TABLE 8.1-1

OFF-NORMAL OPERATION ANNUAL DOSES AT THE SITE BOUNDARY AND FOR THE NEAREST RESIDENT DUE TO EFFLUENT RELEASE

	Site Boundary Dose[a] (mrem)	Nearest Resident Dose[b] (mrem)
Whole body ADE[c]	0.18	0.75
Thyroid ADE	0.014	0.060
Critical Organ ADE (Max)	1.30	5.49

Note:
[a] Occupancy at the site boundary is assumed to be 2,080 hrs/yr.
[b] Occupancy for the nearest resident is assumed to be 8,760 hrs/yr. Also, the site boundary χ/Q is used for the nearest resident; this is conservative because the nearest resident is located farther away from the release point than the site boundary.
[c] ADE is annual dose equivalent.

TABLE 8.2-1

MODAL DAMPING VALUES FOR VARIOUS STRUCTURES

Type of Structure	Percent of Critical Damping			
	DE	DDE	HE	LTSP
Cask/Module Assembly - Mechanical Components	2	2	4	5
Welded Steel Assemblies	1	1	4	5
Bolted or Riveted Steel Assemblies	2	2	7	5
Reinforced Concrete Structures Above Ground	5	5	7	5

TABLE 8.2-2

DIABLO CANYON CASK TRANSPORTER GEOMETRY AND WEIGHT

Item	Value
Length of Tracks	294 inches
Width of Tracks	29.5 inches
Outer Dimension Between Tracks	152.5 inches
Maximum Height of Center-of-Gravity Above Ground	87 inches
Minimum Height of Center-of-Gravity Above Ground	77.4 inches
Distance Between Center-of-Gravity and Rear of Tracks	132 inches
Distance Between Tower Centerline and Rear of Tracks	173.74 inches
Weight of Cask Transporter Without Payload	170,000 lb

TABLE 8.2-3

GENERIC CASK TRANSPORTER GEOMETRY AND PROPERTIES USED IN SEISMIC SIMULATIONS

Item	Value
Length of Tracks	234 inches
Width of Tracks	30 inches
Outer Dimension Between Tracks	152 inches
Height of Center-of-Gravity Above Ground	77.4 inches
Distance Between Center-of-Gravity and Rear of Tracks	122 inches
Distance Between Tower Centerline and Rear of Tracks	118 inches
Weight of Cask Transporter Without Payload	170,000 lb

TABLE 8.2-4

TRANSFER CASK AND OVERPACK INPUT DATA FOR CASK TRANSPORTER SEISMIC ANALYSIS

Transport Mode	Lifted Weight (With Loaded MPC) (lb)	Grade (percent)	Height Above Roadway In Transit (at lowest point of cask) (inches)	Center of Gravity Height (above lowest point on cask) (inches)
Vertical HI-STORM Overpack	360,000	5	10	118.5
Vertical HI-TRAC Transfer Cask	260,000	5	42	95
Horizontal HI-TRAC Transfer Cask	260,000	8.5	6	65

TABLE 8.2-5

CASK TRANSPORTER DYNAMIC SIMULATIONS FOR STABILITY EVALUATION

Phase	Transporter Configuration	Grade and Friction Factors	Time Histories
1	Transporter with horizontal HI-TRAC rigidly connected to Transporter	Flat surface 0.4 friction factor	5 time history sets. Time history sets are designated as Sets 1, 2a, 3, 5, and 6
2	Transporter with horizontal HI-TRAC rigidly connected to Transporter	6% grade 0.4 friction factor	Sets 1P, 5N, 6N, 6P
3	Transporter with horizontal HI-TRAC rigidly connected to Transporter	8.5% grade 0.4 friction factor	Set 5N
4	Transporter with vertical HI-STORM rigidly connected to Transporter	6% grade 0.4 friction factor	Sets 5N and 6N
5	Transporter with vertical HI-STORM rigidly connected to Transporter	Flat surface 0.8 friction factor	Set 6

Note: For all simulations in Phase 1, and for Phase 5, the longitudinal axis of the transporter is aligned with the Fault Parallel time history. For simulations in Phases 2-4, the designator of N or P means that the component (N for Fault Normal and P for Fault Parallel) is aligned down-slope.

TABLE 8.2-6

MAXIMUM CASK TRANSPORTER HORIZONTAL EXCURSION DURING A SEISMIC EVENT

Simulation Phase No.	Mode Of Operation	Max. Horizontal Excursion (inches)		
		Bounding Seismic Time History Set	Transverse	Longitudinal
1	HI-TRAC in Horizontal Orientation	Saratoga	8.90	8.9
2		El Centro (Longitudinal) Saratoga (Transverse)	10.7	21.5
3		El Centro	4.6	30.2
4	HI-STORM in Vertical Orientation	El Centro (Longitudinal) Saratoga (Transverse)	10.6	21.3
5		Saratoga	0.43	0.24

TABLE 8.2-7

KEY INPUT DATA USED FOR CTF SEISMIC/STRUCTURAL ANALYSIS

Parameter	Value
HI-STORM 100SA Overpack Weight (empty)	270,000 lb
Loaded MPC Weight	90,000 lb
HI-TRAC Transfer Cask Weight (empty)	142,000 lb
HI-STORM Mating Device Weight	20,000 lb
CTF Lifting Platform and Jacks Weight	30,000 lb
HI-STORM 100SA Overpack Height	217 inches
HI-STORM 100SA Overpack Outer Diameter	146-1/4 inches
HI-STORM 100SA Overpack Center-of-Gravity Height	118.5 inches
HI-TRAC Transfer Cask Height	196-3/4 inches
HI-TRAC Transfer Cask Outer Diameter	93 inches
HI-TRAC Transfer Cask Center-of-Gravity Height	95 inches
Lifting Jack Threaded Root Diameter	6 inches
HI-STORM Mating Device Height (excluding lift lugs and alignment ring)	11.75 inches
HI-STORM Mating Device (spacer ring) Length/Width	143/117 inches
HI-TRAC-to-Mating Device Bolt Geometry	1½-6 UNC
HI-STORM-to-Mating Device Bolt Geometry	1½-6 UNC
Structural Steel Material	SA-516-Gr. 70
Bolt Material	SA 193-B7
Lifting Jack Material Strength	S_y = 77 ksi, S_u = 91 ksi

TABLE 8.2-8

GROUND SPECTRAL ACCELERATIONS

	Seismic Ceofficient		
Earthquake	Horizontal #1	Horizontal #2	Vertical (See Note)
DE	.225	0	0.1335
LTSP	1.12	1.12	0.725

NOTE: The vertical accelerations are the ZPA values as the stacked unit vertical frequency is 65.7 Hz. The horizontal spectral accelerations correspond to a horizontal frequency of 19.85 Hz.

TABLE 8.2-9

ISFSI STORAGE PAD SEISMIC ANALYSIS RESULTS - INTERFACE LOADS

Seismic Event at ISFSI	HE	LTSP	HE[a]	LTSP[a]
Maximum/Minimum Interface Compression Force (kip)[b]	674.2/127.6	684.1/105.8	773.3/130.6	632.0/55.6
Maximum Interface Shear Force Along X-Axis[c] (kip)	509.4	432.0	379.9	325.8
Maximum Interface Shear Force Along Y-Axis[c] (kip)	460.5	355.5	426.1	364.6
Maximum Net Interface Shear Force (kip)	515.0	440.0	428.0	390.0
Maximum Interface Moment About X-Axis at Interface (kip-in.)	54,564	42,139.2	50,498	43,209
Maximum Interface Moment About Y-Axis at Interface (kip-in.)	60,369	51,197.2	45,017	38,603
Maximum Interface Moment (kip-in.)	61,000	52,000	50,500	46,000
Effective COF at Cask/Embedment Interface	0.18	0.154	0.150	0.132
Maximum Tensile Load in Embedment Anchor Rods (kip)	62.13	48.85	49.73	42.34

(a) These simulations have the vertical excitation reversed in direction over the total event time.
(b) Includes dead load = 360,000 lb.
(c) Base maximum shear forces are computed by dividing the appropriate maximum moment by the height to the centroid (118.5 inch). Y-Shear corresponds to MX, X-Shear corresponds to MY.

The moments and forces reported above act at the lower surface of the embed plate. The X, Y, Z-axes are located at a point on the cask longitudinal centerline (extended to the bottom surface of the embed plate). The X, Y directions correspond to the East-West and North-South directions, respectively, and the Z-axis is vertically upward.

TABLE 8.2-10

SUMMARY OF RESULTS FOR CASK ANCHORAGE (Flange, Shell, Gussets, and Cask Anchor Studs) FROM QUASI-STATIC STRENGTH EVALUATION

Item	Calculated Value	Allowable Value	Safety Factor[a]
Maximum Primary Membrane + Bending Stress away from Loaded Region and Discontinuity (ksi) – Case 1 - Preload	10.23	26.3	2.57
Maximum Primary Membrane + Bending Stress Intensity away from Loaded Region and Discontinuity (ksi) – Case 2 - Preload + Seismic	43.73	62.3	1.43
Maximum Weld Shear Stress (ksi)	26.997	29.4	1.089

(a) Allowable Value/Calculated Value

TABLE 8.2-11

INCIDENT OVERPRESSURE DUE TO EXPLOSIONS

Explosion Event[a]	Equivalent Weight of TNT (lb)	Scaled Ground Distance (ft/lb$^{1/3}$)	Incident Overpressure (psi)
1	117	10.2	9.2
2	10.4	22.9	2.4
3	2.0	39.6	1.2
4	12,100	52.3	0.84

[a] See Section 8.2.6 text for definitions of these events

TABLE 8.2-12

CONFINEMENT BOUNDARY LEAKAGE DOSES AT THE SITE BOUNDARY

Dose Category	30-Day Dose (rem)	10 CFR 72.106 Limit (rem)
TEDE	8.3E-04	5
TODE=DDE+CDE (Max)	6.36E-03	50
LDE	2.2E-05	15
SDE	2.6E-05	50

TEDE: total effective dose equivalent
TODE: total organ dose equivalent
DDE: deep dose equivalent
CDE: committed dose equivalent
LDE: lens dose equivalent
SDE: shallow dose equivalent

TABLE 8.2-13

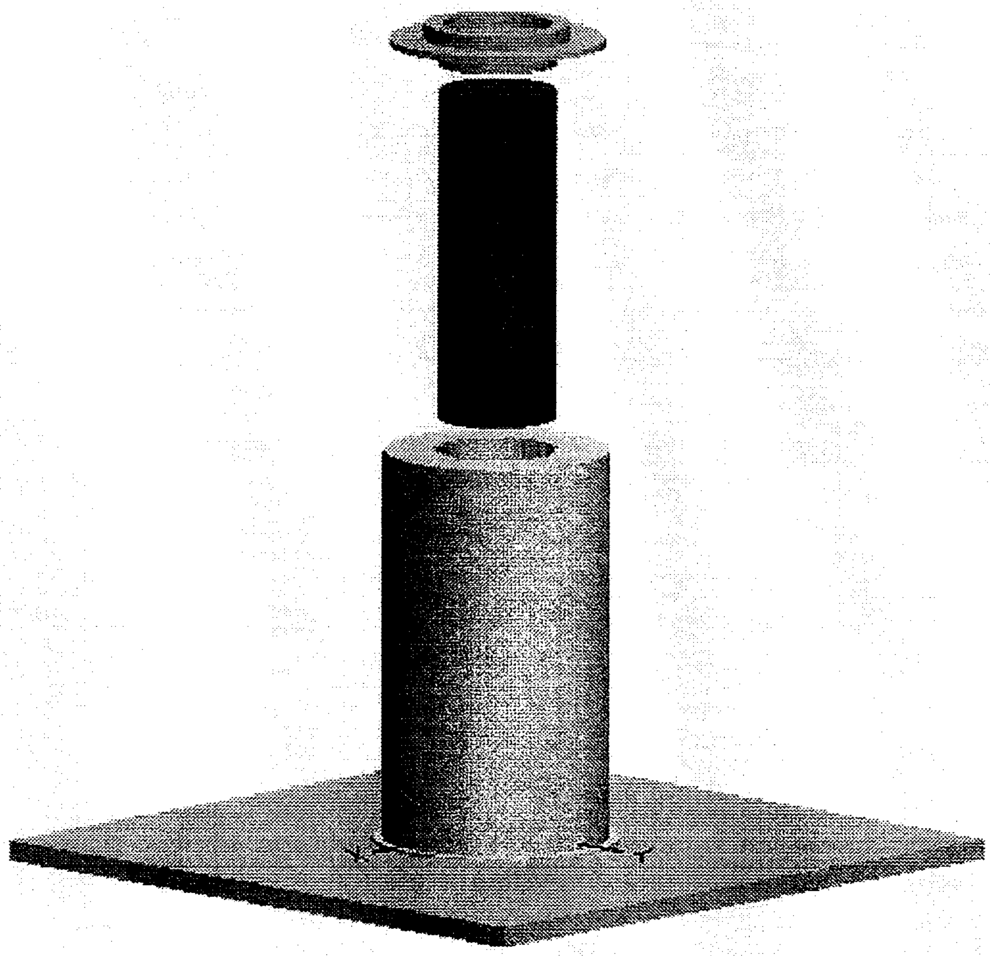
EVALUATION RESULTS DUE TO AN
ATMOSPHERIC LIGHTNING STRIKE ONTO A CASK

Cask Type	Resistance Heat Generated (watt-seconds)	Outer Shell Temperature Rise (°F)
Atmospheric Lightning Strike		
HI-STORM Storage Cask	6,523	0.22
HI-TRAC Transfer Cask	7,905	0.45

