS were postulated:

- The trolley will not move
- The trolley is incorrectly positioned
- The trolley moves without activation
- The limit switch fails to stop the trolley motion
- The trolley will not lock
- The trolley will not unlock
- The cask is not secured on the trolley
- The cask will not fit on the trolley
- The cask will not come off of the trolley

The applicant assumed in the TSAR that there are no radiological consequences associated with any postulated failure of the CTS. The justification given for this assumption is that the cask lid and plug will always be in place (but not necessarily sealed) whenever the CTS is used to reposition the trolleys and the brakes and locking pin will be engaged otherwise.

The detection of the inability of a trolley to move will be accomplished visually or electronically via the positioning sensors. This event may be the result of a motor failure, a failure of the brakes to disengage, a lock that is still engaged, or the jamming of the trolley.

If a trolley is incorrectly positioned, the cause can be attributed to a failed positioning sensor or a fault in the control subsystem. An incorrect position would be indicated by the inability to lock the trolley in place. To circumvent the problem, the trolley would be placed in the proper position manually until maintenance can be performed.

An unintended movement of the trolley can occur as a result of operator error, control subsystem malfunction, or an earthquake. This unintended movement could cause a collision between the two trolleys or the collision of one of the trolleys with either the LAA wall or sliding confinement door. Unintended movement should only occur during active repositioning of the trolley because, once in place, the trolley brakes and the lock pin designed to withstand seismic loads are engaged. Trolley bumpers are employed to mitigate any damage caused by an inadvertent collision. In addition, limit switches are mounted on the front and back of each trolley and at the end of the runway rails as well to stop any further motion if a collision does occur. Other limit switches are used to facilitate the proper positioning of the trolleys as they are moved in and out of the PA and LAA. If a limit switch fails to stop the trolley from moving, it is the operator’s responsibility to stop the trolley. The TSAR did not indicate what mechanisms or procedures are available to the operator to accomplish this task.

If the trolley lock pin does not engage, it is because the trolley is not in the proper position or the locking jack is not working properly. The detection of this event is accomplished by simple visual inspection and/or by way of the locking pin and positioning sensors.

If it is found that the trolley will not move because the locking pin will not retract, the locking jack will be repaired or replaced.

The cask is attached to the trolley manually. As a consequence, any difficulties in securing, fitting, and/or removing the cask from the trolley are addressed on contact. These manual procedures may result in increased worker radiation doses due to extended periods of time spent in close proximity to the cask.

Table 7.2.2.Δ in Appendix 5A of the TSAR lists the various types of sensors used in the CTS, the possible repercussions of their failure, the means used to detect their failure, and the compensating provisions taken to mitigate the effects of their failure. The functionality and uses of the proposed sensors are adequate, but more detailed information is required to assess their operating limitations.

Table 4 of the response to round one RAI 8-2 (Stewart, 1999a) provides the postulated failure modes for the CTS, the most probable cause for the failure, the possible effects of the failure, how the failure is detected, and the compensating provisions to recover from the failure. The guidelines provided in this table are acceptable except for those instances previously noted. In addition, details of the compensating provisions still need to be provided so the ability to recover and resume operations can be assessed more fully.

Moreover, from review of Subsection 4.3.7.2 of the TSAR, it is not clear as to what alarms, if any, would be automatically initiated as a result of any of the postulated failures of the CTS.

12.4.1.2 Failure of the Cask Mating Subsystem

Reviews of the potential impact of a CMS failure included Subsections 1.1.2, 1.2.3.2, 1.3, 3.1.2, 3.3.2, 3.3.3.1, 3.4, 4.1, 4.3.7.2, 5.1, 5.2.2, 5.4.1.1, 5.4.1.3, 5A.5.2.2, 5A.7, 7.3.1.4, 8.1.2.1.2, 8A.3, 9.2, 10.1, and 10.2 of the TSAR (U.S. Department of Energy, 1996); the responses to round one RAIs 3-21, 3-22, 4-1, 5-1 through 5-4, 5-9, 8-2 through 8-6, 8-33, 9-2, 10-4, and 10-6 (Stewart, 1999a); and responses to round two RAIs 1-1, 5-1 thru 5-4, 5-6, 5-7, 5-9, 5-10, and 8-3, as well as Table 2 of the attachment (Stewart, 1999b).

The CMS mates the casks with the floor of the TCA to provide a confinement barrier between the cask and the mezzanine floor. The CMS works in conjunction with the ventilation subsystem to prevent the spread of contaminated particulates from the TCA to the LAA by maintaining a pressure differential between the TCA and LAA so that the air flow is always directed toward the TCA under normal operating conditions. The CMS has not been designated an important to safety SSC.

The two CMSs (i.e., one for the source cask and the other for the receiving cask), are comprised of an overlid with a gripping device, confinement bellows, and a motorized annular platform, which supports the overlid. The overlid protects the upper surface of the cask lid from contamination. The gripping device is activated by a drive shaft, which is driven by the motorized grapple of the upper crane. The confinement bellows, the annular platform, and a static seal between the annular platform and the top surface of the cask provide the confinement barrier between the TCA and the LAA. The vertical position of each CMS is controlled by three electrical screw jacks. The CMS is structurally supported by the mezzanine steel plate.

The overlid contains a gripping device that is used to grasp/engage the lifting pintle on the cask lid or shield plug so they can be removed. The gripping device is operated by a drive screw activated by the motorized grapple of the upper crane. The functional objective of the overlid-gripper mechanism is to provide a means for removing the cask lid or shield plug without allowing contaminated particulates to come in contact with the cask. All of the load bearing components of the overlid-gripper mechanism have been designated important to safety components.

The materials of the CMS have been selected for their radiation resistance. In particular, the bellows are made of silicon coated polyester fabric, which has a minimum integrated dose design value of 10^7 rad. Note that the maximum operating temperature of this material is 240 °F (115 °C). The bellows and seals will be replaced during each maintenance cycle, which occurs after loading 10 receiving casks (approximately every 100 days).

The three electrical jacks used to raise and lower the annular platform are mounted on spherical bearings. These jacks operate independently and allow for angular and axial misalignment between the cask and the CMS.

The annular platform lowering operation is interlocked with its concomitant cask trolley locking device to prevent the platform from being lowered if the cask trolley is not locked in place. This procedure ensures that the cask cannot be opened without the trolley being locked. Moreover, the cask mating status is also used by the PLC to manage the HVAC subsystem. Redundant instrumentation is not provided for the control of the annular platform. Redundancy is provided, however, for each jacks proper position detection by way of the CCTV subsystem. Table 5.4-3 of the TSAR lists the required instrumentation for the CMS.

The following failures of the CMS were postulated:

- The annular platform will not lower
- The annular platform only partially lowers
- The annular platform lowers without activation
- The annular platform is positioned incorrectly
- The annular platform cannot be lifted
- The annular platform only partially lifts
- The annular platform lifts without activation
- The seals are damaged
- The bellows tear or are punctured
- The electric jack vertical positioning is erroneously reported to the PLC
- The load sensor on an electrical jack reads higher than actual
- The load sensor on an electrical jack reads lower than actual

According to the TSAR, there are no radiological consequences associated with any postulated failure of the CMS. The justification given for this assumption is that the HVAC ventilation subsystem can maintain sufficient negative pressure within the TCA to avoid particulate release to the LAA. The TSAR postulates that this is true even if there are breaches in the CMS. In addition, there would be no particulate release to the environment because the sliding door and concrete structure provide a barrier to the PA and the outside. If possible, the casks would be moved into the PA prior to performing maintenance and repair operations.

All of the postulated failures of the CMS, other than breaches in the seals and/or bellows, can be attributed to failures of the load sensor, positioning sensor, electrical jack, and/or control subsystem. These events would be detected by at least one of the following (i) the load or positioning sensors themselves (if operational), (ii) a timing device in the PLC that would indicate the operation is taking too long to perform, and/or (iii) visually using the CCTV subsystem. Damage to the CMS could occur if a cask was moved into the LAA when the platform was in the wrong position. Furthermore, if the platform were to lift without activation during the SNF transfer process, particulates may be released into the LAA if the pressure differential with the TCA is not sufficient. There is an interlock, however, that will keep the CMS from detaching (i.e., from being raised) during the fuel transfer process.

The electrical screw jacks have been designed to withstand seismic and static loads. For static loads, factors of safety of 6, with respect to yield; and 10, with respect to ultimate strength, have been used. For seismic loads, the allowable normal stress is 0.9 Δ_y /1.2, and allowable shear stress is 0.5 Δ_y /1.2. Note that an extra safety factor of 1.2 was employed in establishing the allowable stress limits and Δ_y is the yield stress of the material. The NRC staff could not confirm the calculations for the electrical screw jack stress analysis because the details were not provided.

Calculated shear stress values for the CMS cask lid gripper fingers are compared to the allowable normal stress values to establish factors of safety in Appendix 8.A.3 of the TSAR. Moreover, detailed stress calculations for the overlid-gripper device have not been provided. As a consequence, the NRC staff could not assess if the overlid is thick enough to support the local stress concentrations that exist where the gripper finger pins are located.

Table 7.2.2.Δ in Appendix 5A of the TSAR lists the various types of sensors used in the CMS, the possible repercussions of their failure, the means used to detect their failure, and the compensating provisions taken to mitigate the effects of their failure. The functionality and uses of the proposed sensors are adequate, but more detailed information is required to assess their operating limitations.

Table 2 of the response to round one RAI 8-2 (Stewart, 1999a) provides the postulated failure modes for the CMS, the most probable cause for the failure, the possible effects of the failure, how the failure is detected, and the compensating provisions to recover from the failure. The guidelines provided in this table are acceptable except for those instances previously noted. In addition, details of the compensating provisions still need to be provided so the ability to recover and resume operations can be assessed more fully.

12.4.1.3 Failure of the Transfer Confinement Port Covers and Related Instrumentation

Reviews of the potential impact of the TC port covers and/or related instrumentation failures included Subsections 1.2.3.3, 1.3, 3.1.2, 3.3.2, 3.4, 3.6, 4.1, 4.3.7.2, 5.1, 5.2.3, 5.4.1.1, 5.4.1.4, 5A.5.2.3, 5A.7, 8.1.2.1.3, 8A.4, 9.2, and 10.2 of the TSAR (U.S. Department of Energy, 1996); the responses to round one RAIs 3-21, 3-22, 4-1, 5-1, 5-2, 5-3, 5-4, 5-8, 8-2, 8-3, 8-4, 8-5, 8-6, 9-2, and 10-6 (Stewart, 1999a); and responses to round two RAIs 1-1, 5-1 through 5-4, 5-6, 5-7, 5-9, and 5-10, as well as Question 1 and Tables 3 and 5 of the attachment (Stewart, 1999b).

The TC port covers are used for storing the MPC shield plug and source cask lid during fuel transfer. The TC port covers consist of rail mounted trolleys activated by electrical screw jacks that are structurally supported by the mezzanine steel plate. One port cover is positioned above each cask opening in the mezzanine floor plate. The openings allow access into the casks from the TCA for the lid and shield plug grapple and the fuel assembly grapple. A guidance device is mounted on each TC port cover so the cask lid or shield plug can be positioned accurately onto the port cover during fuel transfer operations. The design details for this guidance device were not provided. The main structural components of the TC port covers are made from carbon steel that is painted with a Category A–Service Level 1 coating as defined in ASME NOG–1 (American Society of Mechanical Engineers, 1995).

All of the load carrying components of the cask shield plug and lid handling subsystem have been designated as important to safety. The rationale for this designation is that it would be difficult to recover from an event where the cask shield plug and/or lid were dropped into an inaccessible position. The TC port covers themselves have not been designated important to safety, however.

A locking pin that penetrates into a hole in the mezzanine plate prevents the port cover from accidentally closing when fuel is being transferred (the port covers can only be locked in the open position). The locking pin is jack operated and can be accessed through a penetration in the wall of the DTS for manual operation in the event of equipment failure. Electrical contacts in the mezzanine plate and the jacks are used to verify locking pin engagement.

The motors for the electrical screw jacks that control the positioning of the port covers are located outside the TCA to facilitate their repair or replacement in case of failure. This placement renders the motors and screw jacks susceptible to damage by tornado winds.

The TC port covers are interlocked with other subsystems so that the port cover cannot be unlocked and/or closed while: (i) the fuel assembly crane carriage is in motion, (ii) the fuel assembly grapple is engaged, (iii) the fuel assembly handling hoist is loaded, and/or (iv) the lid/shield hoist system has not cleared the TC port cover height. Other interlocks prevent the TC port covers from opening prematurely (i.e., LAA sliding confinement door has not been closed and locked into position or if the other casks' upper shield cover is not closed and locked into place).

The following failures of the TC port covers were postulated:

- The TC port cover not opening or closing
- The TC port cover spontaneously opening or closing
- The TC port cover not fully opening or closing
- The TC port cover lock will not engage or disengage
- An erroneous TC port cover lock sensor signal
- A TC port cover limit switch failure

According to the TSAR, there are no radiological consequences associated with any postulated failure of the TC port covers.

The most probable causes for a TC port cover not to move when instructed can be attributed to a failure of the electrical screw jack used to reposition the port cover or a derailment of the port cover itself. The TSAR did not elaborate on the consequences of a port cover derailment or how this failure scenario would be resolved, which could be quite difficult if the cask lid or shield plug were being supported by the port cover at the time of derailment.

The LAA could potentially become contaminated if the port cover were to open spontaneously, which could occur if there was a spurious PLC signal, an error in the processor, or operator error.

If the locking pin engagement sensor was to transmit erroneous locking pin information to the PLC, then an improper validation of a safety condition could occur. Table 8.1-3 of the TSAR contends that an alarm would be initiated, but the alarm would not activate if the sensor indicated that the locking pin were shown to be engaged when the port cover was open. That is to say, the only method for failure detection would occur if the locking pin sensor were to indicate locking pin engagement while the port cover were in a position other than the open position. Possible causes for this scenario are a spurious signal or sensor failure.

A mechanical or electrical failure would be the cause of the locking pin to fail to engage or disengage. In either case, an alarm signal would be initiated and subsequent operations would be suspended. No estimates were provided for the amount of radiation exposure this would subject the DTS personnel.

A TC port cover limit switch failure could lead to erroneous positioning information to the PLC or no information at all. Alarms would be initiated if the positioning sensors and sequence time out requirements were not in agreement.

In response to NRC staff concerns over the stability of the source and cask lids on the TC port covers during a seismic event, restraints designed to keep the lids in position during this scenario were added to the TC port covers.

Table 7.2.2.Δ in Appendix 5A of the TSAR lists the various types of sensors used in the Transfer Confinement Port Covers Subsystem, the possible repercussions of their failure, the means used to detect their failure, and the compensating provisions taken to mitigate the effects of their failure. The functionality and uses of the proposed sensors are adequate, but more detailed information is required to assess their operating limitations.

Table 3 of the response to round one RAI 8-2 (Stewart, 1999a) provides the postulated failure mode, the most probable failure cause, the possible effects of the failure, how the failure is detected, and compensating provisions to recover from the failure. The guidelines provided in this table are acceptable except for those instances previously noted. In addition, details of the compensating provisions still need to be provided so the ability to recover and resume operations can be assessed more fully.

12.4.1.4 Failure of the Upper Shield Port Covers and Related Instrumentation

Reviews of the potential impact of the upper shield port covers and related instrumentation failures included Subsections 1.2.3.4, 1.3, 3.1.2, 3.3.2, 3.3.3.1, 3.4, 4.1, 4.3.7.2, 5.1, 5.2.4.1, 5.4.1.1, 5.4.1.5, 5A.5.2.4.4, 5A.7, 8.1.2.1.4, 8A.4, 9.2, and 10.2 of the TSAR (U.S. Department of Energy, 1996); the responses to round one RAIs 3-21, 3-22, 4-1, 5-1 through 5-4, 8-2 through 8-6, 9-2, and 10-6 (Stewart, 1999a); and the response to round two RAIs 1-1, 5-1, through 5-7, 5-9, and 5-10 (Stewart, 1999b).

The upper shield port covers and the equipment that controls their opening and closing are one of two parts of the receiving cask shield plug and source cask lid handling subsystem. The second part is the upper crane. The upper shield port covers provide additional shielding to the REA, where the upper crane is located. A locking device is designed to prevent inadvertent opening or closing once the covers have been positioned in the open or closed position. The upper shield port covers and their respective locking devices have been designated as important to safety SSCs.

The upper shield port covers are interlocked with the radiation monitoring subsystem so they cannot be opened during the fuel transfer process. In addition, the upper shield port covers cannot be opened at any time if the radiation monitor located in the REA indicates that the radiation level is too high.

The upper shield port covers and the upper crane will be maintained on contact in the REA. A sealed door is provided for access to this area by maintenance personnel. Maintenance activities will not be performed in this area when fuel is being transferred or while either cask is open.

The following failures of the upper shield port covers were postulated:

- The upper shield port cover not opening or closing
- The upper shield port cover spontaneously opening or closing
- The upper shield port cover lock will not engage or disengage
- An erroneous upper shield port cover lock sensor signal
- A upper shield port cover limit switch failure

According to the TSAR, there are no radiological consequences associated with any postulated failure of the upper shield port covers.

The most probable cause for an upper shield port cover not to move when instructed can be attributed to a failure of the electrical screw jack used to reposition the port cover, failure of the locking pin to disengage, a derailment of the port cover itself, and/or an interlock requirement not being satisfied. The inability for the port cover to move would be detected via the redundant position sensors and/or the inability to engage the locking pin. If such an event was to occur, subsequent operations within the DTS would have to be suspended until the proper repairs could be made. The TSAR did not elaborate on the consequences of an upper shield port cover derailment or how this failure scenario would be resolved.

The REA could potentially become contaminated if an upper shield port cover was to open spontaneously. Conversely, a spontaneous closing of an upper shield port cover could cause a side collision with the upper crane hoist or grappling system. For either spontaneous opening or closing of an upper shield port cover to occur, the locking pin would have had to fail or not be engaged in conjunction with a spurious PLC signal, an error in the processor, or operator error. Either event would be detected using the position sensors and radiation monitors.

If the locking pin engagement sensor was to transmit erroneous locking pin information to the PLC, an improper validation of a safety condition could occur. Table 8.1-4 of the TSAR contends that an alarm would be initiated, but an alarm would not activate if the sensor

indicated that the locking pin engaged. That is to say, the only method for failure detection would occur if the locking pin sensor was to indicate locking pin engagement while the port cover was not in the desired preset position. Possible causes for this scenario are a spurious signal or sensor failure.

A mechanical or electrical failure would be the cause of the locking pin to fail to engage or disengage. In either case, an alarm signal would be initiated, and subsequent operations would be suspended. No estimates were provided for the amount of radiation exposure this failure would subject the DTS personnel to.

An upper shield port cover limit switch failure could lead to erroneous positioning information or no information at all to the PLC. Alarms would be initiated if the redundant positioning limit switches and sequence time out requirements were not in agreement.

Table 8.1-4 of the TSAR asserts that the upper shield port covers can be repaired or maintained from within the REA once the fuel assembly has been moved into one of the casks and the casks have been subsequently sealed. However, a cask cannot be sealed if its upper shield port cover cannot be opened.

Table 7.2.2.Δ in Appendix 5A of the TSAR lists the various types of sensors used in the upper shield port covers subsystem, the possible repercussions of their failure, the means used to detect their failure, and the compensating provisions taken to mitigate the effects of their failure. The functionality and uses of the proposed sensors are adequate, but more detailed information is required to assess their operating limitations.

Table 3 of the response to RAI 8-2 (Stewart, 1999a) provides the postulated failure mode, the most probable failure cause, the possible effects of the failure, how the failure is detected, and compensating provisions to recover from the failure. The guidelines provided in this table are acceptable except for those instances previously noted. In addition, details of the compensating provisions still need to be provided so the ability to recover and resume operations can be assessed more fully.

12.4.1.5 Failure of the Upper Crane and Related Instrumentation

Reviews of the potential impact of the upper crane and/or related instrumentation failures included Subsections 1.2.3.4, 1.3, 3.1.2, 3.3.2, 3.3.3.1, 3.4, 3.6, 4.1, 4.3.7.2, 5.1, 5.2.4.2, 5.4.1.1, 5.4.1.5, 5A.5.2.4.5, 5A.5.2.4.6, 5A.7, 8.1.2.1.5, 8A.4, 9.2, and 10.2 of the TSAR (U.S. Department of Energy, 1996); the responses to round one RAIs 3-21, 3-22, 4-1, 5-1 through 5-4, 8-2 through 8-6, 9-2, and 10-6 (Stewart, 1999a); and responses to round two RAIs 1-1, 5-1 through 5-7, 5-9, 5-10, 5-16, and 8-3, as well as Table 3 of the attachment (Stewart, 1999b).

The upper crane is one of two distinct mechanisms that make up the receiving cask shield plug and source cask lid handling subsystem. The primary function of the upper crane is to enable the removal and subsequent reinstallation of the receiving cask shield plug and the source cask lid so the fuel assembly transfer operations can be completed. The upper crane has been designed to meet the Type 1 requirements of ASME NOG–1 (American Society of Mechanical Engineers, 1995) and has been designated as important to safety SSC.

The upper crane trolley has a load carrying capacity of 6.1 tons (5.5 metric tons). The main components of the upper crane trolley are made from carbon steel that is to be painted using a Category A–Service Level 1 coating as defined in ASME NOG–1. Two of the trolley wheels are connected to an asynchronous motor. The trolley also has service and emergency brakes. The service brake is located on the motor drive shaft, and the emergency brake is located on the output shaft. Both brakes engage upon a loss of electrical power and can be manually disengaged if necessary. The service brake is used as a parking brake when the trolley is not being repositioned. Two sets of lateral rollers on one of the two runway rails are used to guide the trolley. Plates mounted beneath each of the trolley wheels and the runway rail prevent the trolley from tipping over during a seismic event. The trolley also has a hoist ring for attaching a winch and an auxiliary motor to move the trolley in the event of a malfunction.