TABLE 8.2-14

EVALUATION RESULTS DUE TO A
TRANSMISSION LINE DROP ONTO A CASK

	HI-STORM Storage Cask	HI-TRAC Transfer Cask
Period 1 Total Energy	13,132 watt-hr	
Period 2 Energy	258 watt-hr	
Period 3 Energy	1,101 watt-hr	
Weight of Material Sublimated in Period 1	1.46 lb	
Diameter of Sublimated Hole in Affected Component	2.959 in.	3.625 in.
Affected Component Temperature Rise	11.44°F	31.05°F



SAFETY ANALYSIS REPORT
DIABLO CANYON ISFSI
FIGURE 8.2-1 EXPLODED VIEW OF VISUAL NASTRAN MODEL USED FOR ANCHORED CASK DYNAMIC SIMULATIONS

CHAPTER 9

CONDUCT OF OPERATIONS

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CHAPTER 9

CONDUCT OF OPERATIONS

FIGURES

CHAPTER 9

CONDUCT OF OPERATIONS

This chapter discusses the PG&E organization for the design, fabrication, construction, testing, operation, modification, and decommissioning of the Diablo Canyon ISFSI. Included are descriptions of organizational structure, personnel responsibilities and qualifications, and PG&E interface with contractors and other outside organizations.

Programs under 10 CFR 50 for DCPP, such as radiation protection, environmental monitoring, emergency preparedness, quality assurance, and training will be adopted as necessary to ensure the safe operation and maintenance of the Diablo Canyon ISFSI under 10 CFR 72. PG&E has included in the ISFSI license application the following proposed plans that support the conduct of ISFSI operations: an Appendix to the DCPP Physical Security Plan, a Safeguards Contingency Plan, a Security Training and Qualification Plan, an Emergency Plan, a Quality Assurance (QA) Program, and a Training Program.

As appropriate, 10 CFR 50 license requirements will be removed from ISFSI procedures upon termination of the 10 CFR 50 licenses. During this transition period, appropriate 10 CFR 72.48 reviews will be conducted to ensure continued compliance with ISFSI 10 CFR 72 license requirements. This process will result in stand-alone ISFSI programs that implement the 10 CFR 72 license. PG&E will maintain the appropriate administrative and managerial controls at the ISFSI until the DOE takes title to and assumes responsibility for the spent fuel.

9.1 ORGANIZATIONAL STRUCTURE

9.1.1 CORPORATE ORGANIZATION

The organization charts shown in Figures 9.1-1 and 9.1-2 represent the organizational relationships throughout the life of the ISFSI while DCPP units are operating. Relationships between corporate personnel and Diablo Canyon ISFSI onsite personnel are depicted in the figures. While DCPP units are operating, the costs for construction and operation of the Diablo Canyon ISFSI will be funded from revenues generated from operation of the units. Upon shutdown of the operating units, the costs for construction, operation, and decommissioning of the Diablo Canyon ISFSI will be funded from the DCPP Decommissioning Trust, which has been approved by the California Public Utilities Commission (CPUC). All costs are monitored and controlled by the ISFSI Program Manager during the ISFSI preoperations phase, and by the Station Director during the ISFSI operations phase.

Following decommissioning of both operating units and termination of the 10 CFR 50 operating licenses, the Diablo Canyon ISFSI organization will change. The revised ISFSI organization will be dependent on the new PG&E organization that will result following the decommissioning of the operating units. PG&E will notify the NRC of the new Diablo Canyon ISFSI organization at that time. (The operating licenses for DCPP Units 1 and 2 expire in 2021 and 2025, respectively.)

9.1.2 CORPORATE FUNCTIONS, RESPONSIBILITIES, AND AUTHORITIES

The Senior Vice President, Generation and Chief Nuclear Officer is the corporate executive responsible for overall ISFSI safety and is responsible for taking measures needed to ensure acceptable performance of the staff in designing, fabricating, constructing, testing, operating, modifying, decommissioning, and providing technical support to the ISFSI. The Senior Vice President, Generation and Chief Nuclear Officer, reports to the President and Chief Executive Officer of PG&E.

The Vice President, Nuclear Services, is responsible for providing engineering and design services, safety assessments, and licensing services for the ISFSI. He is the corporate interface with the CPUC for all ISFSI cost matters. The Vice President, Nuclear Services, reports to the Senior Vice President, Generation and Chief Nuclear Officer.

The Vice President, Diablo Canyon Operations, will be responsible for ISFSI operations. The Vice President, Diablo Canyon Operations, reports to the Senior Vice President, Generation and Chief Nuclear Officer.

The Nuclear Safety Oversight Committee (NSOC) is a corporate committee that reports to the Senior Vice President, Generation and Chief Nuclear Officer, and is chaired by the Vice President, Nuclear Services. NSOC membership, functions, meeting requirements and responsibilities are described in Sections 17.1 and 17.2 of the DCPP Final Safety Analysis Report (FSAR) Update (Reference 1).

The Diablo Canyon ISFSI will be operated under the same corporate management organization responsible for the operation of DCPP. Throughout the ISFSI lifetime, legal support will be available from PG&E corporate headquarters; technical and operational support will be available from DCPP personnel and outside consultants. This support will be provided, when needed, for licensing, QA, engineering, radiation protection, maintenance, testing, emergency planning, security, and decommissioning.

As shown in Figures 9.1-1 and 9.1-2, the QA and quality control functions will be performed by personnel independent of the ISFSI line organization. The results of QA audits and recommendations for improvement will be provided directly to the ISFSI Program Manager (during the preoperations phase), the Station Director (during ISFSI operations phase), and the Senior Vice President, Generation and Chief Nuclear Officer (during both phases). The frequency and scope of QA audits is described in Section 17.18 of the QA Program that is included as Attachment E to the ISFSI license application.

9.1.3 IN-HOUSE ORGANIZATION

The Diablo Canyon ISFSI will be designed, constructed, tested, and operated under the same organization responsible for the design, testing, and operation of the DCPP. The only difference is that during the Diablo Canyon ISFSI preoperations phase, the ISFSI Program Manager will be responsible for day-to-day management of ISFSI activities; whereas during the Diablo Canyon ISFSI operations phase, the Station Director will be responsible for the day-to-day management of the ISFSI.

Figure 9.1-1 shows the organization that will be in place during the ISFSI preoperations phase, including design, fabrication, construction, fuel loading, testing, and initial operation of the first cask. During the preoperations phase, the Diablo Canyon ISFSI Program Manager is responsible for day-to-day management of ISFSI activities and ensuring that the design, fabrication, construction, fuel loading, testing, and initial operation of the first cask are safely conducted. Cost control for all of these activities is the responsibility of the Diablo Canyon ISFSI Program Manager. The ISFSI Program Manager is responsible also for the development of the ISFSI license application and associated coordination with appropriate federal and state agencies leading to obtaining the 10 CFR 72 license. The Diablo Canyon ISFSI Program Manager reports to the Vice President, Nuclear Services. The Vice President, Nuclear Services, is responsible for overall safety of ISFSI activities, and the industrial safety program, during the ISFSI preoperations phase.

Figure 9.1-2 shows the organization that will be in place during the ISFSI operations phase, including design, fabrication, construction, fuel loading, and testing of all casks subsequent to the initial cask. During ISFSI operations, the Station Director will be responsible for the overall safety of ISFSI activities, including fuel loading, testing, and operation of all subsequent casks. This individual reports directly to the Vice President, Diablo Canyon Operations. The Engineering Director will be responsible for the design, fabrication, and modification of all subsequent casks. The Engineering Director reports to the Vice President, Nuclear Services.

Throughout both phases, functions such as engineering, design, construction, QA, radiation protection, testing, operations, and security will be performed by DCPP personnel. The existing DCPP Plant Staff Review Committee (PSRC) reviews matters affecting the safe storage of spent nuclear fuel. The PSRC is chaired by the Station Director. PSRC membership, functions, meeting requirements and responsibilities are described in Sections 17.1 and 17.2 of the DCPP FSAR Update.

9.1.4 RELATIONSHIPS WITH CONTRACTORS AND SUPPLIERS

All activities associated with the ISFSI are managed and approved by PG&E. The cask vendor is responsible for providing the HI-STORM 100 System. Consulting firms may be used to support the design and engineering efforts for the ISFSI project, and for the construction of associated structures and components, including the ISFSI storage pad. Qualified vendors may be selected to provide other services and/or equipment as needed.

During the preoperations phase, the Diablo Canyon ISFSI Program Manager is responsible for providing oversight of work activities performed by contractors. Fewer contractors will be involved during the ISFSI operations phase, and their activities will be managed by the Station Director.

9.1.5 TECHNICAL STAFF

The PG&E staff that supports DCPP Units 1 and 2 operations is described in Section 13.1 of the DCPP FSAR Update. This staff will also support the Diablo Canyon ISFSI. The functions, responsibilities and authorities of the Diablo Canyon ISFSI personnel identified in Figures 9.1-1 and 9.1-2 are described in Section 13.1 of the DCPP FSAR Update. Not identified in Section 13.1 of the FSAR Update is the ISFSI Program Manager during the preoperations phase, whose responsibilities are as described in Section 9.1.3. The qualifications of the PG&E technical staff meet or exceed the requirements specified in Section 9.1.7.

The design for the ISFSI storage system will be primarily performed by the cask vendor. Designs, calculations, and analyses performed by the cask vendor and any other vendors will be reviewed and approved by Diablo Canyon personnel prior to construction.

9.1.6 OPERATING ORGANIZATION, MANAGEMENT, AND ADMINISTRATIVE CONTROL SYSTEM

9.1.6.1 Onsite Organization

This section describes the ISFSI operations organization that will be in place during long-term storage of spent nuclear fuel. The ISFSI operations organization is shown in Figure 9.1-2 and is the same organization currently responsible for the operation of DCPP. Approximately 11 full-time equivalent personnel will be used from the existing DCPP organization to perform the functions of ISFSI specialists and security. Lines of authority, responsibility, and communication will be defined and established for all ISFSI organization positions. These relationships will be documented and updated, as appropriate, in organization charts, functional descriptions of departmental responsibilities and relationships, and job descriptions for key personnel positions.

9.1.6.2 Personnel Functions, Responsibilities and Authorities

The Station Director will report directly to the Vice President, Diablo Canyon Operations, and will be responsible for the safe operation of the ISFSI, maintaining personnel trained and qualified in accordance with the Diablo Canyon ISFSI operations training program (as described in Attachment D to the ISFSI license application), and operation of ISFSI equipment that is important to safety. The Station Director will provide direction for the safe operation, maintenance, radiation protection, training and qualification, and security of the ISFSI and personnel.

ISFSI specialists and security staff will be responsible for the day-to-day operation of the ISFSI. They will perform their activities in accordance with the requirements of the Diablo Canyon ISFSI license, TS, physical security plan, plant procedures, and applicable state and federal regulations. Security staff personnel will be responsible for ISFSI site security during routine, emergency, and contingency operations.

In order to ensure continuity of operation and organizational responsiveness to off-normal situations, a formal order of succession and delegation of authority will be established. The Station Director will designate in writing personnel who are qualified to act as the Station Director in his absence.

9.1.6.3 Administrative Control

Planned and scheduled internal and external quality assurance audits in accordance with the DCPP Quality Assurance Program will be performed to evaluate the application and effectiveness of management controls, procedures, and other activities affecting safety. The audit program will describe audit frequency, methods for documenting and communicating audit findings, resolution of issues, and implementation of corrective actions.

The existing DCPP change control program will be revised to incorporate 10 CFR 72.48 and other ISFSI regulatory requirements. The DCPP change control program will be used to manage Diablo Canyon ISFSI change control.

9.1.7 PERSONNEL QUALIFICATION REQUIREMENTS

Each member of the DCPP staff performing work on the Diablo Canyon ISFSI will meet or exceed the qualifications of Regulatory Guide 1.8 (Reference 2), with the exceptions as noted in the License Application, Attachment E, "Quality Assurance Program," Table 17.1-1. In addition, the Station Director and the ISFSI specialists and security staff are qualified as described below:

The Station Director, at the time of assuming the responsibilities for ISFSI operations, shall have a minimum of 8 years of power plant experience, of which a minimum of 3 years shall be nuclear power plant experience. A maximum of 2 years of the remaining 5 years of power plant experience may be fulfilled by satisfactory completion of academic or related technical training on a one-for-one basis. The Station Director will be trained and qualified in accordance with the Diablo Canyon ISFSI Operations Training Program.

The ISFSI specialists and security staff, at the time of appointment to their positions, shall have a high school diploma or successfully completed the General Education Development test. ISFSI specialists shall have 2 years of power plant experience of which a minimum of 1 year shall be nuclear power plant experience. Consistent with the assigned duties, ISFSI specialists will be trained and qualified in accordance with the Diablo Canyon ISFSI Operations Training Program training and qualification requirements. Security staff that support the ISFSI will be trained and qualified in accordance with the DCPP Security Training and Qualifications Plan requirements.

During loading of the ISFSI, fuel handling operations will either be performed by, or supervised by, DCPP personnel trained and qualified by the Diablo Canyon ISFSI Operations Training Program. During ISFSI operations, operation of equipment and controls that are identified as important to safety for the ISFSI will be limited to personnel who are trained and qualified in accordance with the Diablo Canyon ISFSI Operations Training Program, or personnel who are under the direct visual supervision of a person who is trained and qualified in accordance with the Diablo Canyon ISFSI Operations Training Program.

9.1.8 LIAISON WITH OUTSIDE ORGANIZATIONS

All activities associated with ISFSI operations are managed and approved by PG&E. These activities will be performed in accordance with approved procedures. The cask vendor provides engineering, technical support, and other services for the ISFSI project relating primarily to the design and construction of structures and components. Other qualified vendors may be selected to provide specialty services and/or equipment. Interface with DOE, cask vendor, and other outside organizations is performed in accordance with contractual agreements.

9.1.9 REFERENCES

1. Diablo Canyon Power Plant Units 1 & 2 Final Safety Analysis Report Update, Revision 14, November 2001.

2. Regulatory Guide 1.8, Personnel Selection and Training, USNRC, February 1989.

9.2 PREOPERATIONAL AND STARTUP TESTING

This section describes the preoperational and startup testing plans for the storage system, including necessary equipment and facility testing. Prior to the initial movement of any spent fuel for placement on the ISFSI storage pad, preoperational and startup tests will be performed and satisfactorily completed to verify that individual components and the storage system function as described in the SAR.

9.2.1 ADMINISTRATIVE PROCEDURES FOR CONDUCTING TEST PROGRAM

Preoperational and startup test procedures will be prepared, reviewed, approved, performed, and revised in accordance with existing DCPP administrative procedures, which meet the requirements of the QA Program, Sections 17.5 and 17.11 (Refer to License Application, Attachment E). Test procedures will be reviewed to determine if there is any negative impact on existing DCPP structures, systems, and components.

Preoperational test procedures prepared and performed by outside vendors at their facilities will meet the requirements of a PG&E-approved QA Program. PG&E will review and approve vendor test procedures prior to use in accordance with established DCPP procedures. PG&E personnel will witness the performance of preoperational tests performed by vendors.

9.2.2 TEST PROGRAM DESCRIPTION

The test program is divided into two parts: (a) preoperational testing, and (b) startup testing.

The objective of preoperational testing is to verify that the individual components of the storage system, facilities, and equipment meet respective functional requirements as described in the SAR. Successful preoperational testing must be completed before commencing with startup testing. Section 9.2.3 discusses the preoperational test plan.

The objective of startup testing is to verify that the complete loading and unloading sequence, using the storage system components, facilities, and equipment work together as a complete system in accordance with the requirements of this SAR. Successful startup testing must be completed prior to handling spent nuclear fuel. Section 9.2.4 discusses the startup test plan.

Section 9.4 addresses testing during normal operation of the ISFSI.

Discrepancies between the SAR requirements and the results from the preoperational and startup tests will be resolved in accordance with existing DCPP problem resolution procedures.

9.2.3 PREOPERATIONAL TEST PLAN

Preoperational tests will be performed on the cask transfer facility (CTF), the transporter, and all storage system ancillaries, such as the welder and forced helium dehydration to verify the components operate in compliance with the requirements of the SAR and respective functional specifications. For example, the transporter preoperational tests will verify the controls, hydraulic system, brakes, instruments, dead-man switches, locking pins or wedges, and other components operate in compliance with the requirements of the SAR and the transporter functional specification. Load testing will be performed on the CTF as required by DCPP's Control of Heavy Loads Program.

Other items to be tested are described below.

9.2.3.1 Security System

The ISFSI security system will be tested to ensure proper operation prior to startup testing.

9.2.3.2 Construction Tests

Tests associated with construction will be completed as required by construction specifications.

9.2.3.3 Calibration of Measuring and Test Equipment

Measuring and test equipment with an important-to-safety or security function will be controlled in accordance with QA Program, Section 17.12 (Refer to License Application, Attachment E).

9.2.4 STARTUP TEST PLAN

An overall startup testing program procedure will control the startup tests. Individual startup test procedures will be used to supplement the approved ISFSI operation procedures as required. The startup test procedures will verify the performance of the storage system and ensure that plant equipment complies with the requirements of the SAR.

Actual storage system components with a MPC handling simulator will be utilized for startup testing. An MPC handling simulator will be substituted for the MPC. The MPC handling simulator will mimic the external diameter, length, and center of gravity of a loaded MPC and will be equipped with attachment locations for lift cleats. One or more MPC mock-ups will be used to test the automated welding machine, including performance of the MPC-lid-closure weld, MPC-lid-weld removal, moisture removal, helium filling, and MPC cool down.

Personnel performing and managing the physical work during startup testing will have completed applicable ISFSI training program requirements. Refer to Section 9.3.

The following operations will be included in the startup tests for the Diablo Canyon ISFSI:

(1) Preparing the transfer cask and MPC simulator for movement into the spent fuel pool (SFP).

(2) Moving the transfer cask into the fuel handling building/auxiliary building (FHB/AB), upending, and placement in the temporary seismic restraint structure.

(3) Placing the transfer cask into the SFP and simulating movement of fuel, using a dummy fuel assembly, into the transfer cask.

(4) Installing the MPC lid retention device and removing the transfer cask from the SFP and moving it to the cask washdown area and into the temporary seismic restraint structure.

(5) Decontaminating the transfer cask.

(6) Removing the MPC lid retention device, welding the MPC lid, moisture removal, filling the MPC with helium, MPC cooldown, and lid weld removal. These functions may be performed outside of the FHB/AB for ALARA reasons.

(7) Installing the transfer cask top lid.

(8) Loading the transfer cask onto the cask transport frame using the FHB/AB crane and removal from the FHB/AB.

(9) Transporting the loaded transfer cask from the FHB/AB to the CTF using the transporter.

(10) Movement of the MPC simulator from the transfer cask into a storage cask at the CTF.

(11) Placing the top lid on a loaded overpack and raising the storage cask in the CTF.

(12) Transporting a loaded overpack from the CTF to the ISFSI pad location.

(13) Positioning and fastening the loaded overpack to the ISFSI pad.

(14) Removing the loaded overpack from the ISFSI pad.

(15) Transporting the loaded overpack from the ISFSI pad to the CTF.

(16) Removing the top lid off a loaded overpack.

(17) Transfer of the MPC simulator from the overpack back into the transfer cask.

(18) Transporting the loaded transfer cask to the FHB/AB using the onsite transporter.

Discrepancies between the SAR requirements and the results from startup tests will be resolved in accordance with existing DCPP problem resolution procedures.

9.2.5 OPERATIONAL STARTUP TESTING

Additional startup testing may be performed during the initial loading of an MPC. These tests will be limited to gathering information that is available only when nuclear fuel is included in the MPC or final verification of data obtained in previous startup testing.

9.2.6 OPERATIONAL READINESS REVIEW PLAN

PG&E will perform an operational readiness review prior to the commencement of ISFSI operations for the initial set of casks placed on the ISFSI pad. The readiness review will verify that all appropriate actions have been completed prior to initial MPC loading. As a minimum, the operational readiness review plan will ensure that:

- Results of preoperational and startup testing are satisfactory and that all corrective actions and lessons learned have been incorporated into the approved ISFSI operational procedures.

- Radiological procedures and controls are in place.

- Operations procedures including surveillance, operating, and emergency response procedures are approved and in place.

- All engineering issues relating to the storage system initial use are resolved.

- Fire protection procedures are approved and in place.

- Maintenance procedures are approved and in place, and all storage system and related plant components are ready for use.

- Cask Transportation Evaluation Program is in place.

- Procedures are approved and in place that prescribe how planning is performed and verified to ensure the characteristics of selected fuel assemblies are within applicable Diablo Canyon ISFSI Technical Specifications and SAR Section 10.2 requirements.

9.3 TRAINING PROGRAM

Pursuant to 10 CFR 72.190 and 10 CFR 72.192, personnel (including supervisory personnel who personally direct the operation of important-to-safety equipment and controls), working at the Diablo Canyon ISFSI, receive training and indoctrination designed to provide and maintain a well-qualified work force for safe and effective operation of the ISFSI. The existing DCPP training programs are INPO accredited and the General Employee Training portions are directly applicable to the Diablo Canyon ISFSI. Supplemental training specific to the ISFSI is provided to Operations, Maintenance, Security, and Emergency Planning personnel who are assigned duties associated with the ISFSI.

This supplemental training includes training modules developed under PG&E's training program using the SAT process to require a comprehensive, site-specific training, assessment, and qualification (including periodic requalification) program for the operation and maintenance of the ISFSI. Additional details regarding training program content; required "dry run" training; retraining requirements; records; and medical requirements are provided in the ISFSI License Application, Attachment D, "Training Program."

9.4 NORMAL OPERATIONS

This section describes the administrative controls and conduct of operations associated with activities considered important to safety. Also described in this section is the management system for maintaining records related to the operations of the ISFSI.

9.4.1 PROCEDURES

ISFSI activities that are important to safety will be conducted in accordance with detailed written approved procedures. The activities include, but are not limited to, operations identified in the Diablo Canyon ISFSI TS and SAR Chapter 10. Preoperational, normal operating, maintenance, and surveillance testing will be in effect prior to commencing loading operations. These procedures are briefly described in Section 9.4.1.1 of this SAR. These procedures, and any subsequent revisions, will be prepared, reviewed, and approved in accordance with the DCPP administrative program for procedure preparation, review, and approval, as described in the ISFSI License Application, Appendix E, "Quality Assurance Program", Section 17.5. Procedures will contain sufficient detail to allow qualified and trained personnel to properly perform the actions without incident.

9.4.1.1 Categories of Procedures

9.4.1.1.1 Administrative Procedures

Administrative procedures will provide directions and instructions to Diablo Canyon personnel to provide a clear understanding of operating philosophy and management policies. These procedures include instructions pertaining to personnel conduct and procedures to prepare, review, approve, and revise procedures. Administrative procedures include actions and activities to ensure that personnel safety, the working environment, procurement, and other general Diablo Canyon ISFSI activities are carried on at a high degree of readiness, quality, and success.

9.4.1.1.2 Radiation Protection Procedures

Radiation protection procedures are used to implement the radiation protection program. These procedures will ensure compliance with 10 CFR 20 and ALARA principles. The procedures describe the acquisition of data, use of equipment, and qualifications and training of personnel to perform radiation surveys, measurements, and evaluations for the assessment and control of radiation hazards associated with the Diablo Canyon ISFSI.

Under the existing DCPP radiation protection program, procedures have been developed and implemented for monitoring exposures of employees, using accepted techniques, radiation surveys of work areas, radiation monitoring of maintenance activities, and for maintaining records demonstrating the adequacy of measures taken to control radiation exposures of employees and others within prescribed limits and ALARA. These procedures will be revised as necessary to address ISFSI operations prior to operation of the ISFSI. The revised procedures will ensure the safety of personnel performing loading, transport, unloading operations, surveillance testing, and maintenance of the ISFSI. Entrance to, and work performed inside, the ISFSI protected area will require a radiation work permit and will be controlled by radiation protection and security personnel.