The upper crane hoist is designed to raise and lower the source cask lid or the receiving cask shield plug and is remotely controlled by the operator located in the control trailer. The hoist is comprised of two cables, one cable drum, a compensator, a series of pulleys, an asynchronous motor, a gear reduction system, an emergency brake, and a service brake. The reeving system is divided into two separate load paths so that either path will support the load and maintain vertical alignment if the cable were to break or the cable system were to fail. In other words, each cable is independently capable of lifting the load safely. The compensator is used to balance the load and take up any slack between the two cables. The compensator is also used to alert the operator if one of the cables breaks. The service brake is housed within the motor and can be manually disengaged. The emergency brake is housed on the drum and is activated in the event that the service brake should malfunction as indicated by overtravel, overspeed indications, or a loss of power. The acceleration of the hoist is controlled during starting and stopping to avoid load oscillation.

The hoist grapple is used to activate the CMS overlid gripping device. The overlid gripping device employs four fingers to attach itself to the shield plug or lid pintle. The hoist grapple, in turn, uses four fingers of its own to attach itself to the overlid. Both sets of fingers are controlled independently by separate electrical screw jacks located in the hoist-grapple housing. A long-handled pole, which can be installed either through a DTS wall penetration or a roof plate opening, can presumably be used to manually disengage the hoist grapple.

Maintenance and repair would normally be done after the fuel and casks have been removed from the DTS. For off-normal conditions, however, limited repairs can be performed on the upper crane if the upper shield port covers are closed and locked.

The TSAR asserts that redundant instrumentation is not required to control the upper crane since the REA is shielded and uncontaminated. However, redundant instrumentation is provided to prevent any damage to the trolleys via the positioning limit switches. Redundant instrumentation is not required for the upper crane hoist position detection because mispositioning will prevent other operations from being processed (e.g., grapple connection). The overlid presence detector, however, does provide some level of redundancy with regard to the relative positioning of the grapple and overlid. This redundancy does not have an impact on safety. No redundant sensors are necessary for the control of the grapple since a manual backup is provided to disengage it in case of a malfunction. There are redundant sensors employed to detect the position of the grapple fingers, however. Tables 5.4-5, 5.2.4.5.Δ, and 5.2.4.6.Δ of the TSAR lists the instrumentation for the receiving cask shield plug and source cask lid handling subsystem.

The following off-normal events for the upper crane were postulated:

- Upper crane trolley brake failures
- Upper crane trolley positioning failures
- Upper crane hoist-grapple vertical positioning failures
- Upper crane grapple failures

As was mentioned previously, the upper crane trolley employs two braking systems, a service and emergency brake. Both braking systems will be activated in the event of an electrical power loss. There are four failure scenarios for the braking system that have been addressed in the TSAR. The first scenario is that the brake will not disengage. This scenario can occur if the electrical power to the brake has been disrupted. The second brake failure scenario occurs when the brakes have been inadvertently released because of an operating error. An unintended activation of the trolley brakes is the third type of brake failure addressed in the TSAR. This activation can occur by way of an operator error or localized electrical power loss to the brake. Failure of the brake to engage is the fourth and final brake malfunction scenario dealt with in the TSAR. This failure can occur only if the electrical power to the brake cannot be turned off or some type of obstruction is encountered.

Both the service and emergency brakes can be deactivated manually if necessary. The only brake failure scenario that has any significant consequence occurs when the trolley brakes are disengaged while the crane is handling a cask lid or shield plug. An unintended horizontal motion could cause damage to the cask lid or shield plug if they were to impact something with a sufficient amount of force. The potential damage to the upper crane cables caused by striking the perimeter of the upper shield port cover opening needs to be addressed.

The upper crane trolley positioning failures can be attributed to faulty brakes as just described, a trolley motor failure, faulty positioning sensors, and/or operator error. The most significant consequence of a trolley positioning error would occur if the trolley were to overtravel. Damage to the trolley motor could occur for this circumstance if the overtravel limit switches and the motor overload detection did not work. Because the trolley is only repositioned when the upper shield port covers are closed, maintenance personnel can be allowed into the REA to perform the needed repairs. The potential radiation doses to these workers were not provided.

The postulated upper crane hoist-grapple vertical positioning failures are detected visually and/or by using vertical position sensors and/or overtravel alarms. In addition to operator error, the possible sources for these failures can be attributed to malfunctions of the cable drum motor, the cable drum position index mechanism, and/or the cable position sensor (wire potentiometer). The failure with the greatest consequence associated with a vertical positioning failure would occur while the cask shield plug or lid was being hoisted by the crane. In particular, the shield plug or lid could be damaged by, and/or cause damage to, the TC port cover if it impacted one of these devices. A potential ramification would be that the shield plug or lid may not be able to be reinstalled on its respective cask in an acceptable manner. The TSAR did not convey the procedures that would be used to resolve this situation.

The removal and reinstallation of the cask shield plug or lid can only be accomplished if the upper crane grapple mechanism functions properly. Three different types of grapple failures were broached in the TSAR. The first of these failures was that the grapple would not open when instructed to do so. The second and third hoist–grapple failures addressed in the TSAR both result in the cask shield plug or lid being dropped. The lid would drop if the grapple fingers were to partially open or open spontaneously at an inopportune time. Because of the significant consequences of such an event, interlocks that prevent the grapple fingers from opening while under load or in the incorrect position are used to prevent this event from ever occurring.

Table 8.1-5 in the TSAR and Table 3 included in the response to round one RAI 8-2 (Stewart, 1999a) provide the postulated failure mode, the most probable failure cause, the possible effects of the failure, how the failure is detected, and compensating provisions to recover from the failure. The guidelines in these tables are acceptable except for those instances previously noted. In addition, details of the compensating provisions still need to be provided so the ability to recover and resume operations can be assessed more fully.

Table 7.2.2.Δ in Appendix 5A of the TSAR lists the various types of sensors used in the upper crane subsystem, the possible repercussions of their failure, the means used to detect their failure, and the compensating provisions taken to mitigate the effects of their failure. The functionality and uses of the proposed sensors are adequate, but more detailed information is required to assess their operating limitations.

12.4.1.6 Failure of the Fuel Assembly Handling Equipment

Reviews of the potential impact of the fuel assembly handling equipment and/or related instrumentation failures included Subsections 1.2.3.5, 1.3, 3.1.2, 3.3.2, 3.3.3.1, 3.4, 3.6, 4.1, 4.3.7.2, 5.1, 5.2.5, 5.4.1.1, 5.4.1.6, 5A.5.2.5, 5A.7, 8.1.2.1.6, 8A.5, 9.2, and 10.2 of the TSAR (U.S. Department of Energy, 1996); the responses to round one RAIs 3-21, 3-22, 4-1, 5-1 through 5-10, 8-2 through 8-6, 9-2, and 10-6 (Stewart, 1999a); and responses to round two RAIs 1-1, 5-1 through 5-7, 5-9 through 5-14, as well as Table 1 of the attachment (Stewart, 1999b).

The fuel assembly handling subsystem is designed to transfer SNF assemblies from the source cask to the receiving cask. This system uses a crane that is mounted on a rotating platform that, in turn, can be translated in a two-dimensional plane using a bridge and trolley system. Other components of the system include SNF assembly grapple, a special transfer tube used to protect the SNF assembly during lateral movement, a crud catcher at the bottom of the transfer tube designed specifically to contain any radioactive particulates that may spall off the SNF assembly, and redundant winches. The fuel assembly handling subsystem has been designed to meet the Type 1 requirements of ASME NOG–1 (American Society of Mechanical Engineers, 1995) and has been designated an important to safety SSC. The factor of safety for the nonredundant fuel hoist cable is 10, with respect to the manufacturer’s minimum breaking strength under normal conditions, and 2.5, under seismic conditions. The NRC staff finds the use of ASME NOG–1 and the concomitant factors of safety acceptable for this application.

Furthermore, two CCTV cameras are mounted, with concomitant lighting, at the base of the transfer tube. These cameras are used for visual verification that the SNF assemblies are handled in a safe manner during the transfer process. As a secondary function, they are also used to verify the identification markers attached to the SNF assembly.

The fuel assembly handling trolley is supported on rails bolted to the fuel assembly handling bridge. The trolley provides the operator with the ability to reposition the fuel assembly transfer tube in a direction perpendicular to the motion provided by the fuel assembly handling bridge. Two sets of lateral rollers on one of the runway rails are used to guide the trolley. As with the bridge, the guide rollers for the trolley are not designed to withstand seismic loads. Anti-derailing and anti-taking-off devices are used to prevent the trolley from disengaging during a seismic event. Four bumper guards, one at the end of each rail, can stop the trolley in the event of malfunction. How much impact energy these bumper guards can absorb was not provided in the TSAR.

The fuel assembly handling rotating platform is fitted with a service and emergency brake. Both brakes will engage in the event of an electrical power loss. The service brake is used as a parking brake when the platform is not in motion. The emergency brake is activated if an overtravel limit switch is activated, the operator initiates the emergency brake button or, as was just mentioned, electrical power loss.

The fuel assembly rotating platform has an anti-taking-off device used to keep the platform engaged to the trolley during a seismic event. The rotating platform can only be positioned manually when the trolley is in a specific location.

The fuel assembly handling subsystem employs a single failure proof hoisting configuration that utilizes two hoists mounted on the rotating platform, diametrically opposed on either side of the transfer tube. Simultaneous operation of the two hoists allows the grapple to be lifted or lowered. Each hoist has its own wire rope that has a factor of safety of 10 with respect to its breaking strength. This factor of safety is acceptable to the NRC staff. Power to each hoist is supplied by separate power lines. Each hoist has a service brake at the input shaft of the gear box, and each brake is rated to hold the entire load if necessary. Both sets of brakes are engaged if (i) an overtravel limit, overload, or overspeed indication is detected; (ii) the operator activates the emergency brake function; or (iii) power is lost to either hoist. If only one of the hoist motors has failed, the safety system can be overridden so the fuel assembly can be placed into a cask prior to effecting repairs.

In addition, dual load cells are used to measure the grapple load. This information is used to determine if the hoist-grapple system is overloaded, underloaded, or if the fuel assembly may be stuck in the cask. Various interlocks will use this information to stop the hoist in order to prevent damage to the fuel assembly, cask, and/or hoisting equipment.

An interlock is provided to prevent any horizontal movement of the fuel transfer tube unless the grapple is fully retracted and the crud catcher is closed. This interlock eliminates the possibility of the fuel assembly being sheared in two or damaged by an inadvertent impact while it is being raised or lowered. Another interlock uses sensors in the grapple to prevent the hoist from operating if the fuel assembly is not properly engaged.

The fuel assembly grapple has two independent actuating mechanisms. One electrical screw jack connected to the primary power line is used during normal operation. Two redundant screw jacks are available in the event that the primary fails. The secondary screw jacks are connected to the backup power line. The grapple is also designed with dual load path gripping fingers with passive mechanical interlocks under load to ensure that the fuel assembly will not be dropped.

The crud catcher can be operated manually in the event of failure.

Tables 5.4-6, and 5.2.5.3.Δ through 5.2.5.7.Δ of the TSAR contain compilations of the sensors used in conjunction with the fuel assembly handling subsystem. The functionality and uses of the proposed sensors are adequate, but more detailed information is required to assess their operating limitations.

Table 5.4-1 of the TSAR provides a compilation of the interlocks used in the DTS and the sensors, if any, that are used to implement them. The functionality and uses of the proposed interlocks are adequate, but more detailed information pertaining to their implementation is required to assess their operational limitations.

Table 8.1-6 of the TSAR and Table 1 of the response to round one RAI 8-2 (Stewart, 1999a) provides the postulated failure mode, the most probable failure cause, the possible effects of the failure, how the failure is detected, and compensating provisions to recover from the failure of the fuel assembly handling equipment. The guidelines provided in this table are acceptable except for those instances previously noted. In addition, details of the compensating provisions still need to be provided so the ability to recover and resume operations can be assessed more fully.

12.4.1.7 Failure of the Heating, Ventilation, and Air Conditioning Subsystem Components

Reviews of the potential impact of HVAC subsystem component failures included Subsections 1.1, 1.2.1, 1.2.4.1, 3.2.1, 3.2.1.3, 3.3.2.1, 3.3.2.2, 3.3.7.1, 3.4, 3.6, 4.1, 4.1.2.5, 4.2.2.3, 4.2.3.6, 4.3, 4.A, 5.1.3, 5A5.4, 5A6.1.2.3, 6.2, and 8.1.2.1.7 of the TSAR (U.S. Department of Energy,

1996) and the responses to round one RAIs 3-1, 3-21, 3-22, 4-1, 5-4, 6-1, 6-1 Revision 1, 6-2, 6-2 Revision 1, 6-3, 6-4, 6-4 Revision 1, 7-19, 8-1, 8-2, 8-3, and 8-5 (Stewart, 1999a) and responses to round two RAIs 1-1, 3-6, 4-1, 4-2, 5-1, and 8-1 (Stewart, 1999b).

The HVAC subsystem maintains air temperature within the DTS structure at design levels to allow proper functioning of the operating equipment, monitors, cameras and lighting, as well as to ensure that the fuel cladding temperature does not exceed specified levels.

The HVAC subsystem also provides ventilation (i) for the areas intermittently occupied by operators when an uncontrolled contamination release hazard may exist, (ii) during welding of the cask lids, and (iii) for maintaining minimum temperatures consistent with operation of the DTS. All air flow exhausted from the DTS will pass through a HEPA filtration subsystem to ensure most of the potential particulate from the air flow is removed. The cooling subsystem of the HVAC subsystem is designed to collect any water condensate from the dehumidification process (if any) in a reservoir for analysis and disposal.

Each area of the DTS—the PA, LAA, and TCA—is supported by its own heating/cooling subsystem. The cooling units for the PA, LAA, and TCA are located outside the DTS and are susceptible to seismic and tornado damage. An important aspect of the DTS HVAC subsystem is that the heating and air conditioning subsystem components are separate from the ventilation subsystem. The air handling unit (AHU) for the PA is located within the PA. The AHUs for the LAA and TCA and the redundant HEPA filter banks are located in the LAA. The ventilation subsystem also employs redundant exhaust fans, a primary and secondary, that are located in a protective enclosure outside of the DTS. A 20-inch (0.508-meter) diameter exhaust stack for the HVAC subsystem extends 10 feet (3 meters) above the DTS structure.

Each exhaust fan has its own independent electrical wiring harness to supply power. Only one exhaust fan is used at any given time. The secondary exhaust fan is isolated from the ventilation subsystem by a damper until it is needed. Both exhaust fans have been designated as not important to safety. In the event that the primary exhaust fan fails, the control subsystem senses the loss of the pressure differentials within the DTS and initiates an alarm on the control system panel. The secondary exhaust fan must be initiated manually. Similarly, if the primary HEPA filter subsystem fails, then the switch to the redundant subsystem must be accomplished manually as well.

The only components of the HVAC subsystem designated as important to safety are the HEPA filters, the HEPA filter pressure monitoring subsystem, and the exhaust air temperature monitoring subsystem. Readouts for these monitoring subsystems are seismically mounted in the PA and the protective enclosure for the exhaust fans. It should also be noted that the filtered exhaust air is monitored for radiation levels before it is expelled from the ventilation stack.

The HEPA filters are used in the ventilation subsystem to restrict the release of radioactive particulates. Because the HEPA filters are important to safety, monitoring the performance of these filters is also important to safety. As a result, the pressure differential across the filters will be monitored to detect a clogged or failed condition. The two control panels located in the PA and protective enclosure provide readouts from the HEPA filter pressure and exhaust temperature monitoring subsystems.

The ventilation subsystem also maintains negative pressure in the PA, the LAA, and the TCA relative to ambient such that air flows toward areas of increasing levels of potential contamination. The air flow rates will be as low as possible to minimize the potential generation of airborne contamination. Back flow of air is prevented by dampers located between the LAA and TCA, the TCA and HEPA filter banks, and the HEPA filter banks and the exhaust fans. Once the air flow rates have been set manually, the PLC takes over and adjusts the fan speed to maintain the necessary negative pressure in the TCA. The outside air will be filtered after it enters the PA to minimize dust content.

The HVAC control subsystem interfaces with the DTS control and radiation monitoring subsystems. The operating status of all the HVAC equipment, including DTS temperatures and pressures, is transmitted to the control center and displayed. Information on the open/closed status of the DTS doors and the position of the CMS is transmitted to the HVAC control subsystem and is used to control the speed of the exhaust fans when SNF is not being transferred in the TCA.

The following off-normal events for the HVAC equipment were postulated:

- Exhaust fan failure
- HEPA filter failure
- Pressure sensor failure
- Air conditioning subsystem failure in the LAA
- Air conditioning subsystem failure in the TCA

An exhaust fan failure would be detected by an indication of no pressure differential across the blower unit. This failure would be mitigated by switching over to the redundant exhaust fan until the DTS can be placed into a safe condition and the appropriate repairs or replacement made.

If the HEPA filters were to become clogged or dislodged, the differential pressure sensors across the filter will yield readings that are either abnormally high or low. In the event that this should occur, the redundant HEPA filter bank would be placed into service until the needed repairs or replacement can be accomplished.

Pressure sensor failures would be detected by inconsistent readings from their redundant counterparts. These failures will necessitate the fan speed control be manually overridden until the malfunctioning sensor can be replaced.

The inability to maintain the temperature set point, as detected by the temperature sensors in either the LAA or TCA, would be indicative of a malfunction in the affected area air conditioning subsystem. Potential causes can be attributed to failures of one or more of the following components: (i) the temperature sensor, (ii) fan, (iii) cooling condenser, and/or (iv) heater failure. When an abnormal temperature reading occurs, the appropriate air conditioning subsystem would be shutdown, if necessary, and the remaining air conditioning subsystems and ventilation air flow rates would be manually adjusted to compensate for the additional load until repairs could be made.

The cooling, heating, and ventilation components of the HVAC subsystems are not considered to be important to safety because the high thermal inertia of the DTS may provide sufficient time before temperatures fall above or below the allowable operating temperatures to recover from a loss of one or all these components. The HVAC can be rendered inoperable for short periods of time without harming the fuel or the DTS equipment. How short a time and the technical basis for all bounding scenarios were not provided. A thermal analysis for accident conditions presumably demonstrated that a loss of the ventilation subsystem does not result in a loss of the DTS fuel handling equipment or the integrity of the confinement boundary provided by the DTS structure and HEPA filters. The thermal analysis, however, did not take into account the need to keep temperatures below the limits of the CCTV system nor did it consider the scenario when the ambient temperature is -20 °F (-29 °C) and the DTS interior temperature is 50 °F (10 °C), which is a situation where no safety margin is allowed for the temperature gradient across the DTS concrete walls.

The HVAC alarms work on three different levels: (i) high-level alarms, (ii) low-level alarms, and (iii) warnings. High-level alarms correspond to the loss of the double confinement provided by the ventilation subsystem or abnormally high temperatures in any given area of the DTS structure. Low-level HVAC alarms are initiated when: (i) a loss of redundancy for the exhaust fans is detected by acknowledging the absence of a pressure differential; (ii) the loss of a Fan Coil Unit (FCU), which is detected by the absence of a pressure differential in conjunction with a local temperature above the FCU initiation level; or (iii) a damper malfunction that is detected by the equipment. The TSAR did not elaborate on how the equipment is used to detect a damper malfunction. A warning occurs when the pressure differential across the HEPA filter bank is abnormally high or low.

The response to round one RAI 3-1 (Stewart, 1999a) states that the exhaust subsystem is sufficient to maintain temperatures below the allowable limits for 72 hours if the cooling subsystem was to fail. The technical basis for this statement was not provided.

Table 8.1-7 of the TSAR, Table 5 of the response to round one RAI 8-2 (Stewart, 1999a), and the table provided with round two RAI 4-2 (Stewart, 1999b) provide the postulated failure mode, the most probable failure cause, the possible effects of the failure, how the failure is detected, and compensating provisions to recover from the failure of the HVAC subsystem. The guidelines provided in these tables are acceptable except for those instances previously noted. In addition, details of the compensating provisions still need to be provided so the ability to recover and resume operations can be assessed more fully.

12.4.1.8 Failure of the Control Subsystem Components

Reviews of the potential impact of control subsystem component failures included Subsections 1.2.3.6, 3.1.2, 3.2.1.3, 3.3.1, 3.3.3.2, 3.4, 4.1, 4.3.1.4, 4.3.1.8, 4.3.2, 4.3.7.2, 5.1, 5.4.1, 5.5, 5A, 7.3.1.3, 8.1.2.8, and 8A.1.5.1 of the TSAR (U.S. Department of Energy, 1996); responses to round one RAIs 3-1, 3-21, 3-23, 4-1, 5-4, 8-1, 8-5, 8-16, and 8-24 (Stewart, 1999a); and responses to round two RAIs 1-1, 4-1, 5-2 through 5-8, 5-14, and 5-15 (Stewart, 1999b).

The control subsystem controls and monitors system operations, including the radiation monitoring and HVAC subsystems. All fuel transfer operations are controlled remotely from the control center. It was asserted in the TSAR that no recovery requirement is needed for the control subsystem because manual backup can be used to pull the casks outside the LAA, and opening of the sliding door is locally controlled. The PLCs are located in the protective enclosure for the HVAC exhaust fans. The control subsystem, including the individual PLCs, will cause all equipment to stop operating on (1) loss of power, (2) central processing unit (CPU) failure detected by the watchdog timer, and (3) the operator pressing the “Emergency Stop” button. All other control subsystem failures are detected by the operator or other instrumentation. More information is needed to identify how the operator and instrumentation detect control subsystem failures.

Although the HVAC control subsystem operates independently of the DTS control subsystem, the two subsystems are integrated by various interlocks.

The interfaces between the mechanical equipment sensors, radiation monitoring, and HVAC subsystems are managed by the control subsystem to prevent any unsafe operation that could result in an abnormal exposure for the workers (mechanical equipment sensors and radiation monitoring interface), a release of contaminated particles (mechanical equipment sensors and HVAC interface), or a compromise of the recovery requirements (mechanical equipment sensors, radiation monitoring, and HVAC interface).

Mechanical equipment monitored and controlled by the control subsystem includes the (i) CTS, (ii) CMS, (iii) TC port shield subsystem, (iv) MPC shield plug and source cask lid handling subsystem, and (v) the fuel assembly handling subsystem. The control subsystem also provides control and monitoring of the HVAC equipment; manages interfaces and interlocks, internal and external to the equipment and subsystems; and allows communications between the DTS and control center.

The operator/machine interfaces for controlling and monitoring equipment are located in four areas (i) the control center, located in a trailer separate from the DTS structure; (ii) the PA; (iii) the LAA; and (iv) the protective enclosure for the HVAC exhaust fans.

The control subsystem prevents unsafe control of the transfer operations. Adherence to the operating sequence is achieved through administrative procedures. The results of operations or equipment status are used as conditions to allow the initiation of subsequent operations.

During off-normal conditions, the local control panels located in the PA and LAA can only be operated if (i) there is no fuel being transferred, (ii) the two casks are closed, and (iii) the radiation levels are under admissible limits.

Nearly all the mechanical equipment within the DTS has a manual backup or is accessible for repair under any condition. Selectors on the main control panel allows the operator to switch to the secondary hoist and to use backup motors for the grapple in case of a primary power failure. For both systems, the main motors and their backups are on two different power supply channels and do not share any control or power wire.

In the case of a loss of the remote control for the fuel assembly hoist and grapple, the system is designed to fail safe (i.e., the brakes engage on a loss of power, and it is mechanically impossible to open the grapple fingers). If the HVAC PLC fails, the HVAC can be switched to manual control using the HVAC panels in the PA or exhaust fan protective enclosure.

The control subsystem can be lost by either a tornado or seismic event. Manual overrides would have to be employed to return the SNF to the cask for worst case conditions.

A watch dog program detects a failure of the central processing unit (CPU) by using internal clock checking and automatically stops all the equipment in the activity by resetting all its outputs. A coupler failure, network disconnection of a PLC, a network failure between a PLC and the control system PC, or between the main control panel and a PLC can be detected and would result in the equipment being stopped automatically. A failure of the link between the PLC and the electronic cabinet causes power to the controlled equipment being switched off, which in turn activates the emergency brakes. A wire disconnection or breakage between the electronic cabinets and the equipment has the same effect. The PLCs and the PC are supplied by an independent backup in the event of a power loss. While the capability to detect disconnects and communication failures is mentioned in the TSAR, more information is needed on how the detection is performed. In addition, on automatically switching over to the backup power supply, the PLCs and PC will record the current status of the system (i.e., process, positions, etc.), before updating the equipment status to stopped.

In the failure analysis for the DTS, several scenarios require the control subsystem interlocks to compensate for an operator error. Other scenarios require the operator to compensate for potential control subsystem failures involving the PLC or related instrumentation. The staff disagrees with the response to second round RAI question 5-2 which states "...software failure should not be considered to occur coincident with an operator error" since no technical bases to support such an argument was submitted. Rather, more information needs to be given regarding the control subsystem's capability to mitigate an operator error and an operator's capability to mitigate a control subsystem error.

Table 7.2.2.Δ of the TSAR lists all the sensor failures that can have an effect on safety. For each type of failure, the possible effect on the current operation involving the use of the failing sensor is described, as well as the means provided to detect the failure and the compensating provisions. The functionality and uses of the proposed sensors are adequate, but more detailed information is required to assess their operational limitations.

Table 7.2.3.Δ of the TSAR lists all the interlocks and their failure analyses. The interlock failure analysis describes for each interlock the instrumentation failures that can affect its function, its possible effect, the means provided to detect it, and the compensating provisions. The functionality and uses of the proposed interlocks are adequate, but more detailed information pertaining to their implementation is required to assess their operational limitations.

Table 8.1-8 of the TSAR provides the postulated failure mode, the most probable failure cause, the possible effects of the failure, how the failure is detected, and compensating provisions to recover from the failure. The guidelines provided in this table are acceptable except for those instances previously noted. In addition, details of the compensating provisions still need to be provided so the ability to recover and resume operations can be assessed more fully.

12.4.1.9 Failure of the Radiation Monitoring Equipment

Reviews of potential impact from the failure of the radiation monitoring equipment included Subsections 1.2.4.2, 3.3.5, 4.3.7.2, 5.1, 5.5, 5A.5.5, 7.3.1.3, 7.3.1.6, 7.3.4, 8.1.2.1.9, 10.2.2, and 10.2.3 of the TSAR (U.S. Department of Energy, 1996) and the response to round one RAI 7-19 (Stewart, 1999a).

The radiation monitoring subsystem measures radiation contamination levels in specified locations and on specified surfaces. Radiation contamination includes airborne radioactive materials in various locations. Radiation level measurements may be used to establish operation records, notify personnel of unacceptable levels in occupied areas, and provide information to the PLC for the interlock system. These measurements are also used to quantify the effectiveness of the decontamination subsystem and its concomitant procedures. All of the fixed radiation monitors employ backup batteries in the event of a power failure. The radiation monitor in the LAA is interlocked with the sliding door operation to ensure the door cannot be opened unless the radiation level within the LAA is low enough to allow personnel to enter safely. Similarly, the radiation monitor located in the REA is interlocked with the upper shield ports to prevent their opening in the presence of high radiation levels.

In addition to the gamma radiation monitors at fixed locations within the DTS, Subsection 7.3.4 of the TSAR points out that portable monitors will be used to measure radiation levels in the immediate environmental areas and neutron levels within the DTS as necessary. The procedures and criteria for the use of these portable monitors will be defined in the site-specific SAR.

The final component of the radiation monitor subsystem is a continuous air monitor located in the ventilation exhaust stack.

If one of the radiation monitors were to fail in the LAA, TCA, or REA, the remaining monitors that are operational will be sufficient for reading dose rates within the DTS until fuel handling is completed. However, the TSAR did not indicate how a failed radiation monitor is detected. Nor was the potential effect of a failed radiation monitor on the functionality of dependent interlocked systems provided.

12.4.1.10 Failure of Equipment in the Preparation Area

Reviews of the potential impact of PA equipment included Subsections 1.1.1, 1.2.3.7, 3.1.2, 3.2.1.3, 3.3.1, 3.3.6, 3.4, 4.1, 4.2.3.5, 4.2.3.6, 4.3.2, 4.3.3, 4.3.7.2, 5.1.3.4, 5.4.1.1, and 8.1.2.1.10 of the TSAR (U.S. Department of Energy, 1996), responses to round one RAIs 3-21, 4-1, 8-16, and 8-24 (Stewart, 1999a); and responses to round two RAIs 1-1, 5-1, 5-2 through 5-7, 5-9 through 5-14, as well as Table 1 of the attachment (Stewart, 1999b).

The PA is where the receiving and source casks are prepared for fuel transfer and cask removal after the transfer has been completed. The PA is a weather resistant building with two entrances/exits. One is a roll-up door for the casks, and the other is a personnel access door. A sliding door at least 7-inches thick provides access to the LAA from the PA. Lighting and video cameras are located in the PA so operations can be monitored from the control center. The HVAC subsystem keeps the PA at a pressure less than ambient so air will flow into the PA from the outside. Radiation monitors are located in the PA to ensure all operations are performed under safe working conditions. All operations performed in the PA are locally controlled.

The PA: (i) houses the canister welding and cask vacuum/inerting/leak test subsystems; (ii) is the temporary storage location for solid radioactive waste and decontamination materials (e.g., used HEPA filters, rags, and swabs); and (iii) is used as a temporary storage location for the receiving cask lid during the fuel transfer process.

Electrical power is distributed within the DTS from a distribution panel (containing isolators and circuit breakers) located in the PA. All equipment, including the HVAC subsystem, will be supplied by this primary power system. The location for the secondary power system distribution panel was not given. The electrical system is not considered important to safety.

A compressed air tank used to inflate the seals on the sliding door is located in the tank storage area outside the PA along with the carbon dioxide gas used to supply the fire protection system. Piping from the tank storage area will penetrate the walls of the DTS and into the LAA, TCA, and the REA. The adequacy of the seals between the piping and DTS walls was not addressed in the TSAR.

The operations that are locally controlled and monitored in the PA are: (i) the receiving and source cask transfer (including trolley entry, positioning, removal, locking and unlocking); (ii) the rolling and sliding doors (including rolling door opening and closing, sliding door opening, locking, unlocking, and closing operations); and (iii) the receiving cask lid removal and replacement.

No discussion of potential failures or their consequences related to equipment in the PA was provided in the TSAR or responses to RAIs.

12.4.1.11 Loss of External Power Supply for Up to 24 Hours

Reviews of the potential impact of the loss of the external power supply for up to 24 hours included Subsections, 4.3.7.2, 8.1.2.2, and 8A.1.5.1 of the TSAR (U.S. Department of Energy, 1996) the responses to RAIs 8-16 and 8-24 (Stewart, 1999a); and responses to round two RAIs 1-1, 4-2, 5-1, and 8-1 (Stewart, 1999b).

Operations within the DTS would be stopped and automatically placed in a safe condition in the event of a power supply failure. The TSAR asserts that there are no radiological effects if the power failure lasts for only a 24-hour span. The confinement function of the DTS, however, may be adversely affected if the temperature gradient across the DTS wall exceeds 70 °F (39 °C). This detrimental condition is a real possibility when the ambient temperature is −20 °F (−29 °C) and the DTS interior temperature is 50 °F (10 °C). As can be seen, the loss of power to the HVAC subsystems for any period of time for this scenario is unacceptable because the DTS wall temperature gradient is already at its maximum at the time of the power loss.

The radiation monitoring and control subsystems have battery backups. The control subsystem also saves critical sensor, equipment status, and positioning information when electrical power is abruptly interrupted. However, there is no mention of battery backup for the CCTV and lighting subsystems.

12.4.1.12 Off-Normal Thermal Loads

Reviews of the potential impact of off-normal thermal loads included Subsections 4.3.7.2, 8.1.1.1, 8.1.1.2, and 8A.1.5.1 of the TSAR (U.S. Department of Energy, 1996); and the responses to round one RAIs 3-2, 8-16, and 8-24 (Stewart, 1999a); and responses to round two RAIs 1-1, 4-2, 5-1, and 8-1 (Stewart, 1999b).

The allowable temperature ranges within the DTS are 60–100°F (16 to 38°C) in the PA and 40–130°F (4 to 54°C) in the remaining areas. Note that the 130°F (54°C) maximum temperature limit is the maximum allowable temperature for the important to safety CCTVs. Based on a study by Einzinger (cited in the TSAR text but not provided), the following fuel temperature limits were adopted for the DTS: 464°F (240°C) for a 2-week period (before the receiving cask is inerted), 441°F (227°C) for a 1-month period, and 347°F (175°C) for a 2-year period.

As pointed out in Subsection 12.4.1.7, each area of the DTS is provided with its own independent heating and cooling subsystem. In addition, a ventilation subsystem, which is separated from the heating and cooling components, uses redundant exhaust fans to ensure that air flow through the DTS will be uninterrupted in the event of a mechanical failure. Both heating/cooling and ventilation subsystems have access to secondary power sources if the primary supply should be disrupted.

To bound the effects of off-normal thermal loading, a steady-state thermal analysis for the DTS was performed using only passive heat dissipation from the cask to the DTS and from the DTS to the ambient surroundings. In other words, the HVAC subsystem has been assumed to be inoperative. Because of the large thermal mass and inertia of the DTS structure, the temperature rises within the confines of the DTS at a relatively slow rate. Based on the analysis, the temperature rise within the DTS will occur at a rate of approximately 0.68°F (0.38°C) per hour at the time the HVAC subsystem goes out of service. The assumptions used in deriving this result are as follows:

- A fuel decay heat load of 15.5 kW
- An ambient temperature of 115 °F (46°C)
- Insolation is applied to the protective cover and concrete walls
- Heat is dissipated from the outer surfaces of the protective cover and concrete walls via natural convection and radiation to the ambient surroundings
- Radiation heat transfer between the roof plate and protective cover and between the mezzanine plate and the concrete walls in the TCA
- Within the LAA, the cask dissipates heat by way of natural convection and radiation to the mezzanine plate, sliding door, and concrete walls

The steady-state temperatures derived from the analyses are:

Equipment temperature within the REA	
Conservative estimate	134 °F (57 °C)
Optimistic estimate	131 °F (55 °C)
Equipment temperature within the TCA	
Conservative estimate	179 °F (82 °C)
Optimistic estimate	156 °F (69 °C)
Equipment temperature within the LAA	
Conservative estimate	182 °F (83 °C)
Optimistic estimate	172 °F (78 °C)
Fuel cladding temperature in cask	
Conservative estimate	647 °F (342 °C)
Optimistic estimate	575 °F (302 °C)
Fuel cladding temperature of SNF assembly in the fuel transfer tube	
Conservative estimate	209 °F (98 °C)
Optimistic estimate	186 °F (86 °C)
CMS bellows temperature	
Conservative estimate	348 °F (176 °C)
Optimistic estimate	312 °F (156 °C)
“Realistic” DTS wall thermal gradient estimate	42 °F (23 °C)

The TSAR did not indicate if the optimistic temperature estimates correspond to an ambient temperature of −20°F (−29°C), which is the lower bound ambient temperature allowed for operation of the DTS.

Reviewing the results provided, the NRC staff determined that the steady-state fuel cladding temperature exceeds the allowable for a 2-week period. Because an estimate of the time required to reach the steady-state temperature condition was not provided, the NRC staff could not assess the amount of time that will be available for performing repair operations of the HVAC subsystem under extreme conditions. Moreover, the steady-state temperatures for all areas exceed the allowable for the important to safety CCTV components. And, finally, the analysis results also indicate that the CMS temperature limit, 240°F (115°C), is exceeded.

The TSAR asserts that if the cooling subsystem fails, the exhaust subsystem is sufficient to maintain temperatures below the allowable temperature for 72 hours, providing time to either repair the cooling subsystem or bring the DTS into a safe shutdown configuration. The 72 hour time period may be a nonconservative estimate, depending on the nature and extent of the HVAC failure and the ambient conditions existing at the time. In particular, the off-normal thermal analysis did not consider the scenario when the ambient temperature is −20°F (−29°C) and the DTS interior temperature is 50°F (10°C). Under these conditions, the DTS temperature gradient across the concrete wall is already at its maximum and a loss of the HVAC subsystem, for any period of time, is not acceptable.

12.4.1.13 Heavy Snow Storm

Reviews of the potential impact of a heavy snow storm included Subsections 3.2.4, 8.1.2.3, and 8A.1.5.1 of the TSAR (U.S. Department of Energy, 1996) and the responses to round one RAIs 8-16 and 8-24 (Stewart, 1999a).

Heavy snow storms will result in loads on the roof, weather protective cover, and butler building. The TSAR states in Subsection 8.1.2.3 that these structures have been designed for loads considerably greater than those expected from a heavy snow storm. In Appendix 8A.1.5.1 of the TSAR, it is stated that the loads are assumed to be 250 psf and bound all postulated live loads acting on the DTS. However, Subsection 3.2.4 of the TSAR states that the roof of the DTS is designed for a snow or ice load of 100 psf. This load is taken from Minimum Design Loads for Buildings and Other Structures (ANSI/ASCE, 1995) (American National Standards Institute/American Society of Civil Engineers) and is the maximum 100-year roof snow load specified for most areas of the continental United States for an unheated structure. The responses to round one RAIs 8-16 and 8-24 (Stewart, 1999a) indicate that live loads were used, in part, to calculate the stresses in the concrete and steel structures of the DTS. However, it is not clear what value of the load was ultimately used. The response to round one RAI 8-16 also indicates that the details of the calculations used to generate the stress values presented in Tables 8.16-1, 8.16-2, 8.24-1, and 8.24-2 will be provided in Appendix 8A.1 of the revised TSAR.

Moreover, the exhaust stacks will be designed to ensure that snow and water do not drain into the DTS. The details of this design were not provided.

12.4.1.14 Lightning

Information presented in Subsection 8.1.2.4 of the TSAR (U.S. Department of Energy, 1996) and the revised Subsection 2.3.1.4 provided in response to round one RAIs 2-1 and 3-1

(Stewart, 1999a) was reviewed to determine the impact of lightning on the DTS and compliance with the requirements of 10 CFR 72.122(b)(2). Lightning is a large-scale, high-tension natural electrical discharge in the atmosphere. It is a natural event associated with thunderstorms in which one or more cloud-to-ground strikes affect DTS SSCs exposed to the environment.

A lightning strike event is expected to occur once per year in the course of normal operations of the DTS. Consequently, the TSAR categorizes lightning as a Design Event II or an off-normal event following ANSI/ANS 57.9-1992 (American National Standards Institute and American Nuclear Society, 1992). The Standard Review Plan NUREG–1567 (Nuclear Regulatory Commission, 1996), however, classifies lightning as an accident event. The TSAR has categorized both Design Events III and IV as defined in ANSI/ANS-57.9 as accidents. Therefore, the TSAR excludes lightning from the list of accident events. The redesignation of a lightning strike event from an accident event to an off-normal event is acceptable to the NRC staff because the assumption of a higher occurrence rate is inherently conservative.

The fundamental principle in protection against lightning is to provide a low impendence path which a lightning discharge current will follow, instead of high impedance paths offered by important to safety SSCs. To satisfy this criterion, the DTS lightning protection system will be designed in accordance with NFPA Code 780 (National Fire Protection Association, 1992). Since the provisions in the NFPA code are not based on geographical location, this criterion encompasses all of the 48 contiguous United States. A final lightning protection system design, however, will be site-specific, because it will depend upon the soil and corrosion characteristics of the site and the degree of protection offered by other grounded structures in the proximity of the site.

12.4.2 Accidents

Chapter 8 and Appendixes 8A.1 through 8A.6 of the TSAR include a discussion of accidents, both external natural events and man-induced events, at the DTS. Because the DTS is not site-specific, it is expected that the accidents chosen will bound accidents at most sites selected for the installation. Further, limitations have been placed on DTS siting to exclude sites with any possibility for flooding, tsunami, seiches, and, by implication, ground faults, landslides, and volcanic activity. Site-specific studies will be required for the DTS to assure these conditions are met and to evaluate the DTS for conditions that exceed those addressed in the TSAR.

The information presented in Section 8.1, Off-Normal Events, of the TSAR does not specifically address Design Event Categories III or IV as defined in ANSI/ANS 57.9–1992. The analyses of these events are presented in Section 8.2, Accidents, of the TSAR. Specific accident events included in Section 8.2 of the TSAR that the NRC staff reviewed are: (i) loss of the external power supply for an extended interval; (ii) stuck fuel assembly or inability to insert a fuel assembly into a cask; (iii) failure of the fuel grapple to disengage; (iv) seismic loading; (v) tornado missiles, hurricanes, and high winds; (vi) fire; (vii) major mechanical malfunction involving the SNF handling subsystem during operation resulting in dropping of a fuel assembly; (viii) complete loss of HEPA filters and loss of pressure differential; (ix) loss of a shield plug or source cask lid (either by damage or inability to be placed on the cask); and (x) electrical surges and explosions.

Accident analyses consider the response of SSCs important to safety identified in Chapter 3 of the AR. Except as noted, checks were made on the adequacy of the critical components of the SSCs to withstand the postulated accidents. Each event was examined to ensure that it includes a discussion of (i) the cause of the event, (ii) the means of detection of the event,

(iii) an analysis of the consequences of the event and the protection provided by devices or systems designed to limit the extent of the consequences, and (iv) any actions required by the operator.

12.4.2.1 Loss of the External Power Supply for an Extended Interval

Reviews of the loss of external power supply for an extended period and the potential consequences to the DTS facility included Subsections 8.2.1 and 8.2.2 of the TSAR (U.S. Department of Energy, 1996).

Following this event, the DTS facility relies on automatic switching to battery backup for the CPU of the control subsystem, the radiation monitors, and emergency lighting. This automatic switching prevents loss of information by the CPU and provides uninterrupted monitoring of radiation levels and uninterrupted lighting for visual assessment. Secondary power is assumed to be available and is used, along with secondary motors and hoists systems (if required), to return exposed fuel to the nearest cask, replace the source cask lid and receiving cask shield plugs, and to handle all other activities that may be required to return the installation to a safe condition and prevent the release of radiation to the environment.

Not addressed in the TSAR is the effect on the availability of the backup battery supply and secondary power if another simultaneous event, such as a tornado or earthquake, caused the outages. Consequently, no times are given for establishing secondary power to the facility, if it is lost along with the primary power supply.

Radiation exposure from the stuck fuel assembly, Subsection 12.4.2.2 of this AR, envelopes the possible radiation exposure from this event because only one fuel assembly will be allowed out of the confines of a cask at any given time (see the proposed license condition defined in Subsection10.5.1 of this AR). As a result, having a fuel assembly outside of the shielding provided by the cask represents a bounding scenario. Temperatures of the fuel assemblies are shown to be well within the requirements of NUREG–1536 (Nuclear Regulatory Commission, 1997) for short-term durations; however, these same temperature calculations show that the steady-state cladding temperatures are above the allowable 2-week limit, and the operating temperature of the cameras, which are important to safety, will be exceeded in the TCA. Differential temperatures through the walls of the DTS need to be addressed for this accident event based on the maximum time without primary or emergency power and considering worst case ambient temperatures to make sure that the allowable temperature gradient across the DTS walls will not be exceeded.