The operation and use of radiation monitoring instrumentation at the Diablo Canyon ISFSI, including personnel monitoring equipment, along with measurement and sampling techniques, will be described in written procedures. There is no need for airborne radiation monitoring since no airborne radioactivity is anticipated to be released from the casks at an ISFSI.

9.4.1.1.3 Maintenance and Surveillance Testing Procedures

Maintenance procedures will be established for performing preventative and corrective maintenance and for surveillance testing on Diablo Canyon ISFSI equipment and instrumentation. Preventative maintenance and surveillance testing, including calibrations and full load tests, will be performed on a periodic basis to verify operability and to preclude the degradation of ISFSI systems, equipment, and components. Corrective maintenance will be performed to rectify any unexpected system, equipment, or component malfunction, as the need arises.

Important-to-safety structures, systems, and components (SSCs) that are purchased commercial grade will be qualified by test prior to use. Testing will verify functionality and, for structural SSCs, the ability to carry full-rated load without degradation. Subsequent to the qualification testing, preventative maintenance, surveillance testing, and corrective maintenance will be as described above.

9.4.1.1.4 Operating Procedures

The operating procedures will provide the instructions for routine and projected contingency (off-normal) operations, including handling, loading, sealing, transporting, storing and unloading the SSCs and for other operations important to safety. Operating procedures will include off-normal occurrences and operations identified in the Diablo Canyon ISFSI TS and SAR Chapter 10.

9.4.1.1.5 Procedures Implementing the QA Program

Procedures will be established for important-to-safety activities to ensure that the operation and maintenance of the ISFSI is performed in accordance with the QA Program contained in Attachment E to the ISFSI License Application and applicable regulations, the Diablo Canyon ISFSI TS, the radiation protection program, and approved procedures. The requirements for qualification of personnel operating important-to-safety equipment and controls will be specified in written and approved procedures. The quality assurance procedures will clearly communicate that the responsibility for quality rests with each individual employee or visitor who enters the facility.

9.4.2 RECORDS

ISFSI records will be maintained in accordance with established PG&E practices. The records management program is discussed in the ISFSI License Application, Appendix E, "Quality Assurance Program", Section 17.17.

PG&E requests an exemption from 10 CFR 72.72(d), which requires that spent fuel and high-level radioactive waste records in storage be kept in duplicate. The duplicate set of records must be kept at a separate location sufficiently remote from the original records such that a single event would not destroy both sets of records. Pursuant to 10 CFR 72.140(d), PG&E will use an NRC-approved QA program that satisfies the criteria of 10 CFR 50, Appendix B, to implement the QA requirements for the ISFSI. Refer to Chapter 11 of this SAR. The DCPP QA Program meets ANSI N45.2.9-1974, as endorsed by Regulatory Guide 1.88, October 1976. An exemption from the method of storage requirements of 10 CFR 72.72(d) will allow records of spent fuel storage to be maintained in the same manner as the DCPP QA records.

9.5 EMERGENCY PLANNING

The DCPP Emergency Plan for Units 1 and 2 describes the organization, assessment actions, conditions for activation of the emergency organization, notification procedures, emergency facilities and equipment, training, provisions for maintaining emergency preparedness, and recovery criteria used at DCPP. This Emergency Plan will also be used for any radiological emergencies that may arise at the Diablo Canyon ISFSI. As such, the Emergency Plan complies with the provisions of 10 CFR 72.32(c).

Section 4 of the DCPP Emergency Plan and the Emergency Plan Implementing Procedures reflect the conditions and indications that require entry into the Emergency Plan. Response actions and notifications are contained in the Emergency Plan. The Emergency Action Level classification for ISFSI events is the Notification of Unusual Event.

Attachment B to the ISFSI License Application contains the current version of the DCPP Emergency Plan, including proposed changes that address the Diablo Canyon ISFSI and events associated with the Diablo Canyon ISFSI.

9.6 PHYSICAL SECURITY PLAN

The purpose of the security program for the Diablo Canyon ISFSI is to establish and maintain a physical capability for the protection of the stored spent fuel. The physical security program for the Diablo Canyon ISFSI is provided in the DCPP Physical Security Plan, the Safeguards Contingency Plan, and the Security Training and Qualification Plan. This program meets the requirements contained in 10 CFR 72, Subpart H, "Physical Protection," and the applicable portions of 10 CFR 73.55.

Because the ISFSI security program contains information that is to be withheld from the public in accordance with 10 CFR 2.790(d) and 10 CFR 73.21, it will be submitted as a separate document to the NRC. The program as described therein will be prepared and implemented as necessary to support the ISFSI operation schedule discussed in Chapter 1 of this SAR. A summary of physical protection features that does not include safeguards information follows.

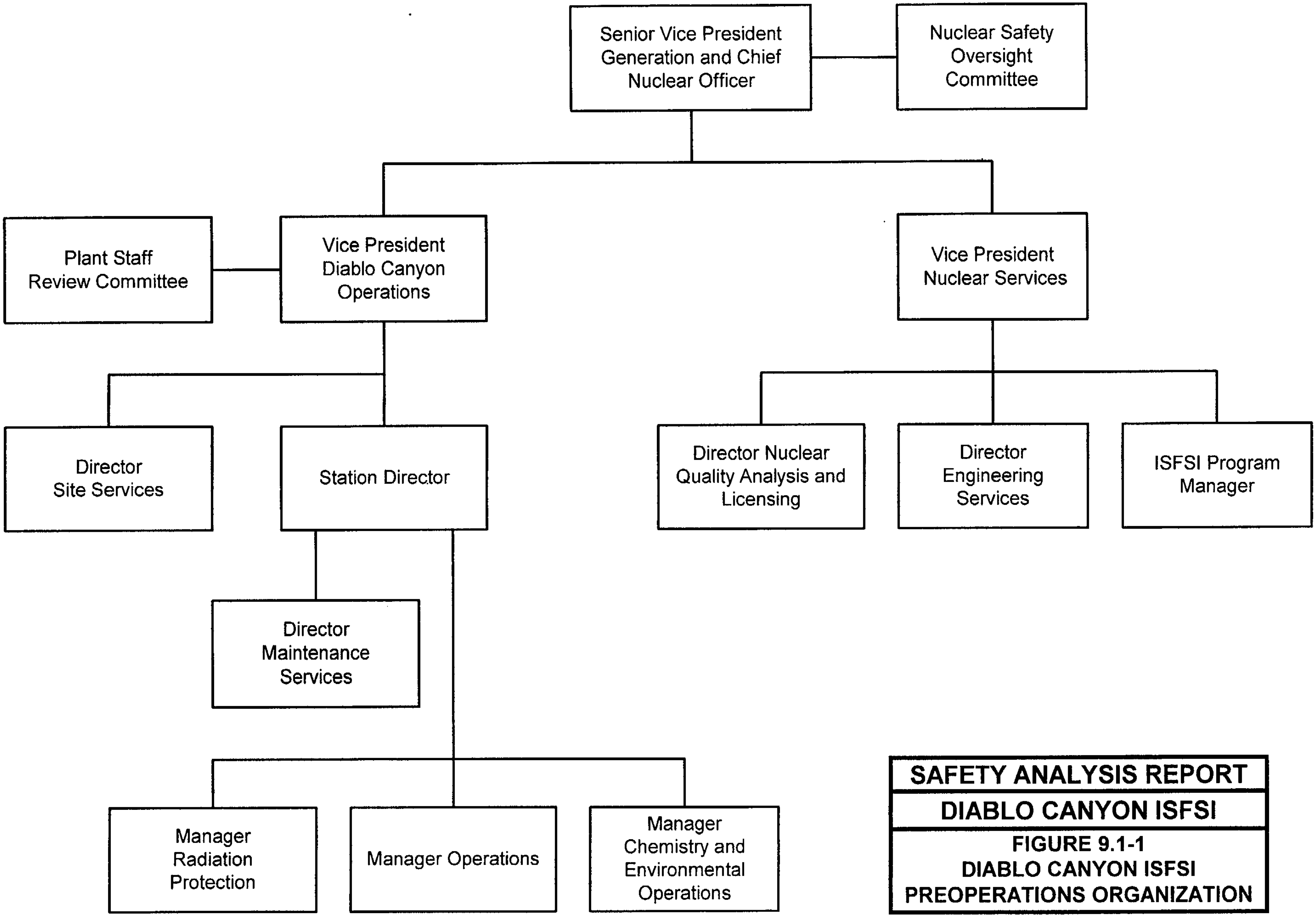
The DCPP security force controls access to the ISFSI protected area. Access is limited to individuals who require access to perform work-related activities. The DCPP security force maintains a list of approved individuals authorized for access. Individuals granted access to the ISFSI protected area are required to display badges indicating authorization and identification. Personnel, hand-carried articles, and vehicles are searched prior to entry to the ISFSI protected area to detect the presence of explosives.

The ISFSI protected area has an intrusion detection system to detect attempted unauthorized entry. Manned alarm stations support the security program by monitoring intrusion detector system alarms, coordinating security communications, and performing closed circuit television surveillance and alarm assessment.

In accordance with 10 CFR 72.184, the DCPP Safeguards Contingency Plan addresses responses to potential threats. The Plan contains a responsibility matrix that provides guidance for corresponding security force actions. Contingency planning involves detailed response procedures and assistance from local law enforcement agencies when requested.

As stipulated in Appendix B to 10 CFR 73.55, provisions for training and qualifying security force members are contained in the DCPP Security Training and Qualification Plan. This Plan identifies crucial security tasks and the associated positions that must be trained in these tasks. The Plan also describes initial and recurring training requirements and a screening program used to determine that security force members meet prescribed background, physical, and mental qualification criteria.

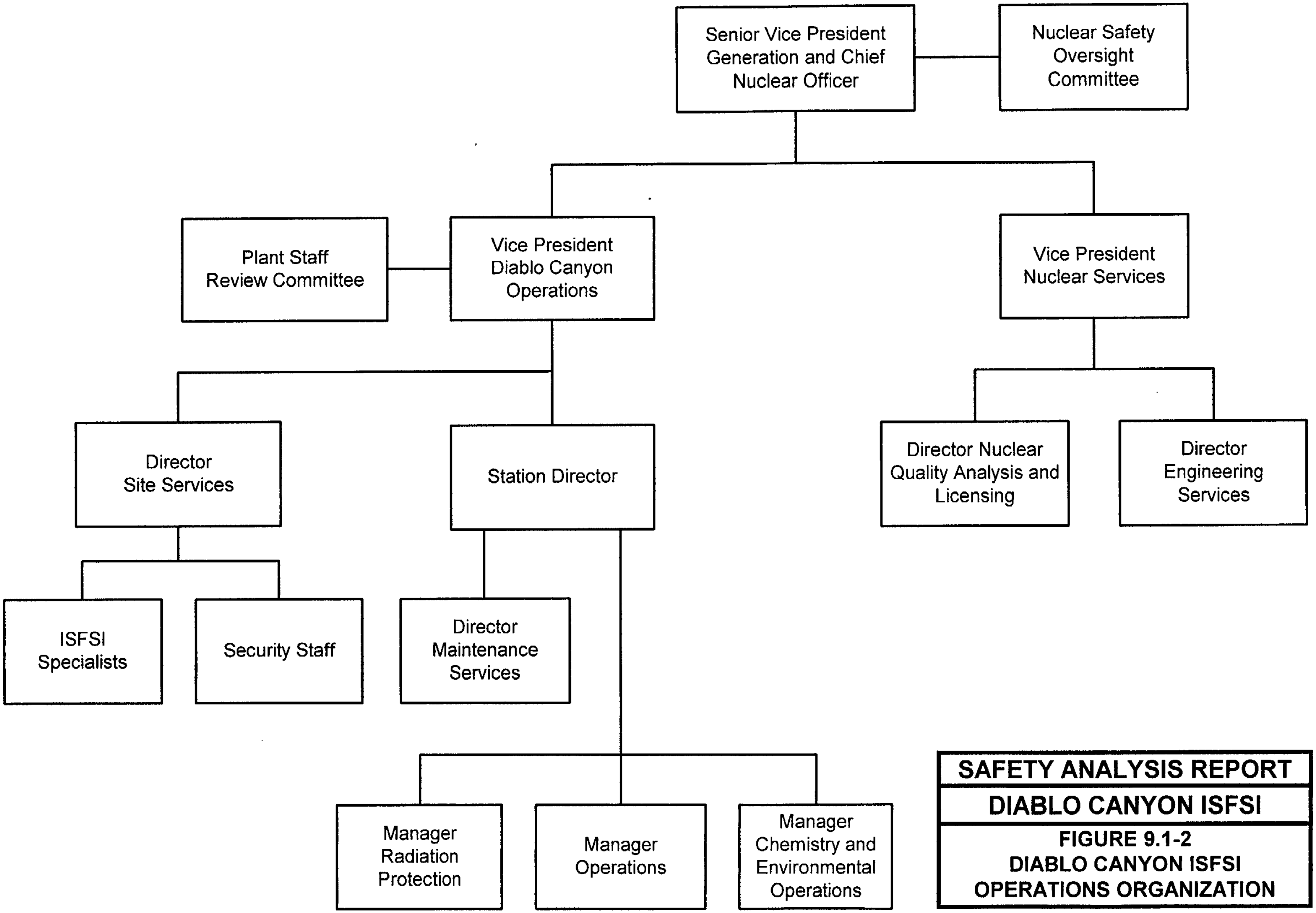
Each commitment made in the DCPP Physical Security Plan, the Safeguards Contingency Plan, and the Security Training and Qualification Plan is implemented via written procedures in accordance with 10 CFR 73.55(b)(3)(i). These implementing procedures, which are developed, approved, and maintained by security management, ensure accurate and organized day-to-day security operations.