12.4.2.2 Stuck Fuel Assembly or Inability to Insert a Fuel Assembly into a Cask

Reviews of the stuck fuel assembly or inability to insert a fuel assembly into a cask and the potential consequences to the DTS facility included Subsection 8.2.2 of the TSAR (U.S. Department of Energy, 1996) and responses to round one and round two RAIs (Stewart, 1999a,b).

The worst case event is identified as the extraction of a fuel assembly and the inability to return it to either the source or receiving casks. General procedures for recovery from this event are outlined in the TSAR. The procedures require (i) an emergency recovery cask into which the "distorted" fuel assembly will be placed and (ii) the erection of a shielded tent over the sliding door for radiation control when the door is opened to remove the source cask and replace it with the emergency recovery cask. In this case, a fuel assembly is exposed for a period of up to 2 weeks, and radiation doses at 100 and 500 meters are calculated to be within acceptable limits for accident conditions. Setting the maximum exposure time at 2 weeks seems reasonable but needs to be verified by developing detailed emergency procedures (including cask availability) and a corresponding timeline for such an event.

The inability to free a stuck fuel assembly was not addressed. Some of the features of the DTS facility designed to prevent such an event from occurring include: (i) acceptance of only intact fuel, (ii) load sensors, (iii) load limits on the hoisting device, (iv) adequate clearance and lead-ins for the transfer tube, and (v) interlocks to prevent lateral movement of the fuel handling equipment if the fuel assembly is not in the full up position. Although the guidelines presented in the TSAR for these preventive measures were acceptable to the NRC staff, more detailed design information and operational procedures will be required before a final assessment can be made.

12.4.2.3 Failure of the Fuel Grapple to Disengage

Reviews of the failure of the fuel grapple to disengage and the potential consequences to the DTS facility included Subsection 8.2.3 of the TSAR (U.S. Department of Energy, 1996) and responses to round one and round two RAIs (Stewart, 1999a,b).

Recovery from a failure of the fuel grapple to disengage requires special procedures and the use of manual tools through access ports in the roof plate and side ports around the DTS. These tools, and their availability, were not discussed. Because the fuel assembly would be in a cask when the attempt is made to disengage the fuel grapple, radiation doses are bounded by the stuck fuel assembly event addressed in Subsection 12.4.2.2 of this AR. Consequently, there is adequate time to procure or make the tools if necessary. Radiation doses to workers are to be evaluated prior to recovery operations.

12.4.2.4 Seismic Loading

Reviews of seismic loading and its potential consequences to the DTS facility included Subsections 3.3.2 and 8.2.4 and Appendixes 8A.1 through 8A.5 of the TSAR (U.S. Department of Energy, 1996); round one RAIs 3-11 through 3-15, 4-2, 8-1 through 8-5, 8-14 through 8-17, 8-29 through 8-31, and 8-34 (Stewart, 1999a); round two RAIs 3-3 through 3-6 and 8-4 through 8-7 (Stewart, 1999b); and backup calculations (Stewart, 1999c).

The DTS facility has been designed for a maximum ground acceleration of 0.25g PHA and 0.17g PVA. A hard rock site was assumed, and the TSAR stipulates that sites will be chosen for the DTS that have no unstable geological characteristics, soil stability problems, or potential for vibratory ground motion in excess of the design conditions. The upper crane assembly was not analyzed using the seismic design conditions and must be redone using the same generic spectrum or a site-specific spectrum.

The seismic analysis considered the strength of the containment boundary as well as the SSCs important to safety. A finite element model of the DTS was developed and subjected to the generic base input seismic motions. Elevated response spectra were developed to define the loads at critical locations. These loads were applied to the structure using an equivalent static procedure. The resulting stresses were compared to the material allowable stress to verify the integrity of the confinement boundary. The elevated response spectra were used to derive loads on SSCs. Spectral and modal contributions were used to define the responses of the systems. Analyses of the SSCs assume that they can be decoupled from the structural response. Decoupling of the SSCs from the structural response is acceptable to the NRC staff because the relative masses are significantly different.

12.4.2.5 Tornado Missiles, Hurricanes, and High Winds

Reviews of tornado missiles, hurricanes, and high winds and their potential consequences to the DTS facility included Subsections 3.2.1, 8.2.5, and Appendix 8A.1 of the TSAR (U.S. Department of Energy, 1996); round one RAIs, 3-6 through 3-10, 8-2, 8-5, 8-8, 8-9, 8-16 through 8-18, 8-24, and 8-27 through 8-28 (Stewart, 1999a); round two RAIs 3-2, 8-2, 8-5, and 8-6 (Stewart, 1999b); and backup calculations (Stewart, 1999c).

The most severe parameters corresponding to Region I in Regulatory Guide 1.76 (U.S. Atomic Energy Commission, 1974) were assumed for the DBT. Loads resulting from normal and tornado winds are calculated according to ANSI/ASCE 7-95. The high velocity of the winds produced by the DBT envelope most other wind loading conditions. The spectrum of tornado generated missiles was based on the National Bureau of Standards as representative of construction site debris in report NBSIR 76-1050 (National Bureau of Standards, 1976). The missiles are identified in NUREG–0800 (Nuclear Regulatory Commission, 1981a) as Spectrum II missiles.

Walls, foundation, sliding door, and roof cover were found to be adequate to resist the moments produced by the tornado generated wind loads and differential pressures. Walls and the sliding door of the DTS facility were shown, using independent calculations to be adequate to resist missile penetration. Concrete spall is predicted to occur for the automobile impact. This spall is judged to be acceptable because it will not materially reduce radiation shielding. Localized damage to the walls of the DTS from missile impact is not expected to significantly affect residual strength. The worst case localized damage will be produced by the 12-inch diameter pipe missile that can cut through two reinforcing bars in each direction on the outside surface of the wall (for an 8-inch rebar spacing). When considering the overall strength of a 20-foot wall section, which is typical for the DTS, the reduction in moment capacity for tension on the outer face is about 7 percent.

Penetration equations used for evaluating the roof cover and the protective enclosure that houses the exhaust fans and PLC are not appropriate for low velocity impacts on a flexible structure. Penetration will be very dependent on the location of the impact. In addition, the repercussions of losing the sliding door seal and the air curtain duct work during a tornadic event was not broached in the TSAR.

12.4.2.6 Fire

Reviews of fire and its potential consequences to the DTS facility included Subsection 8.2.6 of the TSAR (U.S. Department of Energy, 1996) and round one RAI 8-1 (Stewart, 1999a).

Because of the absence of combustible material in the DTS structure and minimal combustible material stored in the DTS facility, a large, long-duration fire at the proposed DTS facility is not considered to be a credible event. Site-specific information about nearby vegetation and the inclusion of any fire-breaks into the facility design will be necessary to evaluate the potential hazard from an offsite fire.

The effects of small fires, such as from clean-up rags or electrical equipment, are minimized by providing onsite fire extinguishers, CO_2 injectors in electrical cabinets, fire retardant electrical wiring, and redundancy in systems important to safety. The radiation consequences of a fire that damages the HEPA filters are bounded by the case in which all filtration is assumed lost. No consideration was given to the possibility of external combustible gases, such as welding gases, being drawn into the DTS by the ventilation subsystem. The CO_2 appears to be stored in unprotected tanks, external to the DTS. No assurance was provided that the CO_2 will be available when needed under all accident conditions.

12.4.2.7 Major Mechanical Malfunction Involving the Spent Fuel Handling System During Operation Resulting in Dropping of a Fuel Assembly

Reviews of a major mechanical malfunction resulting in dropping of a fuel assembly and its potential consequences to the DTS facility included Subsection 8.2.7 of the TSAR (U.S. Department of Energy, 1996) and round one RAIs 8-1 through 8-5 (Stewart, 1999a).

The fuel assembly grapple and hoist have been designed according to ASME NOG–1 (American Society of Mechanical Engineers, 1995) so that dropping a SNF assembly is judged not to be a credible event. Factors of safety of 6, on yield, and 10, on ultimate strength, were used in designing the grapple and cable hoist. The NRC staff finds the use of ASME NOG–1 and the concomitant factors of safety acceptable for this application. Passive mechanical interlocks are provided that physically prevent the grapple from disengaging from the lifted fuel assembly. Electrical interlocks are provided to prevent operation of the grapple finger retraction actuators when under load. Finally, sensors are incorporated into the grapple that will not allow the hoist to lift until the grapple fingers are properly engaged with the fuel assembly.

The TSAR states that the recovery of a dropped fuel assembly will be through extraordinary means evaluated at the time of the event. Offsite radiation doses are bounded by the stuck fuel assembly event (Subsection 12.4.2.2 of this AR) if recovery is within 2 weeks and by the loss of confinement barrier analysis (Subsection 12.4.2.8 of this AR).

12.4.2.8 Complete Loss of High-Efficiency Particulate Air Filters and Loss of Pressure Differential

Reviews of the complete loss of HEPA filters and loss of pressure differential and the potential consequences to the DTS facility included Subsection 8.2.8 and Appendix 8A.6 of the TSAR (U.S. Department of Energy, 1996) and round one RAIs 8-1, 8-19, 8-20, and 8-35 (Stewart, 1999a).

The analysis assumes simultaneous failure of the cladding and fuel pellets in 21 fuel assemblies in a fully loaded receiving cask. Failed pellets are assumed to release 30 percent of Kr-85 and 10 percent of I-129 and H-3 into the fuel rod plenum, and all gaseous products are assumed to be released from the DTS over a period of 20 minutes. Stack height was neglected in the calculations. Relative concentrations were determined using the methodology of Regulatory Guide 1.145 (Nuclear Regulatory Commission, 1982), Subsection 1.1.1. Dose components were calculated following the method of Regulatory Guide 1.109 (Nuclear Regulatory Commission, 1977) and utilizing dose conversion factors from the U.S.

Environmental Protection Agency Federal Guidelines, reports Numbers 11 (Eckerman et al., 1989) and 12 (Eckerman and Ryman, 1993). Offsite radiation dose was well below the 5-rem limit of 10 CFR 72.106 at the minimum controlled boundary. As noted in round one RAI 8-34 (Stewart, 1999a), the source term used in Appendix 8A.6 will be corrected in the revised TSAR. This correction is not expected to change the conclusions from the analyses.

12.4.2.9 Loss of a Shield Plug or Source Cask Lid

Reviews of the loss of a shield plug or source cask lid and the potential consequences to the DTS facility included Subsection 8.2.9 of the TSAR (U.S. Department of Energy, 1996) and round one RAIs 8-2 and 8-12 (Stewart, 1999a).

The shield plug and source cask lid handling subsystem has been designed in conformance with ASME NOG–1 so that the dropping of cask lid or shield plug is judged not to be a credible event. Factors of safety of 6, on yield, and 10, on ultimate strength, were used in designing the grapple and cable hoist. Passive mechanical interlocks are provided that physically prevent the grapple from disengaging from the cask lid or shield plug under load. Electrical interlocks are provided to prevent operation of the grapple finger retraction actuators when under load. Finally, sensors are incorporated into the grapple that will not allow the hoist to lift until the grapple fingers are properly engaged with the grappling device and pintel on the lid or plug.

General procedures are given in the TSAR for recovery from a damaged source cask lid and receiving cask shield plug. Recovery from a damaged source cask lid is to transfer all SNF to the receiving cask, placing the shield plug on the receiving cask, and removing the empty source cask and damaged lid from the LAA. Recovery from damage to the receiving cask shield plug requires the transfer of all fuel from the receiving cask to empty source casks while the shield plug is off the receiving cask. A shielded tent is erected over the sliding door for radiation control when the door is opened to remove and replace multiple source casks. The empty receiving cask is removed from the LAA after the last source cask, into which SNF from the receiving cask has been placed, is removed. Because the SNF assemblies are shielded during this emergency recovery, radiation is bounded by the stuck fuel assembly event, Subsection 12.4.2.2 of this AR, and by the loss of confinement barrier analysis, Subsection 12.4.2.8 of the AR . These analyses assume no damage to the casks or fuel assemblies. This assumption is acceptable to the NRC staff as long as it can be shown that the site-specific casks will not allow a dropped shield plug or cask lid to sufficiently penetrate into the cask and cause damage to the fuel assemblies contained within.

12.4.2.10 Electrical Surges and Explosions

Review of electrical surges and explosions and their potential consequences to the DTS facility included Subsection 8.2.6 of the TSAR (U.S. Department of Energy, 1996), round one RAI 8-1 (Stewart, 1999a), and round two RAI 3-1 (Stewart, 1999b).

NFPA 780, Standard for the Installation of Lightning Protection Systems, (National Fire Protection Association, 1992) will be used for guidance to protect the DTS facility against lightning. Additionally, surge protection will be based on NFPA 70, National Electric Code, (National Fire Protection Association, 1999) which gives requirements for the installation and performance testing of ground fault protection systems. The Institute of Electrical and Electronic Engineers (IEEE) Guide for Instrumentation and Control Equipment Grounding in Generating Stations (Institute of Electrical and Electronic Engineers, 1996) will be followed to select grounding methods for protection of personnel and equipment, and provide suitable electrical noise immunity for the instrumentation and control equipment. IEEE C62.41-1991, IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits, (Institute of Electrical and Electronic Engineers, 1991) will be followed to establish circuit protection requirements and define the appropriate wave forms for equipment testing. Because the surge environment is extremely complex, and equipment protection cannot be fully assured, fire retardant wiring will be used in the DTS. As noted in Subsection 12.4.2.6 of the AR, fire extinguishers are provided and automatic CO_2 injectors are placed in electrical cabinets. Major operating equipment has been provided with redundant systems or provisions for manual operation.

Internal explosions are presumed not to occur because of the absence of explosive material in the DTS facility. Because the facility is under negative pressure to prevent release of radioactive material, a possibility exists that external explosive gas, such as welding gases, could be drawn into the facility.

External explosions are presumed to be bounded by the design of the facility for external pressures of 2.53 psi and for a pressure differential of 3 psi (DBT loads).

12.4.3 Site Characteristics Affecting Safety Analysis

A site has not been selected for the DTS. Bounding site characteristics and design criteria are discussed in Chapters 2 and 3 and were used in the various accident analyses except where noted in the individual evaluations.

12.5 Evaluation Findings

The NRC staff has reviewed the information presented in Chapter 8, Accident Analyses, of the TSAR and other supplementary documents provided by the DOE. Because a specific location for the DTS has not been selected yet, the TSAR does not contain site-specific information.

In addition to the design basis events for the generically sited DTS, the site-specific SAR will consider, at a minimum, the following design basis events to satisfy the requirements of 10 CFR 72.92 and 72.94:

- Analysis of aircraft impact
- Avalanche
- Landslide
- Soil shrinkage/swelling
- Associated consolidation and coastal erosion events

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

12.5.1 Off-Normal Events

The NRC staff has reviewed the generic information on off-normal events presented in the TSAR and found reasonable assurance that the design of the SSCs and the consequences analysis for the off-normal events satisfy the requirements of 10 CFR 72.11, 72.26, 72.44(c), and 72.120(a) for the nonsite-specific DTS installation. The following specific evaluations are given for each off-normal event identified.

12.5.1.1 Failure of the Cask Transfer Subsystem

- The NRC staff has reviewed the information in the TSAR, responses to the NRC RAIs, and the referenced documents and found reasonable assurance that the DTS can recover from any of the postulated off-normal failures of the CTS and related instrumentation in conformance with the requirements of 10 CFR 72.24(c), (l), and (m); 72.26; 72.40(a)(1 and 13); 72.44(c); 72.104(a); 72.106; 72.120(a); 72.122(a), (b), (g), and (h); and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (d), and (k) and 72.122(i) and (l):

- The details of how a tractor or prime mover can be used to reposition a cask trolley manually.

- The design details of the bumpers that are attached to the trolleys to mitigate the damage caused when a collision between the two trolleys, or between a trolley and a confinement barrier, occurs.

- The design details, including dimensions, for the individual trolley components.

12.5.1.2 Failure of the Cask Mating Subsystem

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and found reasonable assurance that the DTS can recover from any of the postulated off-normal failures of the CMS and related instrumentation in conformance with the requirements of 10 CFR 72.24(c), (l), and (m); 72.26; 72.40(a)(1 and 13); 72.44(c); 72.104(a); 72.106; 72.120(a); and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (d), and (k) and 72.122(i):

- Estimates of worker radiation doses that may be incurred while troubleshooting, removing and replacing, or repairing various components and/or sensors associated with the postulated failures of the CMS. This estimate will include the amount of contaminated particulates a worker can potentially be exposed to while replacing the bellows and seals.

- The details of the CMS electrical screw jack stress analysis.

- A demonstration that the CCTV subsystem will allow the remote operator from the control center to visually verify the position of all three vertical positioning jacks.

- Detailed stress calculations for the overlid-gripper device and its components. Calculated factors of safety should use the appropriate criteria, and the technical basis for the overlid thickness will be provided.

- The technical basis for how far a cask can be misaligned from vertical before the overlid-gripper device of the CMS will not be able to properly engage the lifting pintle on the cask lid or shield plug.

12.5.1.3 Failure of the Transfer Confinement Port Covers and Related Instrumentation

- The NRC staff has reviewed information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and found reasonable assurance that the DTS can recover from any of the postulated off-normal failures of the TC port covers and related instrumentation in conformance with the requirements of 10 CFR 72.24(c), (l), and (m); 72.26; 72.40(a)(1 and 13); 72.44(c); 72.104(a); 72.106; and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (d), and (k) and 72.122(i) and (l):

- The details of the manual override procedures and mechanisms related to the TC port covers, including the forces required to operate the manual overrides under worst case conditions. Estimates of worker radiation doses that may be incurred while performing the manual overrides will be included. Moreover, the specific location of the DTS penetrations and the design details of the tools to be used will also be provided. As a minimum bounding condition, it should be assumed that at least one of the casks remains unsealed while performing the manual override.

- Estimates of worker radiation doses that may be incurred while troubleshooting, removing and replacing, or repairing various components and/or sensors associated with the postulated failures of the TC port covers. As a minimum bounding condition, it should be assumed that at least one of the casks remains unsealed while performing the requisite service procedure.

- The procedures to be employed to recover from a TC port cover derailment when a source or receiving cask lid is loaded on it. Note that this scenario implies that one or both casks are unsealed.

- The structural design details for the TC port cover rail systems.

- The design details for the seals between the electrical screw jacks for the TC port cover trolleys and the DTS structure.

12.5.1.4 Failure of the Upper Shield Port Covers and Related Instrumentation

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and found reasonable assurance that the DTS can recover from any of the postulated off-normal failures of the upper shield port covers and related instrumentation in conformance with the requirements of 10 CFR 72.24(c), (l), and (m); 72.26; 72.40(a)(1 and 13); 72.44(c); 72.104(a); 72.106; 72.120(a); 72.122(a), (b), (g), and (h); and 72.128.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (d), and (k) and 72.122(i) and (l):

- The details of the manual override procedures and mechanisms related to upper shield port covers equipment, including the forces required to operate the manual overrides under worst case conditions. Estimates of worker radiation doses that may be incurred while performing the manual overrides will be included. Moreover, the specific location of the DTS penetrations and the design details of the tools to be used will also be provided. As a minimum bounding condition, it should be assumed that both of the casks are unsealed while performing the manual override.

- Estimates of worker radiation doses that may be incurred while troubleshooting, removing and replacing, or repairing various components and/or sensors associated with the postulated failures of the upper shield port covers if both of the casks cannot be resealed manually.

- The structural design details for the upper shield port covers rail systems.

12.5.1.5 Failure of the Upper Crane and Related Instrumentation

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and found reasonable assurance that the DTS can recover from any of the postulated off-normal failure of the upper crane and related instrumentation in conformance with the requirements of 10 CFR 72.24(c), (l), and (m); 72.26; 72.40(a)(1 and 13); 72.44(c); 72.104(a); 72.106; 72.120(a); 72.122(a), (b), (g), and (h); and 72.128.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (d), and (k) and 72.122(i) and (l):

- The details of the manual override procedures and mechanisms related to upper crane equipment, including the forces required to operate the manual overrides under worst case conditions. Estimates of worker radiation doses that may be incurred while performing the manual overrides will be included. Moreover, the specific location of the DTS penetrations and the design details of the tools to be used will also be provided. As a minimum bounding condition, it should be assumed that both of the casks are unsealed while performing the manual override.

- Estimates of worker radiation doses that may be incurred while troubleshooting, removing and replacing, or repairing various components and/or sensors associated with the postulated failures of the upper crane. As a minimum bounding condition, it should be assumed that both of the casks are unsealed while performing the repairs because manual overrides cannot be implemented.

- The details of how the compensator is used to alert the operator if one of the upper crane cables was to break.

- The details of how the hoist emergency brake is activated in the event that the service brake should malfunction as indicated by overtravel, overspeed sensors, or a loss of power.

- The details of how the emergency brake that is housed on the upper crane drum is activated in the event that the service brake should malfunction as indicated by overtravel, overspeed sensors, or a loss of power.

- The details of how the overload limit and concomitant alarms of the upper crane are adapted for the varying weights of the receiving cask shield plug and source cask lid.

- Detailed stress calculations for the upper crane grapple housing when subjected to seismic loading during operation.

- Justify the lack of redundant sensors for the control of the upper crane grapple.

- Explain how the “position selector” is used as a sensor as asserted in Table 5.4-5 of the TSAR.

- The technical basis for the limiting distance that a cask shield plug or lid can be dropped onto a TC port cover or the mezzanine between the TCA and the LAA.

- The materials to be used for the upper crane and its individual components.

12.5.1.6 Failure of the Fuel Assembly Handling Equipment

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and found reasonable assurance that the DTS can recover from any of the postulated off-normal failure of the fuel assembly handling equipment and related instrumentation in conformance with the requirements of 10 CFR 72.24(c), (l), and (m); 72.26; 72.40(a)(1 and 13); 72.44(c); 72.104(a); 72.106; 72.120(a); 72.122(a), (b), (g), and (h); and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information as a minimum to satisfy the requirements of 10 CFR 72.24(b), (d), and (k) and 72.122(i) and (l):

- The details of the manual override procedures and mechanisms related to the fuel assembly handling equipment, including the forces required to operate the manual overrides under worst case conditions. Estimates of worker radiation doses that may be incurred while performing the manual overrides will be included. Moreover, the specific location of the DTS penetrations and the design details of the tools to be used will also be provided. As a minimum bounding condition, it should be assumed that the fuel assembly is suspended within the fuel handling tube while performing the manual override.

- Estimates of worker radiation doses that may be incurred while troubleshooting, removing and replacing, or repairing various components and/or sensors associated with the postulated failures of the fuel assembly handling equipment. As a minimum bounding condition, it should be assumed that the manual overrides were ineffective and the fuel assembly is suspended within the fuel handling tube while performing the required service.

- Estimates for how many iterations may be required to replace the fuel assembly manually into a cask given that the rotating platform and fuel assembly trolley can only be repositioned manually when the system is in a specific location. Estimates of how this will affect the amount of time needed to recover from a severe accident will be provided.

- The definition for overtravel of the rotating platform. An explanation of how the emergency brake for the rotating platform is engaged if the overtravel limit switch is activated will also be included.

- The possible effect, failure detection, and compensating provision associated with the untimely or partial closing of the crud catcher.

- The dimensional details of the conical lead-in for the fuel handling tube designed to minimize the potential of snagging the fuel assembly spacers.

12.5.1.7 Failure of the Heating, Ventilation, and Air Conditioning Subsystem Components

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and found reasonable assurance that the DTS can recover from any of the postulated off-normal failure of the HVAC subsystem components and related instrumentation in conformance with the requirements of 10 CFR 72.24(c), (l), and (m); 72.26; 72.40(a)(1 and 13); 72.44(c); 72.104(a); 72.106(b); 72.120(a); 72.122(a), (b), (g), and (h); and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (d), and (k) and 72.122(i):

- The technical basis for the assertion that the exhaust subsystem is sufficient to maintain temperatures below the allowable for 72 hours in the event that the cooling subsystem was to fail. The analysis needs to take into account the allowable temperature gradient across the DTS concrete walls, cladding temperature, and allowable temperatures for the CCTV subsystem. Moreover, the analysis should be conducted for both minimum and maximum ambient temperature scenarios.

12.5.1.8 Failure of the Control Subsystem Components

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and found reasonable assurance that the DTS can recover from any of the postulated off-normal failure of the control subsystem components in conformance with the requirements of 10 CFR 72.26, 72.40(a)(1 and 13), 72.44(c), 72.104(a), 72.106, 72.120(a), and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b):

- A comprehensive list of off-normal failures of the control subsystem and the design features and operational procedures addressing those failures. A failure analysis of the control subsystem (including instrumentation), requirements for the control subsystem design, and tests and inspections verifying the capability of the control subsystem, DTS, or operator to handle those off-normal failures. Identify the interlocks related to the operation of the control subsystem equipment, the various sensors used to implement the interlocks and their level of redundancy.

- An analysis of actions and procedures that demonstrate the operator’s capability to address off-normal and accident conditions, where credit is given for the mitigation of such conditions.

12.5.1.9 Failure of the Radiation Monitoring Equipment

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and found reasonable assurance that the DTS can recover from any of the postulated off-normal failure of the radiation monitoring equipment in conformance with the requirements of 10 CFR 72.26, 72.40(a)(1 and 13), 72.44(c), 72.104(a), 72.106(b), 72.120(a), and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (d), and (e):

- An explanation of how a failure of a radiation monitor is detected, including the monitor located in the exhaust stack.

- An assessment of the potential effects of a failed radiation monitor on the functionality of interlocks dependent on radiation level readings.

- The technical basis for the assumption that a monitor failure in either the LAA, the TCA, or the REA would be redundantly supported by the monitors still functional in the other two areas.

- The operational interpretations of the various radiation monitoring levels that can be expected during the fuel transfer process.

- Assurance that the radiation monitors conform to (i) ANSI N13.1 (American National Standards Institute, 1999), Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities; (ii) NUREG–0800 (Nuclear Regulatory Commission, 1981a), Section 11.5; or (iii) Regulatory Guides 8.5 (Nuclear Regulatory Commission, 1981b), 8.25 (Nuclear Regulatory Commission, 1980), and 8.34 (Nuclear Regulatory Commission, 1992) as specified in Subsection 9.4.3.5 of NUREG–1567 (Nuclear Regulatory Commission, 1996).

12.5.1.10 Failure of Equipment in the Preparation Area

- The NRC staff has reviewed the information presented in the TSAR and responses to the NRC RAIs and the referenced documents and found reasonable assurance that the DTS can recover from failures of equipment that are located in the PA in conformance with the requirements of 10 CFR 72.24, 72.26, 72.40(a)(1 and 13), 72.44(c), 72.104(a), 72.106(b), 72.120(a), and 72.128(a).

12.5.1.11 Loss of External Power Supply for up to 24 Hours

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and did not find reasonable assurance that the DTS can recover from failure of the external power supply for a 24-hour span to satisfy the requirements of 10 CFR 72.24, 72.26, 72.40(a)(1 and 13), 72.44(c), 72.104(a), 72.106(b), 72.120(a), 72.122, and 72.128(a).

12.5.1.12 Off-Normal Thermal Loads

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and did not find reasonable assurance that the DTS can recover from the postulated off-normal thermal loads necessary to satisfy the requirements of 10 CFR 72.24, 72.26, 72.40(a)(1 and 13), 72.44(c), 72.104(a), 72.106(b), 72.120(a), 72.122, and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of these regulations:

- Detailed off-normal thermal analyses that provide the temporal and spatial variation of the temperature within the DTS and across the concrete walls. This analysis must use the site-specific fuel characteristics to perform this analysis. Both upper and lower bound ambient temperature scenarios must also be addressed. In addition, the parameters typically associated with a thermal analysis must be provided. Specifically, the various convective heat transfer coefficients, radiation emissivities and view factors, material thermal conductivities, insolation values, etc., that were used for the thermal analyses must be provided. If commercial software packages are used to perform the analysis, DOE will provide the necessary documentation for the NRC staff to aid in interpreting the relevant input and output data formats.

12.5.1.13 Heavy Snow Storm

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and found reasonable assurance that the DTS can withstand heavy snow storm loads in conformance with the requirements of 10 CFR 72.24(b) and (g); 72.26; 72.40(a)(1 and 13); 72.44(c); 72.104(a); 72.106(b); 72.120(a); 72.122; and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(c) and (d):

- The design details for the exhaust stack and its components with regard to keeping snow and water from draining into the DTS.

- Clarification of the snow loads applied in the DTS structural analysis.

12.5.1.14 Lightning

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and the referenced documents and found reasonable assurance that the DTS can recover from lightning strike in conformance with the requirements of 10 CFR 72.26, 72.40(a)(1 and 13), 72.44(c), 72.104(a), 72.106(b), 72.120(a), 72.122, and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(b), (c), and (d):

- The design specifications of a site-specific lightning protection system for the DTS structure, the control trailer, and any other SSC susceptible to a lightning strike. Subsection 8.1.2.2 of the TSAR should be revised to reflect the potential consequences of a lightning strike event and any other relevant information.

- Justification for whether or not the trolley rail system should be considered susceptible to a lightning strike must also be provided because it does not appear to be inherently grounded.

12.5.2 Accidents

The NRC staff has reviewed the information on accidents presented in the TSAR and found reasonable assurance that the design of the SSCs and the consequence analysis for the postulated accidents, except for those noted below, satisfy the requirements of 10 CFR 72.11, 72.44(c), and 72.120(a) for the nonsite-specific DTS installation. The following specific evaluations are given for each accident.

12.5.2.1 Loss of the External Power Supply for an Extended Interval

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and references cited in the TSAR and did not find the reasonable assurance that reliable and timely emergency electrical power will be supplied to the facility to permit continued functioning of all DTS SSCs important to safety necessary to satisfy the requirements of 10 CFR 72.122(k)(3).

The site-specific SAR must include at least the following information to satisfy the requirements of 10 CFR 72.122(k)(3):

- Assurance that (i) secondary electrical power is available, even after an external event such as a tornado or earthquake; (ii) it is adequate for both facilities if the secondary power is provided by a collocated utility; and (iii) it can be supplied within the time necessary to prevent excessive differential temperatures through the walls of the DTS under worst case conditions and overheating of the cameras in the TCA.

12.5.2.2 Stuck Fuel Assembly or Inability to Insert a Fuel Assembly into a Cask

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and references cited in the TSAR and found reasonable assurance that the DTS can recover from a stuck fuel assembly, or the inability to insert a fuel assembly into a cask in conformance with the requirements of 10 CFR 72.24(b); 72.26; 72.40(a)(1); 72.44(c); 72.120(a); and 72.122(a), (b), and (h).

The site-specific SAR for the DTS must contain the following information to satisfy the requirements of 10 CFR 72.24(d), (k), and (m); 72.40(a)(13); 72.104(a); 72.106(b); 72.122(d) and (l); and 72.128(a):

- Emergency procedures, time estimates, and estimated radiation doses to workers and offsite personnel for recovery from a fuel assembly that is damaged and a fuel assembly that is stuck and cannot be freed from the cask.

- The relevant equipment design details and operational procedures that will minimize the potential occurrence of a stuck fuel assembly or prevent a fuel assembly from being inserted into a cask.

12.5.2.3 Failure of the Fuel Grapple to Disengage

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and references cited in the TSAR and found reasonable assurance that the DTS can safely recover from the failure of the fuel grapple to disengage in conformance with the requirements of 10 CFR 72.24(a), (b), and (h); 72.26; 72.40(a)(1); 72.44(c); 72.104(a); 72.106(b); 72.120(a); and 72.122(a), (b), (d), and (h).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(d), (k), and (m); 72.40(a)(13); 72.122(l); and 72.128(a):

- Emergency procedures and estimated radiation doses to workers for recovery from failure of the fuel grapple to disengage.

12.5.2.4 Seismic Loading

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and references cited in the TSAR and found reasonable assurance that the DTS can safely withstand the design basis earthquake in conformance with the requirements of 10 CFR 72.11; 72.24(a), (b), and (c)(1, 2, and 4); 72.26; 72.44(c); 72.102(f); and 72.120(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(d); 72.90(c); 72.92; 72.122(a), (b), (d), and (l); and 72.128(a):

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

- Analysis of the upper crane assembly using the generic design spectrum or a site-specific spectrum.

- Revision of the seismic analyses of the cask trolley systems using site-specific cask and trolley weights.

- Analyses using technically defensible methods to determine the seismic loads for the upper crane fingers and grapple analysis because the simple mass proportionality used in Appendix 8A.4.16 of the TSAR may introduce significant errors (i.e., $F_{1T}/F_{2T} \neq M_1/M_2$) for dynamic loads.

- Technically defensible stress and factor of safety calculations for the TC port cover locking pins when subjected to seismic loads.

- The kinematic repercussions of having only two fuel handling grapple fingers holding up a BWR fuel assembly during a seismic event.

12.5.2.5 Tornado Missiles, Hurricanes, and High Winds

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and references cited in the TSAR and found reasonable assurance that the DTS can resist the tornado missiles, hurricanes, and high winds in conformance with the requirements of 10 CFR 72.24(b), 72.26, 72.44(c), and 72.120(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(d); 72.90(c); 72.92; 72.122(a), (b), (d), and (l); and 72.128(a):

- Studies to confirm that DBT loads used for the analysis of the DTS are not exceeded by site-specific conditions.

- Analyses to ensure that source or receiving casks will not tip over due to impact by a tornado driven missile while mounted on trolleys in the PA.

- Demonstration of the adequacy of the REA and the protective enclosure that houses the exhaust fans and PLC to resist penetration by tornado driven, 6-inch diameter and 12-inch diameter pipe missiles when struck near hard points on the structure.

- Clarification of whether the cask lids will be placed back on, or left off the casks in the event of a tornado warning. Conflicting procedures were identified in the TSAR and responses to the RAIs (Stewart, 1999a,b).

- The technical basis for taking a 2-hour credit in which to place the DTS into a safe condition given a tornado warning.

- Evaluation of the consequences of losing the LAA sliding door seals and air curtain duct work in the event that the PA is lost as a result of a tornado strike.

- Clarification of whether the secondary power supply distribution panel is susceptible to tornado damage as is the primary power supply distribution panel located in the PA.

12.5.2.6 Fire

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and references cited in the TSAR and found reasonable assurance that the DTS can resist the effects of fires in conformance with the requirements of 10 CFR 72.24, 72.26, 72.40(a)(1 and 13), 72.44(c), 72.104(a), 72.106(b), 72.120(a), 72.122(c), and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.94(c):

- A demonstration, based on site-specific conditions, that (i) there are no threats from external fires, (ii) no sources of flammable gases that could be drawn into the DTS by the ventilation subsystem, and (iii) a supply of CO_2 will be available when needed under all accident conditions.

12.5.2.7 Major Mechanical Malfunction Involving the Spent Fuel Handling System During Operation Resulting In Dropping of a Fuel Assembly

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and references cited in the TSAR and found reasonable assurance that the DTS can safely recover from a dropped fuel assembly in conformance with the requirements of 10 CFR 72.24(b); 72.26; 72.40(a)(1); 72.44(c); 72.120(a); 72.122(a), (b), and (h); and 72.124.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(d), (k), and (m); 72.40(a)(13); 72.104(a); 72.106(b); 72.122(d) and (l); and 72.128(a):

- Emergency procedures for recovery from a dropped fuel assembly and estimates of offsite and worker radiation doses for the recovery procedures.

12.5.2.8 Complete Loss of High-Efficiency Particulate Air Filters and Loss of Pressure Differential

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and references cited in the TSAR and found reasonable assurance that offsite radiation doses from the complete loss of particulate containment will not endanger the public in conformance with the requirements of 10 CFR 72.24(b), 72.26, 72.40(a)(1), 72.44(c), 72.104(a), 72.120(a), 72.122(h), and 72.128(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.40(a)(13) and 72.106(b):

- Revised offsite radiation doses for this postulated accident with the correct source term.

12.5.2.9 Loss of a Shield Plug or Source Cask Lid

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and references cited in the TSAR and found reasonable assurance that the DTS can recover from a dropped cask lid or shield plug without endangering the general public in conformance with the requirements of 10 CFR 72.24(a) and (b); 72.26; 72.40(a)(1); 72.44(c); 72.104(a); 72.106; 72.120(a); and 72.122(a) and (b).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(d), (k), and (m); 72.40(a)(13); 72.122(h) and (l); and 72.128(a):

- Detailed site-specific emergency procedures for recovery from a damaged cask lid or shield plug and estimated radiation doses to offsite personnel and workers at the DTS.

- Assurance that a cask lid or shield plug, if dropped, will not be able to sufficiently penetrate into the interior of the cask and cause damage to the fuel assemblies contained within.

12.5.2.10 Electrical Surges and Explosions

- The NRC staff has reviewed the information presented in the TSAR, responses to the NRC RAIs, and references cited in the TSAR and found reasonable assurance that the DTS can resist the effects of electrical surges and explosions in conformance with the requirements of 10 CFR 72.24(b), 72.26, 72.44(c), 72.94(c), and 72.120(a).

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.122(c):

- Site-specific information demonstrating that the requirements of Regulatory Guide 1.91 (Nuclear Regulatory Commission, 1978) pertaining to acceptable distances from potential explosion sources have been met.

- A demonstration that the blast load effects as defined by Regulatory Guide 1.91 (Nuclear Regulatory Commission, 1978) are bounded by the DBT loads.

12.5.3 Site Characteristics Affecting Safety Analysis

- A site has not been selected for the DTS. Bounding site characteristics and design criteria are discussed in Chapters 2 and 3. Where appropriate, the off-normal and accident analyses evaluated in Section 12.4 used the bounding site characteristics identified in Chapters 2 and 3 of the TSAR except where noted. An evaluation will be required for each site to determine if the bounding site characteristics are exceeded. The evaluation must include (i) magnitude of design basis earthquake, tornado, and hurricane; (ii) if the site is above the flood plain and free of ground faults; (iii) the probability for seiches, tsunami, landslides, volcanic activity, and aircraft impact; (iv) the probability for significant soil-structure interaction; (v) the magnitude and location of external fire and explosive sources; (vi) population density near the site; (vii) availability of secondary power; (viii) perimeter control afforded by the site; and (ix) the effects of interaction with collocated facilities.

12.6 References

American Concrete Institute. *Code Requirements for Nuclear Safety Related Concrete Structures.* ACI 349-95. Detroit, MI: American Concrete Institute. 1995.

American National Standards Institute. *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*. ANSI N13.1. American National Standards Institute. New York: American National Standards Institute. 1999.

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

American National Standards Institute and American Society of Civil Engineers. *Minimum Design Loads for Building and Other Structures.* ANSI/ASCE 7-95. New York: American National Standards Institute/American Society for Civil Engineers. 1995.

American Society of Mechanical Engineers. *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)*. ASME NOG–1–1995. New York: American Society of Mechanical Engineers. 1995.

Ekerman, K.F., and J.C. Ryman. *External Exposure to Radionuclides in the Air, Water, and Soil.* Federal Guidance Report Number 12. Washington, DC: U.S. Environmental Protection Agency. 1993.

Eckerman, K.F., A.B. Wolbarst, and A.C.B. Richardson. *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion.* Federal Guidance Report Number 11. Washington, DC: U.S. Environmental Protection Agency. 1989.

Institute of Electrical and Electronic Engineers. *IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.* IEEE C62.41–1991. New York: Institute of Electrical and Electronic Engineers. 1991.

Institute of Electrical and Electronic Engineers. *IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations.* IEEE 1050–1996. New York: Institute of Electrical and Electronic Engineers. 1996.

National Bureau of Standards. *Tornado-Borne Missile Speeds*. NBSIR 76-1050. Gaithersburg, MD: National Bureau of Standards. 1976.

National Fire Protection Association. *Standard for the Installation of Lightning Protection Systems*. NFPA 780. Quincy, MA: National Fire Protection Association. 1992.

National Fire Protection Association. *National Electric Code*. NFPA 70. Quincy, MA: National Fire Protection Association. 1999.

Nuclear Regulatory Commission. *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix 1.* Regulatory Guide 1.109. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1977.

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

Nuclear Regulatory Commission. *Calibration and Error Limits of Air Sampling Instruments for Total Volume of Air Sampled.* Regulatory Guide 8.25. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1980.

Nuclear Regulatory Commission. *Missiles Generated by Natural Phenomena, Standard Review Plan*. NUREG–0800 (Formerly NUREG–76/087). Revision 2. Washington, DC: Nuclear Regulatory Commission. 1981a.

Nuclear Regulatory Commission. *Criticality and Other Interior Evacuation Signals.* Regulatory Guide 8.5 Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1981b.

Nuclear Regulatory Commission. *Atmospheric Dispersion Models for Potential Accident Consequence Assessments of Nuclear Power Plants*. Regulatory Guide 1.145.

Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1982.

Nuclear Regulatory Commission. *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses.* Regulatory Guide 8.34. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1992.

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

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

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999b.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (August 18) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999c.

U.S. Atomic Energy Commission. *Design Basis Tornado for Nuclear Power Plants*. Regulatory Guide 1.76. Washington, DC: U.S. Atomic Energy Commission. 1974.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report.* Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

13 CONDUCT OF OPERATIONS

13.1 Review Objective

The objective of the review and evaluation is to ensure that the applicant has the appropriate infrastructure to manage, test, and operate the facility and to conduct effective training and emergency planning and response procedures. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete review of the conduct of operations as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

13.2 Areas of Review

The following listing shows the areas of review addressed in Section 13.4, Conduct of Review:

Organizational Structure

Preoperational Testing and Operation

Training Programs

Normal Operations

Emergency Planning

13.3 Regulatory Requirements

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

- 72.24
- 72.28
- 72.30(d)
- 72.32(a)
- 72.40(a)(4, 5, 9, and 11)
- 72.44(b)(4 and 5)
- 72.72
- 72.74
- 72.75
- 72.76
- 72.78
- 72.80(a), (c), and (d)
- 72.82(e)
- 72.122(d), (e), (f), (g), (h)(1), and (l)
- 72.128
- 72.144(d)
- 72.162
- 72.164
- 72.166
- 72.190
- 72.192
- 72.194
- 72.212(b)(6, 7, and 8)

- 72.104

13.4 Conduct of Review

The NRC staff evaluated conduct of operations by reviewing Chapter 9, Conduct of Operations, of the TSAR (U.S. Department of Energy, 1996), DOE responses to the NRC RAIs (Stewart, 1999a,b), and the documents cited in the RAI responses.

The proposed TSAR as modified by the RAI responses (Stewart, 1999a,b) describes the organizational structure that will manage and operate the DTS and the associated plans and procedures for preoperational testing and operation, training programs, normal operations, and emergency planning. This information includes descriptions of the responsibilities of key personnel and training programs, and commitments to use standards and procedures that govern daily operation and to generate records as a result of those operations. The controls and programs used to promote safety and ensure compliance with the license and the regulations applicable to the facility are also included.

In performing the conduct of operations review, the NRC staff determined that the respective elements required by Regulatory Guide 3.48 (Nuclear Regulatory Commission, 1989) were submitted. The review included consideration of guidance provided in NUREG–1567 (Nuclear Regulatory Commission, 1996), lessons learned from prior reviews, and the documentation submitted by the applicant.

13.4.1 Organizational Structure

Section 9.1, Organizational Structure, of the TSAR and the responses to round one RAI 9-1 (Stewart, 1999a) describe the organizational structure to be used to manage and operate the DTS.