SAFETY ANALYSIS REPORT

DIABLO CANYON ISFSI

FIGURE 9.1-1
DIABLO CANYON ISFSI
PREOPERATIONS ORGANIZATION



SAFETY ANALYSIS REPORT

DIABLO CANYON ISFSI

FIGURE 9.1-2
DIABLO CANYON ISFSI
OPERATIONS ORGANIZATION

CHAPTER 10

OPERATING CONTROLS AND LIMITS

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OPERATING CONTROLS AND LIMITS

10.1 PROPOSED OPERATING CONTROLS AND LIMITS

The Diablo Canyon ISFSI storage system is totally passive and requires minimal operating controls. The Diablo Canyon ISFSI employs a proven technology, stringent codes of construction, and comprehensive quality assurance measures. As a result, it has substantial design and safety margins. The areas where controls and limits are necessary to ensure safe operation of the Diablo Canyon ISFSI are provided in Table 10.1-1.

The items in this chapter that are to be controlled are selected based on the design criteria and safety analyses for normal, off-normal, and accident conditions.

10.2 DEVELOPMENT OF OPERATING CONTROLS AND LIMITS

This section provides an overview of, and the general bases for, operating controls and limits specified for the Diablo Canyon ISFSI.

10.2.1 FUNCTIONAL AND OPERATING LIMITS, MONITORING INSTRUMENTS, AND LIMITING CONTROL SETTINGS

This section provides requirements for the controls or limits that apply to operating variables classified as important to safety and are observable and measurable. The operating variables required for the safe operation of the Diablo Canyon ISFSI are:

- Spent fuel characteristics
- Spent fuel storage cask (SFSC) heat removal capability
- Multi-purpose canister (MPC) dissolved boron concentration level
- Annulus gap water requirement during moisture removal for loading and reflooding for unloading
- Water temperature of a flooded MPC
- MPC vacuum pressures
- MPC recirculation gas exit temperature
- Helium purity
- MPC helium backfill pressures
- Gas exit temperature of a MPC prior to reflooding
- SFSC time limitation while seated in the cast transfer facility (CTF)
- Fuel cladding oxide thickness

Each of the specifications for these characteristics is provided below with the exception of the MPC dissolved boron concentration, SFSC time limitation in the CTF, and heat removal parameters, which are provided in the Diablo Canyon ISFSI Technical Specifications (TS) and their bases.

10.2.1.1 Fuel Characteristics

The Diablo Canyon ISFSI is designed to provide interim storage for up to 4,400 fuel assemblies, which accommodates the number of assemblies predicted to be used during the licensed operating life of the plant. The Diablo Canyon ISFSI storage system will use four MPC types for the storage of fuel assemblies, fuel debris and associated nonfuel hardware. The DCPP fuel will normally be stored as nonconsolidated fuel assemblies both with and without control components. The intact fuel assemblies will be stored in either the MPC-24, MPC-24E, MPC-24EF, or MPC-32 canisters. The damaged fuel assemblies can only be stored in MPC-24E or MPC-24EF canisters, and the fuel debris can only be stored in MPC-24EF canisters. Damaged fuel or fuel debris will be placed in a damaged fuel container before loading into an MPC. The fuel debris can be consolidated, however, the amount of debris is limited to the equivalent of a single intact fuel assembly.

Fuel qualification is based on the requirements for criticality safety, decay heat removal, radiological protection, and structural integrity. The analysis presented in Chapters 4, 7 and 8 of this SAR documents the qualification of DCPP inventory of spent fuel assemblies and associated nonfuel hardware for storage in the Diablo Canyon ISFSI storage system design.

During the operation of DCPP, fuel integrity has been, and continues to be, monitored. Through the detection of radiochemistry changes in the reactor coolant system, most fuel damage is assessed. When damaged rods are suspected, assemblies are inspected as they are removed from the core. All assemblies with positive indication of damage are again inspected in the spent fuel pool (SFP) to determine numbers and location of rods in the assembly that have failed cladding. If the fuel assembly is to be placed back in the reactor core, any failed rods are removed and replaced with nonfuel rods of equivalent dimensional properties. If the suspected damaged fuel assemblies are at the end of their cycle, the assemblies may be stored in the SFP without repair. During this process, all known rod failures are noted and their assemblies are tracked. If the failure is visible from the exterior of the assembly, the damage may be video taped. For assemblies that are removed from the reactor core and were not inspected at that time, similar inspections will be performed prior to loading these assemblies into an MPC for storage. This will ensure that there are no undetected failed rods in any assembly that is placed in an MPC.

Under this failure detection process, inspections to date have found limited failures. Where single failed rods have been identified and removed, they are being stored in the SFP and will ultimately be stored in an MPC that can contain fuel debris. This detection process, along with the past history of plant operations and SFP fuel storage, provide a high level of confidence that the current spent fuel and associated nonfuel hardware will meet the criteria for storage in the appropriate MPC. In addition, based on the condition of the current spent fuel, the continued maintenance of the reactor coolant and SFP water chemistry requirements, and proper handling of the fuel, there is a high level of confidence that future spent fuel assemblies will meet the criteria for storage in the appropriate MPC.

DCPP will develop a cask-loading plan to ensure that no damaged fuel assemblies are loaded into an MPC-24 or MPC-32 canister. Damaged fuel will only be allowed to be stored in either an MPC-24E or MPC-24EF canister. Fuel debris will only be allowed to be stored in an MPC-24EF canister. If the structural integrity criterion is met, then approval for dry storage for a given assembly is made. This qualification will be documented and subsequently referenced in Diablo Canyon ISFSI operating procedures prior to loading spent fuel assemblies into the MPC.

The cask-loading plan will provide a loading sequence based on the various characteristics of the fuel assemblies being loaded. There are two main fuel-loading strategies that are used: uniform fuel loading and regionalized fuel loading. In addition, there is a fuel loading sub-strategy called preferential fuel loading. All of these loading strategies are designed to ensure that the design bases of the fuel, MPCs, and overpacks are maintained.

Uniform fuel loading is used when the fuel assemblies being loaded are all of similar burnup rates, decay heat levels, and post-irradiation cooling times. In this case the actual location of each assembly is less critical and assemblies can be placed at any location in the MPC. However, if the post-irradiation cooling times for any of the assemblies are different by $\geq$ 1-year, preferential fuel loading is required to be considered.

Preferential fuel loading requires that the fuel assemblies with the longest post-irradiation cooling times be located at the periphery of the MPC basket. Fuel assemblies with shorter post-irradiation cooling times are placed toward the center of the basket. Preferential fuel loading is a requirement in addition to other MPC loading restrictions such as those for nonfuel hardware and damaged fuel containers.

Regionalized fuel loading is used when high heat emitting fuel assemblies are to be stored in an MPC. This loading strategy allows these specific assemblies to be stored in locations in the center of the MPC basket provided lower heat emitting fuel assemblies are stored in the peripheral storage locations. Use of regionalized fuel loading must consider other restrictions on loading such as those for nonfuel hardware and damaged fuel containers. Regionalized fuel loading meets the intent of preferential fuel loading.

The following controls will ensure that each fuel assembly is loaded into a known cell location within a qualified MPC:

- A cask-loading plan will be independently verified and approved.
- A fuel movement sequence will be based upon the written loading plan. All fuel movements from any rack location will be performed under controls that will ensure strict, verbatim compliance with the fuel movement sequence.
- Prior to placement of the MPC lid, all fuel assemblies and associated nonfuel hardware, if included, will be either video taped or visually documented by other

means, and independently verified, by ID number, to match the fuel movement sequence.

A cognizant engineer is responsible for performing a third independent verification to ensure that the fuel in the MPCs is placed in accordance with the original cask-loading plan. Based on the qualification process of the spent fuel and the administrative controls used to ensure that each fuel assembly is loaded into the correct location within an MPC, incorrect loading of an MPC is not considered to be a credible event.

10.2.1.2 Fuel Characteristics (Allowable Content)

The characteristics of the fuel that are allowable for storage in the MPCs are as follows:

- Intact fuel assemblies, damaged fuel assemblies, fuel debris, and nonfuel hardware meeting the limits specified in Tables 10.2-1, 10.2-2, 10.2-3, and 10.2-4 and other referenced tables may be stored in the SFSC system.

- For MPCs partially loaded with damaged fuel assemblies or fuel debris, all remaining intact fuel assemblies in the MPC shall meet the decay heat generation limits for the damaged fuel assemblies. This requirement applies only to uniform fuel loading.

10.2.1.3 Uniform and Preferential Fuel Loading

Fuel assemblies used in uniform or preferential fuel loading shall meet all applicable limits specified in Tables 10.2-1, 10.2-2, 10.2-3, 10.2-4, and 10.2-5. Fuel assembly burnup, decay heat, and cooling time limits for uniform loading are specified in Tables 10.2-6 and 10.2-7. Preferential fuel loading shall be used during uniform loading (that is, any authorized fuel assembly in any fuel storage location) whenever fuel assemblies with significantly different post-irradiation cooling times ($\geq$ 1 year) are to be loaded in the same MPC. Fuel assemblies with the longest post-irradiation cooling times shall be loaded into fuel storage locations at the periphery of the basket. Fuel assemblies with shorter post-irradiation cooling times shall be placed toward the center of the basket. Regionalized fuel loading as described in 10.2.1.4 below meets the intent of preferential fuel loading.

10.2.1.4 Regionalized Fuel Loading

Fuel may be stored using regionalized loading in lieu of uniform loading to allow higher heat emitting fuel assemblies to be stored than would otherwise be able to be stored using uniform loading. Figures 10.2-1 through 10.2-3 define the regions for the MPC-24; MPC-24E/MPC-24EF; and MPC-32 models, respectively. Fuel assembly burnup, decay heat, and cooling time limits for regionalized loading are specified in Tables 10.2-8 and 10.2-9. In addition, fuel assemblies used in regionalized loading shall meet all other applicable limits specified in Tables 10.2-1, 10.2-2, 10.2-3, 10.2-4, and 10.2-5. Limitations on nonfuel hardware to be stored with their associated fuel assemblies are provided in Table 10.2-10.

10.2.1.5 For Allowable Content - Functional and Operating Limits Violations

If any fuel specifications or loading conditions above are violated, the following actions shall be completed:

- The affected fuel assemblies shall be placed in a safe condition.
- Within 24 hours, notify the NRC Operations Center.
- Within 30 days, submit a special report that describes the cause of the violation, and actions taken to restore compliance and prevent recurrence.

10.2.2 MPC LOADING CHARACTERISTICS

The confinement of radioactivity during the storage of spent fuel and associated nonfuel hardware in the MPC is ensured by the structural integrity of the strength-welded MPC. However, long-term integrity of the fuel and cladding depends on storage in an inert heat removal environment inside the MPC. This environment is established by removing water from the MPC and backfilling the cavity with an inert gas.

The loading process of an MPC involves placing a transfer cask with an empty MPC in the SFP and loading it with fuel assemblies (intact or damaged that meet the specifications for allowable content discussed above), fuel debris, and/or nonfuel hardware allowed per the type of MPC. Once this is complete a lid is then placed on the MPC. An MPC lid retention device is placed over the MPC lid and attached to the transfer cask. The transfer cask and MPC are raised to the SFP surface. The transfer cask and MPC are then moved into the cask washdown area where dose rates are measured and the MPC lid is welded to the MPC shell and the welds are inspected and tested. The water is drained from the MPC cavity and moisture removal is performed. The MPC cavity is backfilled with helium. Additional dose rates are measured and the MPC vent and drain cover plates and closure ring are installed and welded. Nondestructive examination (NDE) inspections are performed on the welds.