13.4.1.1 Institutional Organization

Section 9.1, Organizational Structure, of the TSAR states that the corporate organization will be site-specific. The responses to round one RAI 9-1 give sufficient detail for a generic site organization. The responses to round one RAI 9-1 present Subsections 9.1.1, Corporate Organization; 9.1.1.1, Corporate Functions, Responsibilities, and Authorities; 9.1.1.2, Site Organization for Operation of the DTS; and Figure 9.1.1.2, which gives the proposed organization, including responsibilities and reporting relationships for the corporate organization and its various generic groups. The organizational interfaces and planning for operations, QA, training, maintenance, radiological control, emergency preparedness, and other vital functions must be coordinated with the corporate organization licensing the DTS to be in compliance with 10 CFR 72.24(h), 72.28(a) and (c), 72.32(a)(7, 8, 9, 12, 14, and 15), 72.122(d) and (e), 72.40(a)(4, 5, 9, and 11), and 72.144(d).

The institutional authority for the management and operation of the DTS will be delegated to the Senior Site Manager. As discussed in the responses to round one RAI 9-1, the Senior Site Manager will be responsible for overall management of the site and for the DTS Manager complying with regulatory provisions. Authority to procure, manage, and operate the DTS will be delegated to the DTS Manager, who reports to the Senior Site Manager, and interfaces with the Site Safety Review Committee, Emergency Response Organization, Radiological Safety Organization, and other Utility and Facility Organizations. The DTS Operations Manager and

Technical Services Manager will report to the DTS Manager. QA responsibility will be delegated to the DTS QA Manager.

The DTS will have a Safety Review Committee that reports to the Senior Site Manager. This committee will review the design, operations, and maintenance procedures and other safety-related operations of the DTS. The technical qualifications for the Safety Review Committee core members are described in Subsection 9.1.1.2.6 of the responses to round one RAI 9-1. Members will be appointed to this committee as determined necessary by the Senior Site Manager.

The proposed organization of the DTS management is depicted in Figure 9.1.1.2 of the responses to RAI 9-1. The duties and responsibilities of these individuals and subordinates, as they relate to the operation of the DTS, are adequately described in the responses to round one RAI 9-1. These descriptions and the organizational figure demonstrate there will be sufficient independence for essential support functions for the DTS, such as QA, radiological control, emergency response, and training.

As discussed in Subsection 9.1.1.2.7.4, Other Site Services, of the responses to round one RAI 9-1, the DTS will use the extensive site infrastructure to support the higher risk operations conducted at the site. Therefore, there is no need for reliance on an offsite response.

13.4.1.2 Onsite Organization

The DTS Manager has ultimate responsibility to identify, establish, or approve requirements and performance objectives applicable to the DTS. These responsibilities will include oversight of the performance of the DTS personnel. Responsibility for oversight of the QA programs and for the DTS will be the responsibility of the DTS QA Manager.

At the completion of facility construction, licensing, and testing, the responsibility for daily operation of the facility will be turned over to the DTS Operations Manager. The DTS Operations Manager will be responsible for the receipt, handling, storage, and transfer of SNF at the DTS. The DTS Operations Manager will be a certified SNF handling operator. The DTS Engineering Manager will be responsible for the safe maintenance of the facility; reconfiguration of equipment, if required; and refurbishment of degrading facilities to ensure safety and environmental compliance.

The DTS Technical Services Manager will report to the DTS Manager and will be responsible for implementing the training requirements described in the new Subsections 9.1.1.2.3 and 9.3, Training Program, given in the responses to round one RAIs 9-1 and 9-3.

The DTS organization will have an operations staff of matrixed engineers and technicians at the site who may be asked to assist in the performance and management of the DTS. The NRC staff review finds the onsite organization structure acceptable because it defines the relationships between corporate organizations and clearly delineates authority and responsibility. Responsibility is clear to specific individuals and parts of the organization and the functions of radiation protection and other safety groups that are organizationally separate from site (nuclear plant) operations. A Safety Review Committee is required in the TSAR to be properly organized and staffed. This onsite committee, which will be established within the existing site structure, manages higher risk facilities than the DTS and provides reasonable assurance that activities at the DTS will be conducted safely and in accordance with applicable requirements.

The NRC staff reviewed the proposed onsite organization to determine if it is acceptable and provides reasonable assurance that activities will be conducted safely and in accordance with regulations 10 CFR 72.24(h), 72.28(c), 72.122(d) and (e), and 72.144(d).

13.4.1.3 Management and Administrative Controls

Section 9.4, Normal Operations, of the TSAR commits to preparing and using operation, maintenance, and testing procedures that will be employed at the DTS. Subsection 9.4.2, Records, of the TSAR describes that the existing site procedures and requirements of the collocated nuclear facility for maintaining records will be used for the DTS. These procedures will comply with, or exceed, the requirements of 10 CFR 72.24(e) and (h), 72.44(c)(5), and 72.144(d), since they are acceptable for a licensed nuclear power plant. The site record keeping procedures will include a record retention period; QA requirements; operating records that document principal maintenance, alterations, and additions to facilities; records of off-normal occurrences and events associated with radioactive releases; records for decommissioning; and environmental surveys. Specific operating maintenance, testing, and training procedures will be developed using existing site document management procedures.

The NRC staff reviewed the management and administrative controls to be applied at the DTS to determine if they provide reasonable assurance that operations at the site will be properly controlled and documented. For the most part, these management and administrative controls will consist of controls already applied to higher risk activities at the host nuclear facility or DOE nonreactor site.

13.4.2 Preoperational Testing and Operation

As stated in Section 9.2, Pre-Operational Testing and Operation, the TSAR commits to using procedures that encompass preoperational testing for normal and off-normal operations. The TSAR includes a listing and description of the system and subsystem testing to be done prior to SNF transfer. Prior to any transfer of SNF, a series of preoperational test, start-up tests, and a readiness review will be developed and implemented.

Subsection 9.2.1.1, Pre-Operational Testing Plan, of the responses to round one RAI 9-2 states that pre-operational testing will be performed on all systems important to safety. The specific preoperational tests identified in Section 9.2 of the TSAR will be directly observed by NRC staff to determine that the preoperational test plan will provide for safe operation of the DTS in accordance with the requirements of 10 CFR 72.24(g), (j), and (p); 72.122(f); 72.162; and 72.164.

Subsection 9.2.1.2, Operating Start-up Plan, of the responses to round one RAI 9-2, states that operating start-up tests are performed on all components important to safety. These tests verify the handling times and radiation dose rates within the DTS. Start-up testing will provide for safe operation of the DTS in accordance with the requirements of 10 CFR Part 72 and any site-specific license conditions to verify operational limits.

13.4.3 Training Programs

Subsection 9.3.1, General, and Subsection 9.3.2, General Employee Training, in the responses to round one RAI 9-3, provide the generic training program description for the DTS. The training program for the DTS operation will be consistent with site-specific programs, provided the DTS training includes the elements described in Subsection 9.3.1. The DTS training addresses General Employee Training, Nuclear Safety Training, and the Technical Training Program and will be specific to employee needs. Subsection 9.3.3, Continuing Training, of the responses to round one RAI 9-3, establishes a program to ensure the employees maintain proficiency on the job, in compliance with 10 CFR 72.28(a), (b), and (d); 72.32(a)(10); 72.40(a)(4 and 9); 72.44(b)(4 and 5); 72.144(d); 72.190; 72.192; and 72.194.

13.4.4 Normal Operations

Section 9.4, Normal Operations, of the TSAR includes Subsections 9.4.1, Procedures, and 9.4.2, Records, which are evaluated in the following subsection.

13.4.4.1 Procedures

The DTS operational procedures address normal operations for radiation protection, maintenance, testing, and QA procedures. These procedures are to be established to assure the safe operation of the DTS. The NRC staff reviewed the commitment to prepare procedures to govern safety-related activities using proven administrative controls in effect at the collocated nuclear facility. This commitment provides reasonable assurance that safety-related activities will be conducted in accordance with 10 CFR 72.24(e), (f), and (l); 72.40(a)(4 and 5); 72.104; 72.122(h) and (l); and 72.166.

13.4.4.2 Records

Records for the DTS operations and training will be maintained in accordance with the site-specific programs, which is consistent with 10 CFR Part 72 requirements. The site-specific program will specify record retention periods and quality assurance requirements for all the various procedures, documents, and records generated for normal and off-normal operations. These records include shipping, receiving and SNF transfers. The NRC staff reviewed the record keeping procedures committed to in the TSAR. This commitment provides reasonable assurance that the DTS records will be properly developed and maintained in accordance with 10 CFR 72.30(d); 72.72, 72.74, 72.75, 72.76, 72.78, 72.80(a), (c), and (d), 72.82(e), 72.122(g), (h)(1), and (l), and 72.212(b)(7 and 8).

13.4.5 Emergency Planning

No evaluation of emergency planning was conducted because the TSAR is non site-specific. The Emergency Plan will be addressed in the site-specific SAR.

13.5 Evaluation Findings

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

13.5.1 Organizational Structure

- The NRC staff has reviewed the information on the generic organizational structure presented in Section 9.1, Organizational Structure, of the TSAR and in the responses to round one RAI 9-1 and found reasonable assurance that the guidelines provided address: (i) the basic requirements of 10 CFR 72.24 for an appropriate organizational structure and for a set of effective administrative and management controls; (ii) the basic requirements of 10 CFR 72.28(c) for the proposed onsite operating organization, delegations of responsibility and authority, and the skills and qualifications; (iii) the basic requirements of 10 CFR 72.40 that the licensee be qualified by reason of training and experience for proper management and administrative controls; and (iv) the requirements of 10 CFR 72.122 (d) and (e) that the interactions between the site and the DTS are appropriate.

The site-specific SAR must include the following information to satisfy the requirements of 10 CFR 72.24(e) and (h); 72.28(a) and (c); 72.32(a); 72.40(a)(4, 5, 9, and 11); 72.44(b)(4 and 5); and 72.144(d):

- Details of the organizational structure, administrative and management controls, delegations of responsibility and authority, and the relevant qualifications of the personnel.

13.5.2 Preoperational Testing and Operation

- The NRC staff has reviewed the information on the preoperational and operational testing presented in Section 9.2, Pre-Operational Testing and Operation, of the TSAR and the responses to round one RAI 9-2, and found reasonable assurance that the proposed guidelines satisfy the regulatory requirements of 10 CFR 72.122(f) for the conduct of operations without endangering the health and safety of the public and DTS personnel.

The site specific SAR must include the following information to satisfy the requirements of 10 CFR 72.24(g), (j), and (p); 72.162; and 72.164:

- The detailed preoperational and operational testing to be conducted at the DTS facility.

13.5.3 Training Programs

- The NRC staff has reviewed the information on the generic training program presented in Section 9.3, Training Program, of the TSAR and responses to round one RAI 9-3 and found reasonable assurance that the proposed guidelines satisfy the basic requirements of 10 CFR 72.190, 72.192, and 72.194 for (i) the training and qualification of personnel to engage in the proposed activities; (ii) the applicant’s technical qualifications; (iii) ensuring that the applicant is qualified by training and experience to conduct the licensed activities without endangering the health and safety of the public; (iv) the training and certification of personnel; (v) adequate operator training and certification program; and (vi) the physical condition and general health of operators.

The site-specific SAR must include the following information to satisfy the requirements of 10 CFR 72.28(a), (b), and (d); 72.32(a)(10); 72.40(a)(4 and 9); 72.44(b)(4 and 5); and 72.144(d):

- The details of the training program to be implemented at the DTS facility.

13.5.4 Normal Operations

- The NRC staff has reviewed the information on normal operations presented in Section 9.4, Normal Operations, of the TSAR and found reasonable assurance that the proposed guidelines satisfy the basic requirements of 10 CFR 72.122(g), (h)(1), and (l), and 72.212(b)(6, 7, and 8) for appropriate technical qualifications for the licensee staff and for reasonable assurance that the activities authorized by the license can be conducted without endangering health and safety or the environment.

The site-specific SAR must include the following information to satisfy the requirements of the regulations:

- Assurance that the vegetative cover surrounding the DTS will be maintained to ensure it is not a credible fuel source for a fire.

- The normal operational procedures shall address:

  - The suspension of fuel transfer operations when the DTS external temperature approaches $-20°F$ (-29 C). Reference Subsection 3.6.5 of the TSAR.

  - The suspension of fuel transfer operations when the DTS external temperature approaches 115°F (46°C). Reference Subsection 3.6.5 of the TSAR.

  - Those actions that must be initiated or ceased when the differential temperature across the DTS concrete structures approaches 70°F (39°C), note that ($\Delta T°F \times 5/9$) $= \Delta T°C$. Reference Subsection 4.3.1.4 of the TSAR.

13.5.5 Emergency Planning

The site-specific SAR must include the following information to satisfy the requirements of the regulations:

- A detailed description of the emergency plan.

13.6 References

Nuclear Regulatory Commission. *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage)*. Regulatory Guide 3.48. Revision 1. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1989.

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. October 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report*. Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

14 TECHNICAL SPECIFICATIONS

14.1 Review Objective

The objective of this review and evaluation is to ensure that the functional and operational limits and the limited technical specifications developed by the DOE for the nonsite-specific DTS are appropriately justified, defined, and acceptable to provide for safe facility operations and ensure health and safety of the public and DTS personnel. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete review of the technical specifications as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The limited proposed technical specifications do not meet the requirements of 10 CFR 72.26. The additional information that must be included in the site-specific SAR of the DTS is identified.

14.2 Areas of Review

The following listing shows the areas of review addressed in Section 14.4, Conduct of Review:

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

Limiting Conditions of Operation

Surveillance Requirements

Design Features

Administrative Controls

14.3 Regulatory Requirements

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

- 72.7
- 72.24
- 72.26
- 72.44
- 72.48
- 72.82(e)
- 72.90
- 72.92
- 72.94
- 72.96
- 72.98
- 72.100
- 72.102
- 72.104
- 72.106
- 72.108
- 72.122
- 72.126(c)(2)

14.4 Conduct of Review

The NRC staff evaluated technical specifications by reviewing Chapter 10, Operating Controls and Limits, of the TSAR (U.S. Department of Energy, 1996), DOE responses to the NRC RAIs (Stewart, 1999a,b), and documents cited in the RAI responses. The proposed TSAR as modified by the RAI responses present the DTS technical specifications, conditions of operation, operating controls, and limits for the five areas of review previously listed. As noted in the TSAR, the technical specifications define the necessary and sufficient conditions for safe operation of the DTS. Chapter 3, Principal Design Criteria, presents the design features of the DTS.

In performing the technical specifications review, the NRC staff determined that the respective elements required by Regulatory Guide 3.48 (Nuclear Regulatory Commission, 1989) were submitted. The review included consideration of guidance provided in NUREG–1567 (Nuclear Regulatory Commission, 1996), lessons learned from prior reviews, and the documentation submitted by the applicant.

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

Review of this section consisted of evaluating functional and operating limits for the DTS related to SNF or waste handling conditions. The limits are necessary to: (i) protect the integrity of the SNF and casks, (ii) protect employees against occupational exposures, and (iii) guard against the uncontrolled releases of radioactive materials that may affect the health and safety of the public and DTS personnel (Sections 10.1 and 10.2 of the TSAR). Monitoring limits and limiting control settings for the DTS are those related to SNF and waste handling conditions having significant safety functions as defined in 10 CFR 72.24(e) and (l), 72.26, and 72.44. The NRC staff reviewed the operating limits and control settings to assure compliance with 10 CFR 72.7, 72.24, 72.26, 72.44, 72.104, 72.106, 72.122, and 72.126(c)(2).

The following technical conditions and characteristics are specified for the DTS:

- Limitations on SNF and casks
- Surface examination of casks
- Ventilation system and HEPA filter performance requirements
- Cask and SNF handling equipment
- System interlocks for safe operation
- Radiation monitoring inside and outside the DTS
- Cranes, grapples, and transfer trolleys

The bases for selecting these conditions and characteristics are described in the bases sections for each of the technical specifications in Sections 3.3, Safety Protection Systems; 4.2, Confinement Structures; and Chapter 10, Operating Controls and Limits, of the TSAR. The overall technical and operational considerations are to minimize the likelihood of the uncontrolled release of radioactive material and to ensure dose limits are not exceeded at the DTS.

14.4.2 Limiting Conditions of Operation

Review of this section consisted of evaluating the limiting conditions for operation that are the lowest functional capability of equipment required for safe operation for the cask and SNF handling systems as described in Sections 10.1, Proposed Operating Controls and Limits, and 10.2, Development of Operating Controls and Limits, of the TSAR. The NRC staff reviewed the limiting conditions of operations necessary to meet the regulations of 10 CFR 72.24, 72.26, 72.44, 72.104, 72.106, and 72.122. The review also consisted of evaluating the responses to round one RAIs 10-1, 10-2, 10-3, and 10-7 (Stewart, 1999a). This evaluation covers the following equipment and technical conditions and characteristics of the installation necessary for operation, which are:

- Only intact fuel assemblies will be transferred in the DTS.
- All cask designs will be verified to ensure proper interface with the DTS.
- Dose rates will be limited to levels less than or equal to (i) 300 mrem/hr at the surface on the side of a cask and (ii) 250 mrem/hr on the center of the cask top.
- Cask handling will be done to prevent cask damage and to ensure SNF containment during credible events.

The following specification applies:

- DTS handling of SNF and casks is governed by site-approved procedures and administrative controls.

The following surveillance activities are required:

- Crane inspections
- Grapple inspections
- Sensor functional testing
- Radiation and ventilation systems surveys will be performed consistent with the 10 CFR Part 20, Radiation Protection Program

14.4.3 Surveillance Requirements

Review of this section consisted of evaluating the surveillance requirements, including frequency and scope, described in Subsections 10.2.3, Surveillance Requirements, and the response to round one RAIs 10-4, 10-5, and 10-6 (Stewart, 1999a) regarding surveillance and monitoring requirements. The NRC staff reviewed the surveillance requirements to assure compliance with 10 CFR 72.24, 72.26, 72.44, 72.104, 72.106, 72.122, and 72.126(c)(2). Table 14-1 provides a summary of the surveillance and monitoring requirements for the DTS facility.

Table 14-1. Summary of surveillance and monitoring requirements for the Dry Transfer System

Surveillance or Monitoring	Period	Reference of TSAR Subsection
Limitation on SNF	PT	10.2.1.4
Examination of Casks	L	10.2.1.1
Spent Fuel and Cask Handling and Alignment	L, TS, FI, SM	10.2.1.2, 10.2.1.3, 10.2.1.5-8, 10.2.1.10-14, and 10.2.2.2.2
Tornados	C	10.2.3.4
Leak Testing Ventilation Housing and HEPA Seals	FI	10.2.2.1.2
Surveillance of Ventilation System and HEPAs and Particulates System Checks	C, PS, SM	10.2.2.1.1, 10.2.2.1.3, and 10.2.3.3
Radiation Monitoring	C	10.2.3.1
Sensor Function	TS, L	10.2.1.9, 10.2.1.10, 10.2.1.12, 10.2.1.14 and 10.2.2.2.3
Legend: C — Continuous PT — Prior to transfer L — Before loading, unloading, and/or prior to movement FI — Following installation HEPA — High-efficiency particulate air PS — Per shift TS — Per specified technical specification SM — Scheduled maintenance SNF — Spent nuclear fuel TSAR — Topical Safety Analysis Report		

14.4.4 Design Features

Review of this section consisted of evaluating Section 3.6, Summary of Design Criteria, of the TSAR. The NRC staff reviewed the design features to assure compliance with 10 CFR 72.7, 72.82(e), 72.90, 72.94, 72.96, 72.98, 72.100, 72.102, 72.108, and 72.122. The following design features are important to the safe operation of the DTS:

- Lifting and handling equipment
  - — Material mechanical properties for structural integrity.
  - — Maximum allowable loads.

- DTS
  - — Site conditions and design specification.
  - — Material specifications for structural integrity and shielding.
  - — Configuration for effective decay heat removal.
  - — Maximum dose rates.

- Cask
  - — Material specifications for structural integrity and shielding.
  - — Decay heat removal during dry storage cask transport and transfer.
  - — Maximum dose rates.

Component dimensions are not specified here because the combination of materials, dose rates, and component fit-up define the operable limits for dimensions (e.g., thickness of shielding materials and concrete). The values for these design parameters are specified on the TSAR drawings. Changes to any of these design features will be implemented in accordance with the safety evaluation requirements of 10 CFR 72.48.

The combination of the above controls and limits, and those discussed in the previous subsections of Section 10.2, Development of Operating Controls and Limits, of the TSAR define requirements for the DTS components that provide radiological protection and structural integrity during normal SNF transfers and postulated accident conditions.

14.4.5 Administrative Controls

Review of this section included the technical specifications in Subsection 10.2.5, Administrative Controls, of the TSAR. These conditions were deemed necessary for safe operation of the DTS. This section was reviewed in conjunction with Chapter 9, Conduct of Operations, of the TSAR to ensure they are defined. The NRC staff reviewed the administrative controls to assess compliance with 10 CFR 72.24(e), (h) and (j), 72.44, 72.106, and 72.122.

A documentation package will be prepared for each site-specific DTS. This package will document that the unloading of these casks and the sealing and testing operation have been performed in accordance with the detailed procedures and controls that will be developed consistent with the TSAR and site-specific requirements.

14.5 Evaluation Findings

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

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

- The NRC staff has reviewed the information presented in Sections 10.1, Proposed Operating Controls and Limits, and 10.2, Development of Operating Controls and Limits, of the TSAR and found reasonable assurance that the requirements for the DTS operating limits and controls under 10 CFR 72.7, 72.122, and 72.126(c)(2) have been satisfied at a generic level. The proposed nonsite-specific technical specifications for functional and operating limits, monitoring limits, and limiting control settings provide reasonable assurance that the DTS will allow safe handling of SNF provided that the cask systems are appropriately licensed, and the controls and conditions identified in the TSAR are properly monitored and limited.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24, 72.26, 72.44, 72.104, and 72.106:

- All the site-specific technical specifications for functional and operating limits, monitoring limits, and limiting control settings necessary to ensure regulatory compliance.

14.5.2 Limiting Conditions of Operation

- The NRC staff has reviewed the information presented in Sections 10.2, Development of Operating Controls and Limits, of the TSAR and found reasonable assurance that the requirements for the limiting conditions of operation under 10 CFR 72.122 are satisfied at a generic level. The proposed limiting conditions for operation provide reasonable assurance that the DTS will allow safe transfer of SNF with the condition that the various cask systems are appropriately licensed and the equipment, technical conditions, and characteristics of the installation necessary for continuous operation, identified in Sections 10.1 and 10.2 of the TSAR, are properly monitored or under adequate surveillance.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24, 72.26, 72.44, 72.104, and 72.106:

- The site-specific technical specifications for limiting conditions of operation necessary to ensure regulatory compliance.

14.5.3 Surveillance Requirements

- The NRC staff has reviewed the information presented in Subsection 10.2.3, Surveillance Requirements, of the TSAR and found reasonable assurance that the surveillance requirements under 10 CFR 72.122 and 72.126(c)(2) are satisfied at a generic level. The proposed surveillance requirements provide reasonable assurance that the DTS will allow safe transfer of SNF.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24, 72.26, 72.104, and 72.106:

- All the site-specific technical specifications for surveillance requirements necessary to ensure regulatory compliance.

14.5.4 Design Features

- The NRC staff has reviewed the information presented in Sections 3.6, Summary of Design Criteria, of the TSAR and found reasonable assurance that the requirements for the design features under 10 CFR 72.7 and 72.122 are satisfied at a generic level. The proposed design features for the SSCs provide reasonable assurance that the DTS will allow safe transfer of SNF.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.82(e), 72.90, 72.94, 72.96, 72.98, 72.100, 72.102, and 72.108:

- The site-specific technical specifications for the design features necessary to ensure regulatory compliance.

14.5.5 Administrative Controls

- The NRC staff has reviewed the information presented in Subsection 10.2.5, Administrative Controls, of the TSAR and found reasonable assurance that the requirements of 10 CFR 72.122 are satisfied at a generic level. The proposed administrative controls provide reasonable assurance that the DTS will allow safe transfer of SNF.

The site-specific SAR for the DTS must contain at least the following information to satisfy the requirements of 10 CFR 72.24(e), (h), and (j), 72.44, and 72.106:

- All the site-specific technical specifications for the administrative controls necessary to ensure regulatory compliance.

14.6 References

Nuclear Regulatory Commission. *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage).* Regulatory Guide 3.48. Revision 1. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1989.

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities*. NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348 Washington, DC: U.S. Department of Energy. 1999b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report*. Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

15 QUALITY ASSURANCE

15.1 Review Objective

The objective of this review and evaluation is to determine whether a site-specific user of the DTS has a QA program that complies with the requirements of 10 CFR Part 72, Subpart G. Development of the design of the DTS was performed in accordance with a QA program established in conformance with the requirements of 10 CFR Part 72, Subpart G and approved by NRC. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete review of the principal design criteria as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

15.2 Regulatory Requirements

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

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

15.3 Conduct of Review

As indicated in Section 11 of the TSAR, the NRC has issued a 10 CFR Part 72 Subpart G QA program approval to Transnuclear. Based on the review of the QA program described in the SAR and previous NRC determinations regarding Transnuclear's 10 CFR Part 72 QA program, the staff has determined that the design of the DTS was conducted by a vendor with a QA program meeting the requirements of Subpart G of 10 CFR Part 72. Because the TSAR is not site-specific no further QA program review was conducted.

15.4 Evaluation Findings

The site specific SAR for the DTS must contain information to satisfy the requirements of 10 CFR Part 71, Subpart G.

15.5 References

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report.* Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

16 DECOMMISSIONING

16.1 Review Objective

The objective of this review of the conceptual decommissioning plan for the DTS is to ensure that it provides reasonable assurance that the owner/user of the DTS can conduct decontamination and decommissioning in a manner that adequately protects the health and safety of the public. Nothing in this review considers, or involves the review of, ultimate disposal of SNF. Information presented in Sections 3.4 and 3.5 of the TSAR was not evaluated. Because the TSAR (U.S. Department of Energy, 1996) is not site-specific, a complete review of the principal design criteria as specified in NUREG–1567 (Nuclear Regulatory Commission, 1996) is not possible. The additional information that must be included in the site-specific SAR of the DTS is identified.

16.2 Regulatory Requirements

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

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

16.3 Conduct of Review

DOE determined that the DTS can be decommissioned using standard industry practices. All components can be decontaminated using existing mechanical or chemical methods. Equipment that is not practical to decontaminate will be packaged for disposal in accordance with the site requirements. However, information relating to the site-specific requirements was not in the TSAR.

16.4 Evaluation Findings

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

16.5 References

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities. NUREG–1567.* Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report. Volumes 1, 2, and 3.* Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

17 EVALUATION CONCLUSIONS

This chapter provides a summary of the NRC staff conclusions and recommendations with regard to the TSAR.

17.1 Satisfaction of Required Contents of Application

The required contents of a license application are stated in 10 CFR Part 72, Subpart B. The following entries identify the information given in the TSAR and responses to RAIs and include summarized NRC staff conclusions.

17.1.1 General and Financial Information

The evaluation of general and financial information is beyond the scope of this review.

17.1.2 Technical Information (Topical Safety Analysis Report)

- The documention includes technical information provided by the TSAR and responses to the RAIs. The information that was provided is considered to comply to the nonsite-specific requirements for its content as stated in 10 CFR 72.24.

17.1.3 Technical Specifications

- The documentation includes only limited proposed technical specifications for a nonsite-specific DTS with supporting bases and justifications provided in the TSAR and responses to the RAIs. The proposed technical specifications do not meet the requirements of 10 CFR 72.26.

17.1.4 Applicant's Technical Qualifications

- The documentation includes descriptions of general technical qualifications for the nonsite-specific DTS. These qualifications are incorporated into the TSAR as required. The adequacy of these qualifications, however, can only be assessed on a site-specific basis and cannot be considered to meet the requirements of 10 CFR 72.28.

17.1.5 Proposed Decommissioning Plan

- Information presented in the TSAR concerning decommissioning of the TSAR is not evaluated because it is beyond the scope of this review and can only be assessed on a site-specific basis and cannot be considered to meet the requirements of 10 CFR 72.30.

17.1.6 Emergency Plan

- The evaluation of the emergency plan is beyond the scope of this review and can only be assessed on a site-specific basis and cannot be considered to meet the requirements of 10 CFR 72.32.

17.1.7 Environmental Report

- The evaluation of the environmental report is beyond the scope of this review and can only be assessed on a site-specific basis and cannot be considered to meet the requirements of 10 CFR 72.34 and 10 CFR Part 51.

17.2 Satisfaction of Requirements for Issuance of License

- This information in this section can only be assessed on a site-specific basis and cannot be considered to meet the requirements of 10 CFR 72.28.

17.2.1 Design Compliance with 10 CFR Part 72, Subpart F

- The TSAR is considered to provide acceptable evidence that the proposed generic design meets the requirements of 10 CFR Part 72, Subpart F, based on the recommended nonsite-specific bounding design criteria, technical specifications.

17.2.2 Site Compliance with 10 CFR Part 72, Subpart E

- The proposed DTS is a nonsite-specific facility and, consequently, cannot be fully evaluated regarding compliance with the requirements of 10 CFR Part 72, Subpart E.

17.2.3 Compatibility with Collocated Licensed Facilities

- The proposed DTS is a nonsite-specific facility that will be built at multiple reactor sites or DOE facilities. As a result, the compatibility of the proposed DTS with collocated licensed facilities for compliance with 10 CFR 72.40(a) and (b) cannot be assessed.

17.2.4 Applicant Qualifications to Conduct Operations

- The proposed DTS is a nonsite-specific facility and, consequently, cannot address the requirements of 10 CFR 72.40(a)(4). However, the TSAR and responses to RAIs convey DOE commitment to providing adequate and acceptable evidence that the DOE is qualified to operate the DTS.

17.2.5 Operating Procedures to Protect Health and Minimize Dangers

- The TSAR and responses to RAIs submitted in support of the application include proposed guidelines for the operating procedures and administrative controls that will provide adequate and acceptable provisions for protection of health and minimization of danger to life or property, as required by 10 CFR 72.40(a)(5). The specific details of this requirement have been left to the site-specific license applicant to address.

17.2.6 Quality Assurance Compliance with 10 CFR Part 72, Subpart G

- The design of the DTS was conducted by a vendor with a QA program meeting the requirements of 10 CFR 72 Subpart G. All other QA requirements have been left to the site-specific license applicant to address.

17.2.7 Physical Protection Planning in Compliance

- The evaluation of physical protection planning is beyond the scope of this review and can only be assessed on a site-specific basis and cannot be considered to meet the requirements of 10 CFR 72.24, 72.40 and 10 CFR Part 72, Subpart G.

17.2.8 Personnel Training Compliance with 10 CFR Part 72, Subpart I

- The TSAR and responses to RAIs submitted in support of the application include proposed guidelines for training, proficiency testing, and certification of DTS personnel, as required by 10 CFR Part 72, Subpart I. The specific details of this requirement have been left to the site-specific license applicant to address.

17.2.9 Decommissioning Planning Compliance with 10 CFR 72.30

- The evaluation of decommissioning planning is beyond the scope of this review and can only be assessed on a site-specific basis and cannot be considered to meet the requirements of 10 CFR 72.30.

17.2.10 Emergency Plan Compliance with 10 CFR 72.32

- The evaluation of the emergency plan is beyond the scope of this review and can only be assessed on a site-specific basis and cannot be considered to meet the requirements of 10 CFR 72.32.

17.2.11 Payment of Fees in Compliance with 10 CFR Part 170

- The evaluation of payment of fees is beyond the scope of this review.

17.2.12 Reasonable Assurance

- The TSAR and responses to RAIs submitted in support of the application provides sufficient information for the NRC staff to conclude that there is reasonable assurance the activities to be authorized by a site-speicific license could be conducted in compliance with 10 CFR Part 72, Chapter 1 so long as the site-specific requirements are within the bounding parameters identified in the application are met and the site-specific Environmental Report complies with the regulatory requirements.

17.2.13 Not Inimical to Common Defense and Security

- The documentation submitted with the TSAR must be augmented with site-specific information before the NRC staff can consider making a finding that there is reasonable assurance that the issuance of a license will not be inimical to the common defense and security and is in compliance with 10 CFR 72.40(a)(14).

APPENDIX A

REQUIRED SCOPE OF SITE-SPECIFIC SAFETY ANALYSIS REPORT

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

A.1.5.1 Introduction

- Location of the site: vicinity and sketch of location on a map extract of approximately 1:100,000 or larger scale.

- The Quality Assurance (QA) program that satisfy the requirment of Subpart G to be applied to:

  — Select the site
  — Construct the facility
  — Fabricate and install the equipment
  — Test the systems
  — Operate the systems
  — Modification of equipment and facility
  — Decommission the facility and site

A.1.5.2 General Description of the Dry Transfer System Installation

- A summary of principal site characteristics: potential for flooding; seismic characteristics; proximity to habitation, communities, and transportation and pipeline routes; soil conditions; and external events.

A.1.5.4 Identification of Agents and Contractors

- The prime agent for the construction and operation of each DTS facility will be determined after site selection and will be identified in the site-specific SAR.

A.2.5.1 Geography and Demography

- Information on site location including site host state and county; site latitude, longitude, and Universal Mercator coordinates; and map and aerial photographs with radial coverage extending a minimum of 8 km (5 miles) from the site.

- A detailed site description indicating the site boundary and the controlled area, controlled area access points, and the distances from the boundary to significant features of the installation, as required by 10 CFR 72.106.

- Maps showing the site topography and surface drainage patterns as well as roads, railroads, transmission lines, wet lands, and surface water bodies of the site.

- Descriptions of the vegetative cover and surface soil characteristics.

- Demographic information, such as current population data and projections throughout the planned period of operation of the dry transfer system (DTS).

- A sector map of population dividing the area within an 8 km radius of the site by concentric circles with radii of 1.5, 3.0, 5.0, 6.5, and 8.0 km and by 22.5-degree segments, each segment centered on one of the 16 compass points.

- Population data overlaid on a base map showing the nearby cities or towns.

- Locations of maximally exposed individual(s) identified including the rationale for selection.

- A description of the land and water use within an 8 km radius of the site.

A.2.5.2 Nearby Industrial, Transportation, and Military Facilities

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

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

- A description of the services supplied by the collocated nuclear facility or the U.S. Department of Energy (DOE) nonreactor site.

- An analysis of the impact of the DTS on the collocated nuclear facility or DOE nonreactor site.

A.2.5.3 Meteorology

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

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

- Define the probable maximum precipitation (PMP).

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

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

- The site characteristics must demonstrate that the probability of occurrence of floods, tsunami, and seiches is sufficiently low to consider them noncredible events. This includes adequate supporting documentation to claim the selected site is flood dry, as indicated in American National Standards Institute/American Nuclear Society 2.8-1992, taking into account probably maximum flood (PMF) on adjacent streams and rivers, seismically induced dam failures, and ice-jam flooding. As identified in the accident analysis chapter, Section 12.1 of the assessment report (AR), these natural phenomena are not addressed.

A.2.5.4 Surface Hydrology

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

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

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

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

A.2.5.5 Subsurface Hydrology

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

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

- A description of the water table history and anticipated groundwater conditions beneath the site during DTS construction and operation.

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

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

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

A.2.5.6 Geology and Seismology

- Geologic history of the area describing its lithologic, stratigraphic, and structural conditions.
- A large-scale map of the site showing surface geology and the location of major faults.
- Stratigraphic columns and cross sections of the site.
- Planar and linear features such as folds, faults, synclines, anticlines, basins, and domes identified on a geologic map showing bedrock surface contours.
- A description of the site morphology including areas of potential landslide or subsidence along with a topographic map showing geomorphic features and principal site facilities.
- Any physical evidence of behavior of surficial site materials during previous earthquakes.
- If the site is located in an active volcanic region, then site-specific investigations should be performed to determine if ash fall from volcanic eruptions will affect the safety and environmental impact of the proposed DTS.
- Maps showing all potentially significant faults or parts of faults within 161 km of the site and epicenters of historical earthquakes with all capable faults (as defined in 10 CFR Part 100, Appendix A) identified.
- A description of any mapped faults 300 meters or longer within the site.
- A description of the stability of the rock (defined as having a shear velocity of at least 1,166 m/s) and soil beneath the foundations of the DTS structures.
- A description of the geologic features, such as areas of potential uplift or collapse, or zones of deformation, alteration, structural weakness, or irregular weathering.
- A description of the static and dynamic engineering properties of the materials underlying the site as well as physical properties of foundation materials.
- A plot plan showing the locations of all borings, trenches, seismic lines, piezometers, geologic cross sections, and excavations with all DTS structures superimposed illustrating relationships among major foundations and subsurface materials, structure, and the water table.
- Plans and profiles of any excavation and backfill with compaction criteria.
- An analysis of rock and soil responses to dynamic loading along with estimation calculations of the liquefaction potential and safety factors.
- A contour map to demonstrate that the selected site is flat without potential for slope stability problems.

- A discussion of the potential effects of erosion and deposition.

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

- A description of any dissolution features or karst deposits.

A.3 Principal Design Criteria

- A detailed probabilistic risk assessment/risk analysis for the DTS including a detailed failure modes and effects analysis.

A.3.5.2 Classification of Structures, Systems, and Components

- It must be demonstrated that either primary or emergency power will be sufficient and available within an acceptable time frame for all credible accident scenarios.

A.3.5.3.2 Structural

- The characteristics of the soil in relationship to a hard rock site analyzed in the TSAR (U.S. Department of Energy, 1996). Site-specific response spectra will have to be generated for sites at which the soil will influence response of the DTS structure.

A.3.5.3.4 Shielding/Confinement/Radiation Protection

- The characteristics of the fuel assemblies and the specific source and receiving casks including geometry, design characteristics, and spent nuclear fuel (SNF) characteristics. If these characteristics are bounded by those given in the topical safety analysis report (TSAR), no additional analysis is required. If the site-specific data are not bounded by the TSAR, additional shielding and confinement analysis will be required.

A.3.5.3.5 Criticality

- The design details and specifications of the criticality monitoring system to be employed at the DTS (see the proposed license condition pertaining to criticality monitoring defined in Subsection 10.5.1 of this AR).

A.4.5.1 General Operating Functions

- The site-specific operation steps to accomplish SNF transfer in the DTS.

A.4.5.2 Spent Fuel Waste Handling Systems

- Procedures for cask transfer from transportation vehicles, cask receipt inspection, and initial cask decontamination.

- Confirmation that the programmable logic controllers (PLC) selected meets all conditions specified in the response to round two request for additional information (RAI) 5-7 (Stewart, 1999b).

- Confirmation that the technical specifications and scheduled maintenance procedures for the selected closed-circuit television (CCTV) system components comply with the specifications given in response to round two RAI 5-9 (Stewart, 1999b).

A.4.5.4 Other Operating Systems

- A description of, and operation procedures for, the welding subsystem used to open and seal cask lids and shield plugs.

- The operational procedures that will be employed to ensure that the weld cutting operation used in the preparation area (PA) to unseal the source cask lid has been completed satisfactorily.

- A description of, and operation procedures for, the inerting subsystem used for inerting the receiving cask after it has been filled with SNF assemblies.

- A description of, and operation procedures for, the portable decontamination vacuum subsystem.

A.4.5.5 Operation Support Systems

- Design specifications of the sensors and other relevant instrumentation demonstrating these devices can function as intended within the radiation and temperature ranges expected under normal, off-normal, and accident conditions.

- A description of safety requirements, tests, and surveillance procedures ensuring the capability of the instrumentation and control systems to support operations of the DTS and to mitigate those off-normal and accident situations.

A.4.5.6 Control Room and Control Areas

- Details of the security monitoring system.

A.5.5.1 Description of Operations

- Specific details of the DTS operating characteristics and concomitant safety considerations.

A.5.5.2.1 Spent Nuclear Fuel Handling Subsystems

- Specific operational details of the SNF handling subsystems

A.5.5.2.3 Operation Support System

- A detailed description of the operation of the support systems.

- Detailed descriptions of all auxiliary systems required to support the loading and off-loading of the SNF. These descriptions must include details pertaining to operation, monitoring, and maintenance of these systems.

A.5.5.2.4 Control Room and Control Areas

- Detailed descriptions of the Control Room and Control Areas. These descriptions must include details pertaining to operation, monitoring, and maintenance.

A.5.5.2.5 Analytical Sampling

- The details of the analytical sampling procedures and methods to be employed at the DTS facility for testing and monitoring components important to safety.

A.5.5.2.6 Preventive Maintenance

- The details of the Preventive Maintenance program to be implemented at the DTS facility.

A.6.5.1 Onsite Waste Sources

- Detailed information of the onsite waste sources and a listing of processes and procedures for disposal of the solid, liquid, and gaseous waste.

A.6.5.2 Offgas Treatment and Ventilation

- Detailed information, including the expected amount of the gaseous waste, the offgas treatment and the ventilation subsystem.

A.6.5.3 Liquid Waste Treatment and Retention

- Detailed information, including the expected amount of the liquid waste, of the liquid waste treatment and retention subsystems.

A.6.5.4 Solid Wastes

- Detailed information, including the expected amounts of the solid waste and its means of disposal.

A.6.5.5 Radiological Impact of Normal Operations

- Radiological impact of normal and off-normal operation based on estimated values of generated waste.

A.7.5.1 Description of Structures, Systems, and Components

- An evaluation of the DTS design, including updated design analyses, in the event that design changes must be made to accommodate any differences in the cask design parameters. This will require consideration of the cask related design criteria presented in Chapter 3, Principal Design Criteria, of the TSAR and the bounding conditions analyzed in Chapter 8, Accident Analyses, of the TSAR.

- Detailed description of the design of the fuel assembly handling subsystem which may be changed based on the source and receiving cask design. The drawings presented in

Chapter 1, Introduction and General Description of Installation, and the description given in Section 4.3, Auxiliary Subsystems, of the TSAR provide a basis for the design. Sufficient information is not provided, however, to determine the adequacy of the SSC to perform its safety function.

- Detailed description of the design provisions and procedures for installation of the pintle to the cask lid and shield plug. Sufficient information is not provided to determine the adequacy of the SSC to perform its safety function.

- Site-specific analysis to accommodate soil-structure interaction and design adjustments. This analysis will have to be made and should include

  — Level of the mezzanine plate if adjusted to accommodate the actual cask and fuel assemblies. This will require reanalysis of the structure.

  — The concrete base mat must be designed for the site-specific foundation requirements.

  — Final reinforcement steel arrangement must be specified to accommodate local shear stress.

- Detailed specifications to establish the quality of the materials and workmanship for both the reinforced concrete and the structural steelwork. These specifications will be based on American Concrete Institute (ACI) 301 (American Concrete Institute, 1996) and American National Standards Institute/American Society of Steel Construction (ANSI/AISC) N690 (American National Standards Institute and American Institute of Steel Construction, 1989).

- Structural design, procurement, testing, construction, fabrication, and erection activities important to safety. These items will be controlled under the overall QA Plan for the project and will be in accordance with the site-specific license requirements.

A.7.5.2 Confinement Structures, Systems, and Components

- The design details, including the material properties used in the design and construction of all SSCs important to safety.

A.7.5.5 Other Structures, Systems, and Components Important To Nuclear Safety

- The current classification, number, and locations of the cameras and lighting elements. The structural integrity and susceptibility of these components to the environment, including temperature and radiation levels, and accident conditions will be reviewed under the site-specific application.

- A description of the cask transfer, cask component handling, and fuel assembly handling subsystems to ensure they are adequate for the site-specific casks. As identified in the TSAR, the secondary response spectra do not correspond to the spectra identified in the analysis of the reinforced concrete structure (Appendix 8A.1 of the TSAR). The analysis will be redone for the site-specific application.