As a part of the loading process there are several characteristics that must be maintained to ensure that the allowable contents placed in any MPC remains stable and intact. These characteristics involve maintaining the MPC cavity temperature. During the loading process there are times when the loaded MPC is water filled and times when it is empty of water. As a result, there are characteristics that must address each of these two conditions. One of these characteristics is MPC water temperature and the other is maintaining the borated water level and recirculation in the annular gap between the transfer cask and the MPC.

Also during the loading process there are several characteristics vital to ensuring that the resulting MPC internal environment is conducive to long-term heat removal and maintaining the integrity of the fuel cladding. These characteristics are; limiting the moisture in the MPC; backfilling the MPC with high quality inert gas; and limiting the leakage of this inert environment over time. The dry, inert and sealed MPC atmosphere is required to be in place during loading, transport and storage operations after an acceptable final NDE on the first weld of the MPC lid to its outer shell.

10.2.2.1 Annulus Gap Water Requirement

During the loading and unloading processes there are time periods when there is no water in the MPC, or it is being removed, or the inert environment in the MPC cavity has not been completely established or maintained at levels that will continue to provide adequate cooling and maintain fuel cladding integrity. During these time periods maintaining the water level in the annular gap and continuous recirculation for high heat fuel (> 22 kw) between the loaded MPC and the transfer cask ensures that the cooling capability is adequate to maintain the fuel cladding integrity. As long as the annular gap water level is maintained with borated water and the temperature of the water in the gap is maintained below boiling through recirculation, there is no time limitation for refilling the MPC with borated water or establishing an acceptable inert environment in the MPC for moderate burnup fuel (≤ 45,000 MWD/MTU). However, without recirculation there is a limit of 2 hours to establish this process or establish an inert environment. For higher burnup fuel (>45,000 MWD/MTU), which requires the use of a forced helium dehydration (FHD) system for drying, once the drying process is completed and if residual helium is not removed from the MPC, there is a limit of 2 hours to re-establish an inert environment in the MPC. This is discussed further in Section 10.2.2.3.

During the loading process, prior to start of the removal of water from the MPC through the drying process, the annular gap shall be filled and maintained full throughout the drying and backfill process. This water level shall be maintained until the MPC inert environment is established at an acceptable level to support long-term storage or the MPC is refilled with water. In addition, during an unloading process the annular gap shall be filled with water prior to removal of the inert environment in the MPC cavity.

10.2.2.2 MPC Water Temperature

During the loading and unloading processes, maintaining the integrity of the fuel in the MPC is the critical activity. As a result of decay heat produced by the spent fuel assemblies, providing a coolant source is imperative to maintaining control of cladding temperature and the fuel integrity. During these processes when there is water in the MPC, the water is considered the coolant source. As long as there is water in the MPC it will continue to perform the coolant function. This water should continue to perform its function as long as it does not reach the boiling temperature. As a result, the parameter that will best indicate the potential reduction of water would be the temperature of the water in the MPC. However, since monitoring the water temperature in the MPC directly may not always be possible, an analysis of the potential for the water to reach the boil-off temperature is performed to ensure that the boil-off temperature cannot be reached. This analysis will be based on the decay heat levels of the contents and the various volumes of water in the MPC as it is loaded. The results of this analysis will provide any time limitation or any requirement for compensatory measures.

While there is water in the MPC, there will be adequate assurance through analysis that the temperature of that water in the MPC will not reach the boil-off level and that the volume of water in the MPC is not allowed to decrease significantly. If the water temperature is shown to potentially reach the boiling level, action will be taken to limit the time of the activity to less than the time to boil off or, as a minimum, continue to replace the volume of water that is boiling off. If no action is possible to correct this condition, then the content loaded in the MPC shall be removed and placed back in the SFP.

10.2.2.3 MPC Drying Characteristics

Dependent on the allowable content of a specific MPC, cavity moisture removal can be performed by using either vacuum drying or a Forced Helium Dehydration (FHD) system after the MPC has been drained of water. See Figure 10.2-4 for a schematic diagram of the FHD system. The Standard Review Plan (SRP) acceptance criterion for dryness is ≤ 1 gram-mole per cask of oxidizing gases. This has been translated by the industry to be 3 torr for vacuum drying. For the recirculation drying process using the FHD system, measuring the temperature of the gas exiting the demoisturizer of the FHD system provides an indication of the amount of water vapor entrained in the helium gas in the MPC. Maintaining a demoisturizer exit temperature of less than or equal to 21°F for 30 minutes or more during the recirculation drying process ensures that the partial pressure of the entrained water vapor in the MPC is less than 3 torr.

If the MPC contains only moderate burnup fuel (≤ 45,000 MWD/MTU) vacuum drying can be used. In this process any water that has not drained from the MPC cavity evaporates from the MPC cavity due to the vacuum. This drying is aided by the temperature increase due to the decay heat of the fuel. To ensure adequate drying the vacuum drying pressure in the MPC must be verified to be at ≤ 3 torr for ≥ 30 minutes. This low vacuum pressure is an indication that the cavity is dry and the moisture level in the MPC is acceptable.

For any MPC that contains fuel assemblies of any authorized burnup, the FHD system can be used to remove the remaining moisture in the MPC cavity after all of the water that can practically be removed through the drain line using a hydraulic pump has been expelled in the water blowdown operation. The FHD system is required to be used for any MPCs containing at least one high burnup fuel assembly (>45,000 MWD/MTU).

The recirculation process using the FHD involves introducing dry gas into the MPC cavity that absorbs the residual moisture in the MPC. This humidified gas exits the MPC and the absorbed water is removed through condensation and/or mechanical drying. The dried gas is then forced back through the MPC until the gas exit temperature from the FHD demoisturizer is ≤ 21°F for at least 30 minutes. Meeting these temperature and time criteria ensures that the cavity is dry and the moisture level in the MPC is acceptable. The FHD system shall be designed to ensure that during normal operation (that is, excluding startup and shutdown ramps) the following criteria are met:

(1) The temperature of helium gas in the MPC shall be at least 15°F higher than the saturation temperature at coincident pressure.

(2) The pressure in the MPC cavity space shall be less than or equal to 60.3 psig (75 psia).

(3) The recirculation rate of helium shall be sufficiently high (minimum hourly throughput equal to ten times the nominal helium mass backfilled into the MPC for fuel storage operations) so as to produce a turbulated flow regime in the MPC cavity.

(4) The partial pressure of the water vapor in the MPC cavity will not exceed 3 torr if the helium temperature at the demoisturizer outlet is ≤ 21°F for a period of 30 minutes.

In addition to the above system design criteria, the individual modules shall be designed in accordance with the following criteria:

(1) The condensing module shall be designed to devaporize the recirculating helium gas to a dew point of 120°F or less.

(2) The demoisturizer module shall be configured to be introduced into its helium conditioning function after the condensing module has been operated for the required length of time to ensure that the bulk moisture vaporization in the MPC has been completed.

(3) The helium circulator shall be sized to effect the minimum flow rate of circulation required by the system design criteria described above.

(4) The preheater module shall be engineered to ensure that the temperature of the helium gas in the MPC meets the system design criteria described above.

At completion of the drying operation using the FHD system, the partial pressure of the helium/water vapor will be at 3 torr or less, however, the total pressure in the MPC will be approximately 2000 torr or 3 atm. This is the result of the MPC still containing helium and the approved contents continuing to heat that helium. To complete the backfill and loading process when the FHD system is used, the contained helium/water vapor mixture in the MPC must be withdrawn down to an MPC total pressure of 10 torr. This ensures the helium backfill process can be properly completed. Once the residual helium/water vapor mixture is drawn down to 10 torr the cooling capability of the MPC is reduced. As a result, there is a 2-hour limitation during which either the backfill gas must be introduced into the MPC; or as a minimum the MPC must be refilled with helium. Either of these actions will re-establish adequate cooling capability in the MPC and ensure that the fuel cladding short-term temperature limit is not exceeded.

If the cavity moisture removal limits are not met, an engineering evaluation will be necessary to determine the potential quantity of moisture left within the MPC cavity. Once the quantity of moisture potentially left in the MPC cavity is determined, a corrective action plan shall be developed and actions initiated to the extent necessary to return the MPC to an analyzed condition. As the quantity of moisture estimated can range over a broad scale, different recovery strategies may be necessary.

Since moisture remaining in the cavity may represent a potential long-term degradation concern, immediate action is not necessary. The actions to develop and initiate the corrective actions should be undertaken as soon as possible commensurate with the safety significance of the condition. Completion times for the determined corrective actions will be controlled by the DCPP corrective actions program and will be determined and controlled based on the safety significance of the condition.

10.2.2.4 MPC Helium Backfill Characteristics and Purity

Having the proper helium backfill pressure or density ensures adequate heat transfer from the fuel to the fuel basket and surrounding structure of the MPC. During the loading operation, once the dryness limits are met, the MPC cavity is backfilled with helium to provide the inert environment required for long-term storage. To ensure the proper environment is established the helium used in the backfill process shall have a purity of ≥ 99.995 percent. In addition, the helium backfill pressure shall be verified during loading for all MPCs to be ≥ 29.3 psig and ≤ 33.3 psig.

If it has been determined that the helium backfill pressure limit has not been met, an engineering evaluation shall be undertaken to determine the actual helium pressure within the MPC cavity. Since too much or too little helium in the MPC cavity represents a potential overpressure or heat removal degradation concern, the engineering evaluation shall be performed in a timely manner commensurate with the safety significance of the condition (that is, if it is not addressed there is a possibility of a failure to adequately cool the contained fuel resulting in cladding damage).

Once the helium pressure in the MPC cavity is determined, a corrective action plan shall be developed and initiated to the extent necessary to return the MPC to an analyzed condition. Since the helium pressure estimated can range over a broad scale, different recovery strategies may be necessary. Completion times for the determined corrective actions will be controlled by the DCPP corrective actions program and will be determined and controlled based on the safety significance of the condition.

10.2.2.5 MPC Leakage Characteristics

The MPC helium leak rate limit ensures there is adequate helium in the MPC for long-term storage and proper heat removal. The leak rate acceptance limit of ≤ 5.0E-6 atm cc/sec (He) is assumed in the confinement analyses and is bounding for offsite dose. This is a mass-like leakage rate as specified in ANSI N 14.5 (1997). This is defined as the rate of change of the pressure-volume product of the leaking fluid at test conditions. This allows the leakage rate as measured by a mass spectrometer leak detector (MSLD) to be compared directly to the acceptance limit without the need for unit conversion from test conditions to standard, or reference conditions.

During transport operations or storage operations if the helium leak rate limit is determined not to be met, an engineering evaluation shall be performed to determine the impact of increased helium leak rate on heat removal and offsite dose. Since the SFSC is a ventilated system, any leakage from the MPC is transported directly to the environment. An increased helium leak rate represents a potential challenge to MPC heat removal and the offsite doses calculated in the Diablo Canyon ISFSI SAR confinement analyses, reasonably rapid action is warranted.

Once the cause and consequences of the elevated leak rate from the MPC are determined, a corrective action plan shall be developed and initiated to the extent necessary to return the MPC to an analyzed condition. Since the recovery mechanisms can range over a broad scale based on the evaluation performed, different recovery strategies may be necessary. An elevated helium leak rate represents a challenge to heat removal rates and offsite doses, reasonably rapid action and completion of the corrective actions shall be commensurate with the safety significance of the condition. Completion times for the determined corrective actions are controlled by the DCPP corrective actions program and will be determined based on the safety significance of the condition

10.2.2.6 Returning MPC to Safe Condition

If for a loaded MPC the fuel cavity dryness, backfill pressure, or helium leakage rate cannot be successfully met or maintained for any reason, the MPC must be returned to a safe analyzed condition, which may ultimately require the fuel to be placed back in the SFP. The completion time for this effort shall be based on the safety significance of the condition. The completion time shall consider the time required to perform fuel cool-down operations, reflood the MPC, cut the MPC lid welds, move the transfer cask into the SFP, remove the MPC lid, and remove the spent fuel assemblies in an orderly manner and without challenging personnel.

10.2.3 MPC UNLOADING CHARACTERISTICS

In the event that an MPC must be unloaded, the transfer cask with its enclosed MPC is returned to the auxiliary building/fuel handling building to begin the process of fuel unloading. The MPC closure ring, and vent and drain port cover plates are then removed. The MPC gas is sampled to determine the integrity of the spent fuel cladding. The MPC is attached to the cool-down system. The cool-down system is a closed-loop forced ventilation gas cooling system that cools the fuel assemblies by cooling the surrounding helium gas inside the MPC.