A.7.5.6 Other Structures, Systems, and Components Subject to Nuclear Regulatory Commission Approval

- A general description of the cask mating subsystem (CMS) based on the characteristics of the site-specific source and receiving casks.

- Information on the inventory and characteristics of the nuclear materials of the collocated services.

- Information on the analysis of the other SSCs and the ability of the collocated services to provide the required services to the DTS.

- A detailed description of the design and testing of the control system. The description should include applicable codes and standards that are applied to the control subsystem during design and operation.

A.8.5.2 Material Temperature Limits

- Description of the strength and temperature characteristics of the concrete to be used for the DTS SSCs. Identify all applicable codes and technical specification requirements

A.8.5.4 Analytical Methods, Models, and Computations

- The various assumptions and techniques employed in constructing the mathematical abstraction for all relevant thermal analyses. In addition, the parameters typically associated with a thermal analysis must be provided. Specifically, the various convective heat transfer coefficients, radiation emissivities and view factors, material thermal conductivities and insolation values that were used for the thermal analyses. If commercial software packages are used to perform the analyses, the licensee must provide the necessary documentation for the NRC staff to aid in interpreting the relevant input and output data formats.

A.9.5.1 Ensuring that Occupational Radiation Exposures Are As Low As Reasonably Achievable

- A description of the as low as reasonably achievable (ALARA) policy of the DTS facility to demonstrate compliance with 10 CFR 20.1101(b).

- Procedures used for summation of external and internal doses as required by 10 CFR 20.1202 and 10 CFR 72.122(e).

- A description of the storage and control of licensed materials as required by 10 CFR 20.1801 and 20.1802.

A.9.5.3 Radiation Protection Design Features

- The site of the facility with respect to population centers and a description of the attempts made to locate the site away from population centers to the extent feasible to demonstrate compliance with 10 CFR 72.40(a)(13).

- The areas of the facility that will be designated as radiation areas, high-radiation areas, and very-high-radiation areas and controlled access as required by 10 CFR 20.1601(a–e) and 20.1602.

A.9.5.4 Estimated Onsite Collective Dose Assessment

- Estimates of annual doses to individual workers involved in the transfer of SNF to demonstrate that the worker dose limits does not exceed the limits defined in 10 CFR 20.1201.

- A description of the administrative procedures that will be required to ensure that the annual dose to any individual worker does not exceed the 10 CFR 20.1201 total effective dose equivalent limit of 5 rem.

A.9.5.5 Health Physics Program

- A description of the organization of the health physics program to meet the requirements of 10 CFR 20.1101(a).

- A description of the equipment, instrumentation, and facilities that will be available at the DTS and collocated nuclear facility to support the health physics program to meet the requirements of 10 CFR 20.1101(a).

- A description of the procedures used to implement the health physics program to meet the requirements of 10 CFR 20.1101(a).

- An indication that workers will be trained in accordance with 10 CFR 19.12.

- Documentation that doses to a minor and an embryo/fetus will be in accordance with 10 CFR 20.1207 and 20.1208.

- A description of the records required to satisfy the requirements of 10 CFR 20.2101, 20.2102, 20.2103, and 20.2106.

- A description of the conditions requiring individual radiation monitoring to satisfy 10 CFR 20.1502.

A.9.5.6 Direct Dose to the Offsite Public

- A demonstration that the annual dose equivalent at the fence from all sources of radiation exposure will not exceed the limits defined in 10 CFR 72.104.

A.11.5.1 Confinement Design Characteristics

- The design details of the ventilation and offgas systems.

A.11.5.2 Confinement Monitoring Capability

- The details of the confinement monitoring equipment and related procedures to be employed at the DTS facility.

A.11.5.4 Confinement Analyses

- A description of how internal exposures will satisfy the requirements of 10 CFR 20.1204.

A.11.5.5 Estimated Offsite Collective Dose Assessment

- A demonstration that radioactive materials released to the atmosphere during accident conditions will not cause a dose to a member of the public that exceeds the limits of 10 CFR 72.106.

A.12.5 Evaluation Findings

- In addition to the design basis events for the generically sited DTS, the site-specific SAR will consider, at a minimum, the following design basis events to satisfy the requirements of 10 CFR 72.92 and 72.94:

  — Analysis of aircraft impact
  — Avalanche
  — Landslide
  — Soil shrinkage/swelling
  — Associated consolidation and coastal erosion events.

A.12.5.1.1 Failure of the Cask Transfer Subsystem

- The details of how a tractor or prime mover can be used to reposition a cask trolley manually.

- The design details of the bumpers that are attached to the trolleys to mitigate the damage caused when a collision between the two trolleys, or between a trolley and a confinement barrier, occurs.

- The design details, including dimensions, for the individual trolley components.

A.12.5.1.2 Failure of the Cask Mating Subsystem

- Estimates of worker radiation doses that may be incurred while troubleshooting, removing and replacing, or repairing various components and/or sensors associated with the postulated failures of the CMS. This estimate will include the amount of contaminated particulates a worker can potentially be exposed to while replacing the bellows and seals.

- The details of the CMS electrical screw jack stress analysis.

- A demonstration that the CCTV Subsystem will allow the remote operator from the control center to visually verify the position of all three vertical positioning jacks.

- Detailed stress calculations for the overlid-gripper device and its components. Calculated factors of safety should use the appropriate criteria, and the technical basis for the overlid thickness will be provided.

- The technical basis for how far a cask can be misaligned from vertical before the overlid-gripper device of the CMS will not be able to properly engage the lifting pintle on the cask lid or shield plug.

A.12.5.1.3 Failure of the Transfer Confinement Port Covers and Related Instrumentation

- The details of the manual override procedures and mechanisms related to the transfer confinement (TC) port covers, including the forces required to operate the manual overrides under worst case conditions. Estimates of worker radiation doses that may be incurred while performing the manual overrides will be included. Moreover, the specific location of the DTS penetrations and the design details of the tools to be used will also be provided. As a minimum bounding condition, it should be assumed that at least one of the casks remains unsealed while performing the manual override.

- Estimates of worker radiation doses that may be incurred while troubleshooting, removing and replacing, or repairing various components and/or sensors associated with the postulated failures of the TC port covers. As a minimum bounding condition, it should be assumed that at least one of the casks remains unsealed while performing the requisite service procedure.

- The procedures to be employed to recover from a TC port cover derailment when a source or receiving cask lid is loaded on it. Note that this scenario implies that one or both casks are unsealed.

- The structural design details for the TC port cover rail systems.

- The design details for the seals between the electrical screw jacks for the TC port cover trolleys and the DTS structure.

A.12.5.1.4 Failure of the Upper Shield Port Covers and Related Instrumentation

- The details of the manual override procedures and mechanisms related to upper shield port covers equipment, including the forces required to operate the manual overrides under worst case conditions. Estimates of worker radiation doses that may be incurred while performing the manual overrides will be included. Moreover, the specific location of the DTS penetrations and the design details of the tools to be used will also be provided. As a minimum bounding condition, it should be assumed that both of the casks are unsealed while performing the manual override.

- Estimates of worker radiation doses that may be incurred while troubleshooting, removing and replacing, or repairing various components and/or sensors associated with the postulated failures of the upper shield port covers if both of the casks cannot be resealed manually.

- The structural design details for the upper shield port covers rail systems.

A.12.5.1.5 Failure of the Upper Crane and Related Instrumentation

- The details of the manual override procedures and mechanisms related to upper crane equipment, including the forces required to operate the manual overrides under worst case conditions. Estimates of worker radiation doses that may be incurred while performing the manual overrides will be included. Moreover, the specific location of the DTS penetrations and the design details of the tools to be used will also be provided. As a minimum bounding condition, it should be assumed that both of the casks are unsealed while performing the manual override.

- Estimates of worker radiation doses that may be incurred while troubleshooting, removing and replacing, or repairing various components and/or sensors associated with the postulated failures of the upper crane. As a minimum bounding condition, it should be assumed that both of the casks are unsealed while performing the repairs because manual overrides cannot be implemented.

- The details of how the compensator is used to alert the operator if one of the upper crane cables was to break.

- The details of how the hoist emergency brake is activated in the event that the service brake should malfunction as indicated by overtravel, overspeed sensors, or a loss of power.

- The details of how the emergency brake that is housed on the upper crane drum is activated in the event that the service brake should malfunction as indicated by overtravel, overspeed sensors, or a loss of power.

- The details of how the overload limit and concomitant alarms of the upper crane are adapted for the varying weights of the receiving cask shield plug and source cask lid.

- Detailed stress calculations for the upper crane grapple housing when subjected to seismic loading during operation.

- Justify the lack of redundant sensors for the control of the upper crane grapple.

- Explain how the “position selector” is used as a sensor as asserted in Table 5.4-5 of the TSAR.

- The technical basis for the limiting distance that a cask shield plug or lid can be dropped onto a TC port cover or the mezzanine between the TCA and the LAA.

- The materials to be used for the upper crane and its individual components.

A.12.5.1.6 Failure of the Fuel Assembly Handling Equipment

- The details of the manual override procedures and mechanisms related to the fuel assembly handling equipment, including the forces required to operate the manual overrides under worst-case conditions. Estimates of worker radiation doses that may be incurred while performing the manual overrides will be included. Moreover, the specific location of the DTS penetrations and the design details of the tools to be used will also be provided. As a minimum bounding condition, it should be assumed that the fuel assembly is suspended within the fuel handling tube while performing the manual override.

- Estimates of worker radiation doses that may be incurred while troubleshooting, removing and replacing, or repairing various components and/or sensors associated with the postulated failures of the fuel assembly handling equipment. As a minimum bounding condition, it should be assumed that the manual overrides were ineffective and the fuel assembly is suspended within the fuel handling tube while performing the required service.

- Estimates for how many iterations may be required to replace the fuel assembly manually into a cask given that the rotating platform and fuel assembly trolley can only be repositioned manually when the system is in a specific location. Estimates of how this will affect the amount of time needed to recover from a severe accident will be provided.

- The definition for overtravel of the rotating platform. An explanation of how the emergency brake for the rotating platform is engaged if the overtravel limit switch is activated will also be included.

- The possible effect, failure detection, and compensating provision associated with the untimely or partial closing of the crud catcher.

- The dimensional details of the conical lead-in for the fuel handling tube designed to minimize the potential of snagging the fuel assembly spacers.

A.12.5.1.7 Failure of the Heating, Ventilation, and Air Conditioning Subsystem Components

- The technical basis for the assertion that the exhaust system is sufficient to maintain temperatures below the allowable for 72 hours in the event that the cooling subsystem was to fail. The analysis needs to take into account the allowable temperature gradient across the DTS concrete walls, cladding temperature, and allowable temperatures for the CCTV subsystem. Moreover, the analysis should be conducted for both minimum and maximum ambient temperature scenarios.

A.12.5.1.8 Failure of the Control Subsystem Components

- A comprehensive list of off-normal failures of the control subsystem and the design features and operational procedures addressing those failures. A failure analysis of the control subsystem (including instrumentation), requirements for the control subsystem design, and tests and inspections verifying the capability of the control subsystem, DTS, or operator to handle those off-normal failures. Identify the interlocks related to the operation of the control subsystem equipment, the various sensors used to implement the interlocks and their level of redundancy.

A.12.5.1.9 Failure of the Radiation Monitoring Equipment

- An explanation of how a failure of a radiation monitor is detected, including the monitor located in the exhaust stack.

- An assessment of the potential effects of a failed radiation monitor on the functionality of interlocks dependent on radiation level readings.

- The technical basis for the assumption that a monitor failure in either the lower access area (LAA), the transfer confinement area (TCA), or the roof enclosure area (REA) would be redundantly supported by the monitors still functional in the other two areas.

- The operational interpretations of the various radiation monitoring levels that can be expected during the fuel transfer process.

- Assurance that the radiation monitors conform to: (i) ANSI N13.1 (American National Standards Institute, 1999), Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities; (ii) NUREG–0800 (Nuclear Regulatory Commission, 1981a) , §11.5; or (iii) Regulatory Guides 8.5 (Nuclear Regulatory Commission, 1981b), 8.25 (Nuclear Regulatory Commission, 1980), and 8.34 (Nuclear Regulatory Commission, 1992) as specified in Subsection 9.4.3.5 of NUREG–1567 (Nuclear Regulatory Commission, 1996).

A.12.5.1.12 Off-Normal Thermal Loads

- Detailed off-normal thermal analyses that provide the temporal and spatial variation of the temperature within the DTS and across the concrete walls. This analysis must use the site-specific fuel characteristics to perform this analysis. Both upper-and-lower bound ambient temperature scenarios must also be addressed. In addition, the parameters typically associated with a thermal analysis must be provided. Specifically, the various convective heat transfer coefficients, radiation emissivities and view factors, material thermal conductivities, insolation values, etc. that were used for the thermal analyses must be provided. If commercial software packages are used to perform the analysis, DOE will provide the necessary documentation for the NRC staff to aid in interpreting the relevant input and output data formats.

A.12.5.1.13 Heavy Snow Storm

- The design details for the exhaust stack and its components with regard to keeping snow and water from draining into the DTS.

- Clarification of the snow loads applied in the DTS structural analysis.

A.12.5.1.14 Lightning

- The design specifications of a site-specific lightning protection system for the DTS structure, the control trailer, and any other SSC susceptible to a lightning strike. Subsection 8.1.2.2 of the TSAR should be revised to reflect the potential consequences of a lightning strike event and any other relevant information.

- Justification for whether or not the trolley rail system should be considered susceptible to a lightning strike must also be provided because it does not appear to be inherently grounded.

A.12.5.2.1 Loss of the External Power Supply for an Extended Interval

- Assurance that: (i) secondary electrical power is available, even after an external event such as a tornado or earthquake; (ii) it is adequate for both facilities if the secondary power is provided by a collocated utility; and (iii) it can be supplied within the time necessary to prevent excessive differential temperatures through the walls of the DTS under worst-case conditions and overheating of the cameras in the TCA.

A.12.5.2.2 Stuck Fuel Assembly or Inability to Insert a Fuel Assembly into a Cask

- Emergency procedures, time estimates, and estimated radiation doses to workers and offsite personnel for recovery from a fuel assembly that is damaged and a fuel assembly that is stuck and cannot be freed from the cask.

- The relevant equipment design details and operational procedures that will minimize the potential occurrence of a stuck fuel assembly or prevent a fuel assembly from being inserted into a cask.

A.12.5.2.3 Failure of the Fuel Grapple to Disengage

- Emergency procedures and estimated radiation doses to workers for recovery from failure of the fuel grapple to disengage.

A.12.5.2.4 Seismic Loading

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

- Analysis of the upper crane assembly using the generic design spectrum or a site-specific spectrum.

- Revision of the seismic analyses of the cask trolley systems using site-specific cask and trolley weights.

- Analyses using technically defensible methods to determine the seismic loads for the upper crane fingers and grapple analysis because the simple mass proportionality used in Appendix 8A.4.16 of the TSAR may introduce significant errors (i.e., $F_{1T}/F_{2T} \neq M_1/M_2$) for dynamic loads.

- Technically defensible stress and factor of safety calculations for the TC port cover locking pins when subjected to seismic loads.

- The kinematic repercussions of having only two fuel handling grapple fingers holding up a boiling water reactor (BWR) fuel assembly during a seismic event.

A.12.5.2.5 Tornadoes Missiles, Hurricanes and High Winds

- Studies to confirm that design basis tornado (DBT) loads used for the analysis of the DTS are not exceeded by site-specific conditions.

- Analyses to ensure that source or receiving casks will not tip over due to impact by a tornado driven missile while mounted on trolleys in the PA.

- Demonstration of the adequacy of the REA and the protective enclosure that houses the exhaust fans and PLC to resist penetration by tornado driven, 6-inch diameter and 12-inch diameter pipe missiles when struck near hard points on the structure.

- Clarification of whether the cask lids will be placed back on, or left off the casks in the event of a tornado warning. Conflicting procedures were identified in the TSAR and responses to the RAIs (Stewart, 1999a,b).

- The technical basis for taking a 2-hour credit in which to place the DTS into a safe condition given a tornado warning.

- Evaluation of the consequences of losing the LAA sliding door seals and air curtain duct work in the event that the PA is lost as a result of a tornado strike.

- Clarification of whether the secondary power supply distribution panel is as susceptible to tornado damage as is the primary power supply distribution panel located in the PA.

A.12.5.2.6 Fire

- A demonstration, based on site-specific conditions, that: (i) there are no threats from external fires, (ii) no sources of flammable gases that could be drawn into the DTS by the ventilation subsystem, and (iii) a supply of CO_2 will be available when needed under all accident conditions.

A.12.5.2.7 Major Mechanical Malfunction Involving the Spent Fuel Handling System During Operation Resulting In Dropping of a Fuel Assembly

- Emergency procedures for recovery from a dropped fuel assembly and estimates of offsite and worker radiation doses for the recovery procedures.

A.12.5.2.8 Complete Loss of High-Efficiency Particulate Air Filters and Loss of Pressure Differential

- Revised offsite radiation doses for this postulated accident with the correct source term.

A.12.5.2.9 Loss of a Shield Plug or Source Cask Lid

- Detailed site-specific emergency procedures for recovery from a damaged cask lid or shield plug and estimated radiation doses to offsite personnel and workers at the DTS.

- Assurance that a cask lid or shield plug, if dropped, will not be able to sufficiently penetrate into the interior of the cask and cause damage to the fuel assemblies contained within.

A.12.5.2.10 Electrical Surges and Explosions

- Site-specific information demonstrating that the requirements of Regulatory Guide 1.91 (Nuclear Regulatory Commission, 1978) pertaining to acceptable distances from potential explosion sources have been met.

- A demonstration that the blast load effects as defined by Regulatory Guide 1.91 (Nuclear Regulatory Commission, 1978) are bounded by the DBT loads.

A.13.5.1 Organizational Structure

- Details of the organizational structure, administrative and management controls, delegations of responsibility and authority, and the relevant qualifications of the personnel.

A.13.5.2 Preoperational Testing and Operation

- The detailed preoperational and operational testing to be conducted at the DTS facility.

A.13.5.3 Training Programs

- The details of the training program to be implemented at the DTS facility.

A.13.5.4 Normal Operations

- Assurance that the vegetative cover surrounding the DTS will be maintained to ensure it is not a credible fuel source for a fire.

- The normal operational procedures shall address:

    - The suspension of fuel transfer operations when the DTS external temperature approaches −20°F (−29°C). Reference Subsection 3.6.5 of the TSAR.

    - The suspension of fuel transfer operations when the DTS external temperature approaches 115°F (46°C). Reference Subsection 3.6.5 of the TSAR.

    - Those actions that must be initiated or ceased when the differential temperature across the DTS concrete structures approaches 70°F (39°C), note that ($\Delta T°F \times 5/9$) = $\Delta T°C$. Reference Subsection 4.3.1.4 of the TSAR.

A.13.5.5 Emergency Planning

- A detailed description of the sites emergency plan.

A.14.5.1 Functional/Operating Limits, Monitoring Limits, and Limiting Control Settings

- All the site-specific technical specifications for functional and operating limits, monitoring limits, and limiting control settings necessary to ensure regulatory compliance.

A.14.5.2 Limiting Conditions of Operation

- The site-specific technical specifications for limiting conditions of operation necessary to ensure regulatory compliance.

A.14.5.3 Surveillance Requirements

- All the site-specific technical specifications for surveillance requirements necessary to ensure regulatory compliance.

A.14.5.4 Design Features

- The site-specific technical specifications for the design features necessary to ensure regulatory compliance.

A.14.5.5 Administrative Controls

- All the site-specific technical specifications for the administrative controls necessary to ensure regulatory compliance.

A.15.5.4 Quality Assurance

- A detailed description of the site-specific quality assurance program.

A.16.5.4 Decommissioning

- A detailed description of the site-specific decommissioning plan for the DTS.

References

American Concrete Institute. *Specification for Structural Concrete for Building.* ACI 301-96. Detroit, MI: American Concrete Institute. 1996.

American National Standards Institute. *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*. ANSI N13.1. American National Standards Institute. New York: American National Standards Institute. 1999.

American National Standards Institute and American Institute of Steel Construction. *Nuclear Facilities-Steel Safety and Related Structures for Design Fabrication and Erection.* ANSI/AISC N690. New York: American National Standards Institute and American Institute of Steel Construction. 1989.

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

Nuclear Regulatory Commission. *Calibration and Error Limits of Air Sampling Instruments for Total Volume of Air Sampled.* Regulatory Guide 8.25. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1980.

Nuclear Regulatory Commission. *Missiles Generated by Natural Phenomena, Standard Review Plan*. NUREG–0800 (Formerly NUREG–76/087). Revision 2. Washington, DC: Nuclear Regulatory Commission. 1981a.

Nuclear Regulatory Commission. *Criticality and Other Interior Evacuation Signals.* Regulatory Guide 8.5 Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1981b.

Nuclear Regulatory Commission. *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses.* Regulatory Guide 8.34. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development. 1992.

Nuclear Regulatory Commission. *Standard Review Plan for Spent Fuel Dry Storage Facilities*. NUREG–1567. Draft Report for Comment. Washington, DC: Nuclear Regulatory Commission. 1996.

Stewart, L. Letter (January 19) to M. Raddatz, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999a.

Stewart, L. *Dry Transfer System Topical Safety Analysis Report*. Letter (September 9) to S. Baggett, Nuclear Regulatory Commission. Docket No. 72-1024. TAC No. L22348. Washington, DC: U.S. Department of Energy. 1999b.

U.S. Department of Energy. *Dry Transfer System Topical Safety Analysis Report*. Volumes 1, 2, and 3. Docket No. 72-1024. Revision 0. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. 1996.

APPENDIX A

REQUIRED SCOPE OF SITE-SPECIFIC SAFETY ANALYSIS REPORT