During fuel cool-down, the MPC/transfer cask annular gap is reflooded with borated water to ensure adequate cooling capability is maintained. Once the fuel cool-down process is complete the MPC is reflooded with borated water and the MPC lid weld is removed leaving the MPC lid in place. The transfer cask and MPC are placed in the SFP and the MPC lid is removed. The contents are removed from the MPC and the MPC and transfer cask are removed from the SFP and decontaminated.

10.2.3.1 Gas Exit Temperature Of An MPC Prior To Reflooding

The integrity of the MPC depends on maintaining the internal cavity pressures within design limits. During the unloading process, reducing the fuel cladding temperatures significantly reduces the temperature gradients across the cladding, thus minimizing thermally-induced stresses on the cladding during MPC reflooding. In addition, reducing the MPC internal temperatures eliminates the risk of high MPC pressure due to sudden generation of steam during reflooding. This is accomplished by using the cool-down system that reduces the MPC internal temperatures such that there is no sudden formation of steam during MPC reflooding. Monitoring the circulating MPC gas exit temperature from the cool-down system ensures that there will be no large thermal gradient across the fuel assembly cladding during reflooding, which could be potentially harmful to the cladding. The exit gas temperature limit of ≤ 200°F ensures that the MPC gas exit temperature will closely match the desired fuel cladding temperature prior to reflooding the MPC. This temperature was selected to be lower than the boiling temperature of water with additional margin to eliminate the possibility of flashing to steam during reflooding.

During the fuel cool-down process, if the MPC helium gas exit temperature limit is not met, proceeding with reflooding shall be prohibited and actions must be taken to restore the parameters to within the limits before reflooding. In addition, while this parameter is being restored within limits, the proper conditions must be verified to exist for the transfer of heat from the MPC to the surrounding environs to ensure the fuel cladding remains below the short term temperature limit. Maintaining the annular gap water level between the MPC and the transfer cask will ensure that adequate cooling capability exits.

10.2.4 OTHER OPERATING CONTROLS AND LIMITS

10.2.4.1 Fuel Cladding Oxide Thickness

In determining whether fuel assemblies are considered intact or damaged, several parameters are considered as is discussed in Section 10.2.1. Most of these parameters concern known or suspected cladding failures. However, for high burnup fuel (> 45,000 MWD/MTU), fuel-cladding oxidation is also a concern and shall be evaluated prior to a specific fuel assembly being identified as an intact assembly. A very high oxidation level can mean that a fuel assemble is not structurally sound and may fail in storage causing a change in the conditions inside the affected MPC. The evaluation of fuel cladding oxidation can be performed by actual physical measurement or an appropriate predictive methodology. For a high burnup spent fuel assembly to be classified as an intact fuel assembly, the computed or measured average oxidation layer thickness shall not exceed the applicable maximum allowable average fuel cladding oxidation layer thickness provided in the Diablo Canyon ISFSI Technical Specifications.

For a high burnup fuel assembly, if the fuel cladding oxidation layer thickness that is computed or measured on any fuel rod exceeds the limit, that fuel assembly will be considered a damaged fuel assembly. As such it will require storage in a damaged fuel container and limited to what MPC type it may be stored in.

10.2.5 LIMITING CONDITIONS FOR OPERATION

10.2.5.1 Equipment

All Diablo Canyon ISFSI equipment important to safety is passive in nature, therefore, there are no limiting conditions regarding minimum available equipment or operating characteristics. The MPC, transfer cask, CTF, and overpack have been analyzed for all credible equipment failure modes and extreme environmental conditions. No credible postulated event results in damage to fuel, release of radioactivity above acceptable limits, or danger to the public health and safety. All operational equipment is to be maintained, tested, and operated according to the implementing procedures developed for the ISFSI. The failure or unavailability of any operational equipment can delay the transfer of an MPC to the transfer cask or to the SFSC, but would not result in an unsafe condition.

10.2.5.2 Technical Conditions and Characteristics

The following technical conditions and characteristics are required for the Diablo Canyon ISFSI:

- Spent fuel characteristics
- SFSC heat removal capability
- MPC dissolved boron concentration level
- Annulus gap water requirement during moisture removal for loading and reflooding for unloading

- Water temperature of a flooded MPC
- MPC vacuum pressures
- MPC recirculation gas exit temperature
- Helium purity
- MPC helium backfill pressures
- Gas exit temperature of an MPC prior to reflooding
- SFSC time limitation while seated in the CTF
- Fuel cladding oxide thickness

The spent fuel specifications for allowable content for storage in the ISFSI and their bases are detailed in Section 10.2.1. A description of bases for selecting the above remaining conditions and characteristics are detailed in Sections 10.2.2 through 10.2.4, with the exception of the heat removal capability, SFSC time limitation in the CTF, and dissolved boron concentration. These are provided in the Diablo Canyon ISFSI TS bases.

The technical and operational considerations are to:

- Ensure proper internal MPC atmosphere to promote heat transfer, minimize oxidation, and prevent an uncontrolled release of radioactive material.
- Ensure that dose rates in areas where operators must work are ALARA and that all relevant dose limits are met.
- Ensure that the fuel cladding is maintained at a temperature sufficiently low to preclude cladding degradation during normal storage conditions.

Through the analyses and evaluations provided in Chapters 4, 7, and 8, this SAR demonstrates that the above technical conditions and characteristics are adequate and that no significant public or occupational health and safety hazards exist.

10.2.6 SURVEILLANCE REQUIREMENTS

The analyses provided in this SAR show that the Diablo Canyon ISFSI and the storage system fulfill its safety functions during all accident conditions as described in Chapter 8. Surveillance requirements are provided in the Diablo Canyon ISFSI TS. No continuous surveillance of the MPC is required during long-term storage. Surveillance of the SFSC duct screens is in the Diablo Canyon ISFSI TS and ensures freedom of air movement and adequate heat dissipation during long-term storage.

10.2.7 DESIGN FEATURES

The following storage system design features are important to the safe operation of the Diablo Canyon ISFSI and require design controls and limits:

- Material mechanical properties for structural integrity confinement and shielding
- Material composition and dimensional control for subcriticality
- Decay heat removal

Component dimensions are not specified here since the combination of materials, dose rates, criticality safety, and component fit-up define the operable limits for dimensions (that is, thickness of shielding materials, thickness of concrete, MPC plate thicknesses, etc.) The values for these design parameters are specified in the HI-STORM 100 System FSAR and LAR 1014-1 (References 1 and 2 respectively). Changes to any of these design features will be implemented only after conducting a safety evaluation in accordance with 10 CFR 72.48.

The combination of the above controls and limits and those discussed previously in Section 10.2 define requirements for the Diablo Canyon ISFSI storage system components that provide radiological protection and structural integrity during normal storage and postulated accident conditions.

10.2.8 ADMINISTRATIVE CONTROLS

Use of the existing DCPP organizational and administrative systems and procedures, record keeping, review, audit, and reporting requirements coupled with the requirements of this SAR ensure that the operations involved in the storage of spent fuel at the ISFSI are performed in a safe manner. This includes both the selection of assemblies qualified for ISFSI storage and the verification of assembly identification numbers prior to and after placement into individual MPCs. The spent fuel qualification, identification, and control are discussed in Sections 10.2.1 through 10.2.4 above. Other administrative programs will control revisions to the Diablo Canyon ISFSI TS Bases; radioactive effluents; fuel-cladding-oxide thickness; MPC loading and unloading processes; ISFSI operations, and transportation route conditions. These other programs are defined in the Diablo Canyon ISFSI TS.

10.2.9 OPERATING CONTROL AND LIMIT SPECIFICATIONS

The operating controls and limits applicable to the Diablo Canyon ISFSI, as documented in this SAR, are delineated in the Diablo Canyon ISFSI TS and the TS Bases. These include:

- SFSC heat removal capability
- SFSC time limitation in the CTF
- Dissolved boron concentration

10.2.10 REFERENCES

Detailed information describing the HI-STORM 100 System is provided in the following two references, which must be used together:

1. Final Safety Analysis Report for HI-STORM 100 System, Revision 0, July 2000.

2. License Amendment Request 1014-1, Holtec International, Revision 2, July 2001, including Supplements 1 through 4 dated August 17, 2001; October 5, 2001; October 12, 2001; and October 19, 2001; respectively.

Reference 2 contains information related to MPC-32, MPC-24, MPC-24E, MPC-24EF, and the HI-STORM 100SA. General references to these documents are made in Chapter 10 as needed to supplement SAR information.

TABLE 10.1-1

OPERATING CONTROLS AND LIMITS

Areas For Operating Controls and Limits	Conditions Or Other Items To Be Controlled
Fuel characteristics	Physical condition
Multi-Purpose Canister	Vacuum drying pressure or temperature Helium backfill pressure
Spent Fuel Storage Cask	Heat removal capability
Administrative Controls	Fuel loading verification including assembly location

TABLE 10.2-1

MPC-24 FUEL ASSEMBLY LIMITS

A. Allowable Contents

1. Uranium oxide, intact fuel assemblies listed in Table 10.2-5, with or without nonfuel hardware and meeting the following specifications (Note 1):

Cladding type	Zr (Note 2)
Initial enrichment	As specified in Table 10.2-5 for the applicable fuel assembly.
Post-irradiation cooling time and average burnup per assembly:	
Fuel	As specified in Tables 10.2-6 or 10.2-8.
Nonfuel hardware	As specified in Table 10.2-10.
Decay heat per assembly	As specified in Tables 10.2-7 or 10.2-9.
Fuel assembly length	≤ 176.8 inches (nominal design)
Fuel assembly width	≤ 8.54 inches (nominal design)
Fuel assembly weight	≤ 1,680 lb (including nonfuel hardware)

B. Quantity per MPC: Up to 24 fuel assemblies.

C. Damaged fuel assemblies and fuel debris are not authorized for loading into the MPC-24.

NOTE 1: Fuel assemblies containing BPRAs, WABAs, or TPDs may be stored in any fuel cell location. Fuel assemblies containing RCCAs may only be loaded in fuel storage locations 9, 10, 15, and/or 16 of Figure 10.2-1. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: Zr designates fuel-cladding material, which is made of zirconium or zirconium alloys. Use of Zirlo clad fuel is limited to a maximum burnup of 45,000 MWD/MTU.

TABLE 10.2-2

MPC-24E FUEL ASSEMBLY LIMITS

A. Allowable Contents

1. Uranium oxide, intact fuel assemblies listed in Table 10.2-5, with or without nonfuel hardware and meeting the following specifications (Note 1):

Cladding type	ZR (Note 2)
Initial enrichment	As specified in Table 10.2-5 for the applicable fuel assembly.
Post-irradiation cooling time and average burnup per assembly	
Fuel	As specified in Tables 10.2-6 or 10.2-8.
Nonfuel hardware	As specified in Table 10.2-10.
Decay heat per assembly	As specified in Tables 10.2-7 or 10.2-9.
Fuel assembly length	≤ 176.8 inches (nominal design)
Fuel assembly width	≤ 8.54 inches (nominal design)
Fuel assembly weight	≤ 1,680 lb (including nonfuel hardware)

2. Uranium oxide, damaged fuel assemblies, with or without nonfuel hardware, placed in damaged fuel containers. Uranium oxide damaged fuel assemblies shall meet the criteria specified in Table 10.2-5 and meet the following specifications (Note 1):

Cladding type	ZR (Note 2)
Initial enrichment	≤ 4.0 wt% ^{235}U.
Post-irradiation cooling time and average burnup per assembly:	
Fuel	As specified in Tables 10.2-6 or 10.2-8.
Nonfuel hardware	As specified in Table 10.2-10.
Decay heat per assembly	As specified in Tables 10.2-7 or 10.2-9.
Fuel assembly length	≤ 176.8 inches (nominal design)
Fuel assembly width	≤ 8.54 inches (nominal design)
Fuel assembly weight	≤ 1,680 lb (including nonfuel hardware and DFC)

TABLE 10.2-2

B. Quantity per MPC: Up to four (4) damaged fuel assemblies in damaged fuel containers, stored in fuel storage locations 3, 6, 19 and/or 22 of Figure 10.2-2. The remaining MPC-24E fuel storage locations may be filled with intact fuel assemblies meeting the applicable specifications.

C. Fuel debris is not authorized for loading in the MPC-24E.

NOTE 1: Fuel assemblies containing BPRAs, WABAs, or TPDs may be stored in any fuel storage location. Fuel assemblies containing RCCAs must be loaded in fuel storage locations 9, 10, 15 and/or 16 of Figure 10.2-2. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: ZR designates fuel-cladding material, which is made of zirconium or zirconium alloys. Use of Zirlo clad fuel is limited to a maximum burnup of 45,000 MWD/MTU.

TABLE 10.2-3

MPC-24EF FUEL ASSEMBLY LIMITS

A. Allowable Contents

1. Uranium oxide, intact fuel assemblies listed in Table 10.2-5, with or without nonfuel hardware and meeting the following specifications (Note 1):

Cladding type	ZR (Note 3)
Initial enrichment	As specified in Table 10.2-5 for the applicable fuel assembly.
Post-irradiation cooling time and average burnup per assembly:	
Fuel	As specified in Tables 10.2-6 or 10.2-8.
Nonfuel hardware	As specified in Table 10.2-10.
Decay heat per assembly	As specified in Tables 10.2-7 or 10.2-9.
Fuel assembly length	≤ 176.8 inches (nominal design)
Fuel assembly width	≤ 8.54 inches (nominal design)
Fuel assembly weight	≤ 1,680 lb (including nonfuel hardware)

2. Uranium oxide, damaged fuel assemblies and fuel debris, with or without nonfuel hardware, placed in damaged fuel containers. Uranium oxide damaged fuel assemblies shall meet the criteria specified in Table 10.2-5 and meet the following specifications (Note 1 and 2):

Cladding type	ZR (Note 3)
Initial enrichment	≤ 4.0 wt% ^{235}U.
Post-irradiation cooling time and average burnup per assembly	
Fuel	As specified in Tables 10.2-6 or 10.2-8.
Nonfuel hardware	As specified in Table 10.2-10.
Decay heat per assembly	As specified in Tables 10.2-7 or 10.2-9.
Fuel assembly length	≤ 176.8 inches (nominal design)
Fuel assembly width	≤ 8.54 inches (nominal design)
Fuel assembly weight	≤ 1,680 lb (including nonfuel hardware and DFC)

TABLE 10.2-3

B. Quantity per MPC: Up to four (4) damaged fuel assemblies and/or fuel debris in damaged fuel containers, stored in fuel storage locations 3, 6, 19 and/or 22 of Figure 10.2-2. The remaining MPC-24EF fuel storage locations may be filled with intact fuel assemblies meeting the applicable specifications.

NOTE 1: Fuel assemblies containing BPRAs, WABAs, or TPDs may be stored in any fuel storage location. Fuel assemblies containing RCCAs must be loaded in fuel storage locations 9, 10, 15 and/or 16 of Figure 10.2-2. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: The total quantity of fuel debris permitted in a single damaged fuel container is limited to the equivalent weight and special nuclear material quantity of one intact fuel assembly.

NOTE 3: ZR designates fuel-cladding material, which is made of zirconium or zirconium alloys. Use of Zirlo clad fuel is limited to a maximum burnup of 45,000 MWD/MTU.

TABLE 10.2-4

MPC-32 FUEL ASSEMBLY LIMITS

A. Allowable Contents

1. Uranium oxide, intact fuel assemblies listed in Table 10.2-5, with or without nonfuel hardware and meeting the following specifications (Note 1):

Cladding type	ZR (Note 2)
Initial enrichment	As specified in Table 10.2-5 for the applicable fuel assembly.
Post-irradiation cooling time and average burnup per assembly:	
Fuel	As specified in Tables 10.2-6 or 10.2-8.
Nonfuel hardware	As specified in Table 10.2-10.
Decay heat per assembly	As specified in Tables 10.2-7 or 10.2-9.
Fuel assembly length	≤ 176.8 inches (nominal design)
Fuel assembly width	≤ 8.54 inches (nominal design)
Fuel assembly weight	≤ 1,680 lb (including nonfuel hardware)

B. Quantity per MPC: Up to 32 intact fuel assemblies.

C. Damaged fuel assemblies and fuel debris are not authorized for loading in the MPC-32.

NOTE 1: Fuel assemblies containing BPRAs, WABAs, or TPDs may be stored in any fuel storage location. Fuel assemblies containing RCCAs must be loaded in fuel storage locations 13, 14, 19 and/or 20 of Figure 10.2-3. These requirements are in addition to any other requirements specified for uniform or regionalized fuel loading.

NOTE 2: ZR designates fuel-cladding material, which is made of zirconium or zirconium alloys. Use of Zirlo clad fuel is limited to a maximum burnup of 45,000 MWD/MTU.

TABLE 10.2-5

FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Type	Vantage 5	Standard or LOPAR
Cladding Material	ZR (Note 5)	ZR (Note 5)
Design Initial U (kg/assy.) (Note 2)	≤ 467	≤ 467
Initial Enrichment (MPC-24, 24E, and 24EF without soluble boron credit) (wt% ^{235}U) (Note 4)	≤ 4.0 (24) ≤ 4.4 (24E/24EF)	≤ 4.0 (24) ≤ 4.4 (24E/24EF)
Initial Enrichment (MPC-24, 24E, 24EF, or 32 with soluble boron credit) (wt% ^{235}U) (Notes 3 and 4)	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations	264	264
Fuel Rod Cladding O.D. (in.)	≥ 0.360	≥ 0.372
Fuel Rod Cladding I.D. (in.)	≤ 0.3150	≤ 0.3310
Fuel Pellet Dia. (in.)	≤ 0.3088	≤ 0.3232
Fuel Rod Pitch (in.)	≤ 0.496	≤ 0.496
Active Fuel Length (in.)	≤ 150	≤ 150
No. of Guide and/or Instrument Tubes	25	25
Guide/Instrument Tube Thickness (in.)	≥ 0.016	≥ 0.014

NOTE 1: All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies.

NOTE 2: Design initial uranium weight is the nominal uranium weight specified for each assembly by the fuel manufacturer or DCPP. For each fuel assembly, the total uranium weight limit specified in this table may be increased up to 2.0 percent for comparison with DCPP fuel records to account for manufacturers tolerances.

NOTE 3: Soluble boron concentration per Technical Specification LCO 3.2.1.

NOTE 4: For those MPCs loaded with both intact fuel assemblies and damaged fuel assemblies or fuel debris, the maximum initial enrichment of the intact fuel assemblies is limited to the maximum initial enrichment of the damaged fuel assemblies and fuel debris (i.e., 4.0 wt.% ^{235}U).

NOTE 5: ZR designates fuel-cladding material, which is made of zirconium or zirconium alloys. Use of Zirlo clad fuel is limited to a maximum burnup of 45,000 MWD/MTU.

TABLE 10.2-6

FUEL ASSEMBLY COOLING AND MAXIMUM AVERAGE BURNUP
(UNIFORM FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Burnup (Intact Fuel Assemblies) (MWD/MTU)	MPC-24E/24EF Assembly Burnup (Intact Fuel Assemblies) (MWD/MTU)	MPC-24E/24EF Assembly Burnup (Damaged Fuel Assemblies and Fuel Debris) (MWD/MTU)	MPC-32 Assembly Burnup (Intact Fuel Assemblies) (MWD/MTU)
≥ 5	40,600	41,100	39,200	32,200
≥ 6	45,000	45,000	43,700	36,500
≥ 7	45,900	46,300	44,500	37,500
≥ 8	48,300	48,900	46,900	39,900
≥ 9	50,300	50,700	48,700	41,500
≥ 10	51,600	52,100	50,100	42,900
≥ 11	53,100	53,700	51,500	44,100
≥ 12	54,500	55,100	52,600	45,000
≥ 13	55,600	56,100	53,800	45,700
≥ 14	56,500	57,100	54,900	46,500
≥ 15	57,400	58,000	55,800	47,200

NOTE 1: Linear interpolation between points is permitted.
NOTE 2: Burnup for fuel assemblies with cladding made of materials other than Zircaloy-2 and Zircaloy-4 is limited to 45,000 MWD/MTU or the value in this table, whichever is less.

TABLE 10.2-7

FUEL ASSEMBLY COOLING AND MAXIMUM DECAY HEAT
(UNIFORM FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Burnup (Intact Fuel Assemblies) (Watts)	MPC-24E/24EF Assembly Decay Heat (Intact Fuel Assemblies) (Watts)	MPC-24E/24EF Assembly Decay Heat (Damaged Fuel Assemblies and Fuel Debris) (Watts)	MPC-32 Assembly Decay Heat (Intact Fuel Assemblies) (Watts)
≥ 5	1157	1173	1115	898
≥ 6	1123	1138	1081	873
≥ 7	1030	1043	991	805
≥ 8	1020	1033	981	800
≥ 9	1010	1023	972	794
≥ 10	1000	1012	962	789
≥ 11	996	1008	958	785
≥ 12	992	1004	954	782
≥ 13	987	999	949	773
≥ 14	983	995	945	769
≥ 15	979	991	941	766

NOTE 1: Linear interpolation between points is permitted.

NOTE 2: Includes all sources of heat (i.e., fuel and nonfuel hardware).

TABLE 10.2-8

FUEL ASSEMBLY COOLING AND MAXIMUM AVERAGE BURNUP
(REGIONALIZED FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Burnup for Region 1 (MWD/MTU)	MPC-24 Assembly Burnup for Region 2 (MWD/MTU)	MPC-24E/24EF Assembly Burnup for Region 1 (MWD/MTU)	MPC-24E/24EF Assembly Burnup for Region 2 (MWD/MTU)	MPC-32 Assembly Burnup for Region 1 (MWD/MTU)	MPC-32 Assembly Burnup for Region 2 (MWD/MTU)
≥ 5	49,800	32,200	51,600	32,200	39,800	22,100
≥ 6	56,100	37,400	58,400	37,400	43,400	26,200
≥ 7	56,400	41,100	58,500	41,100	44,500	29,100
≥ 8	58,800	43,800	60,900	43,800	46,700	31,200
≥ 9	60,400	45,800	62,300	45,800	48,400	32,700
≥ 10	61,200	47,500	63,300	47,500	49,600	34,100
≥ 11	62,400	49,000	64,900	49,000	50,900	35,200
≥ 12	63,700	50,400	65,900	50,400	51,900	36,200
≥ 13	64,800	51,500	66,800	51,500	52,900	37,000
≥ 14	65,500	52,500	67,500	52,500	53,800	37,800
≥ 15	66,200	53,700	68,200	53,700	54,700	38,600
≥ 16	-	55,000	-	55,000	-	39,400
≥ 17	-	55,900	-	55,900	-	40,200
≥ 18	-	56,800	-	56,800	-	40,800
≥ 19	-	57,800	-	57,800	-	41,500
≥ 20	-	58,800	-	58,800	-	42,200

NOTE 1: Linear interpolation between points is permitted.

NOTE 2: These limits apply to intact fuel assemblies, damaged fuel assemblies, and fuel debris.

NOTE 3: Burnup for fuel assemblies with cladding made of materials other than Zircaloy-2 and Zircaloy-4 is limited to 45,000 MWD/MTU or the value in this table, whichever is less.

TABLE 10.2-9

FUEL ASSEMBLY COOLING AND MAXIMUM DECAY HEAT
(REGIONALIZED FUEL LOADING)

Post-Irradiation Cooling Time (years)	MPC-24 Assembly Decay Heat for Region 1 (Watts)	MPC-24 Assembly Decay Heat for Region 2 (Watts)	MPC-24E/24EF Assembly Decay Heat for Region 1 (Watts)	MPC-24E/24EF Assembly Decay Heat for Region 2 (Watts)	MPC-32 Assembly Decay Heat for Region 1 (Watts)	MPC-32 Assembly Decay Heat for Region 2 (Watts)
≥ 5	1470	900	1540	900	1131	600
≥ 6	1470	900	1540	900	1072	600
≥ 7	1335	900	1395	900	993	600
≥ 8	1301	900	1360	900	978	600
≥ 9	1268	900	1325	900	964	600
≥ 10	1235	900	1290	900	950	600
≥ 11	1221	900	1275	900	943	600
≥ 12	1207	900	1260	900	937	600
≥ 13	1193	900	1245	900	931	600
≥ 14	1179	900	1230	900	924	600
≥ 15	1165	900	1215	900	918	600
≥ 16	-	900	-	900	-	600
≥ 17	-	900	-	900	-	600
≥ 18	-	900	-	900	-	600
≥ 19	-	900	-	900	-	600
≥ 20	-	900	-	900	-	600

<u>NOTE 1</u>: Linear interpolation between points is permitted.

<u>NOTE 2</u>: Includes all sources of decay heat (i.e., fuel and nonfuel hardware).

<u>NOTE 3</u>: These limits apply to intact fuel assemblies, damaged fuel assemblies, and fuel debris.

TABLE 10.2-10

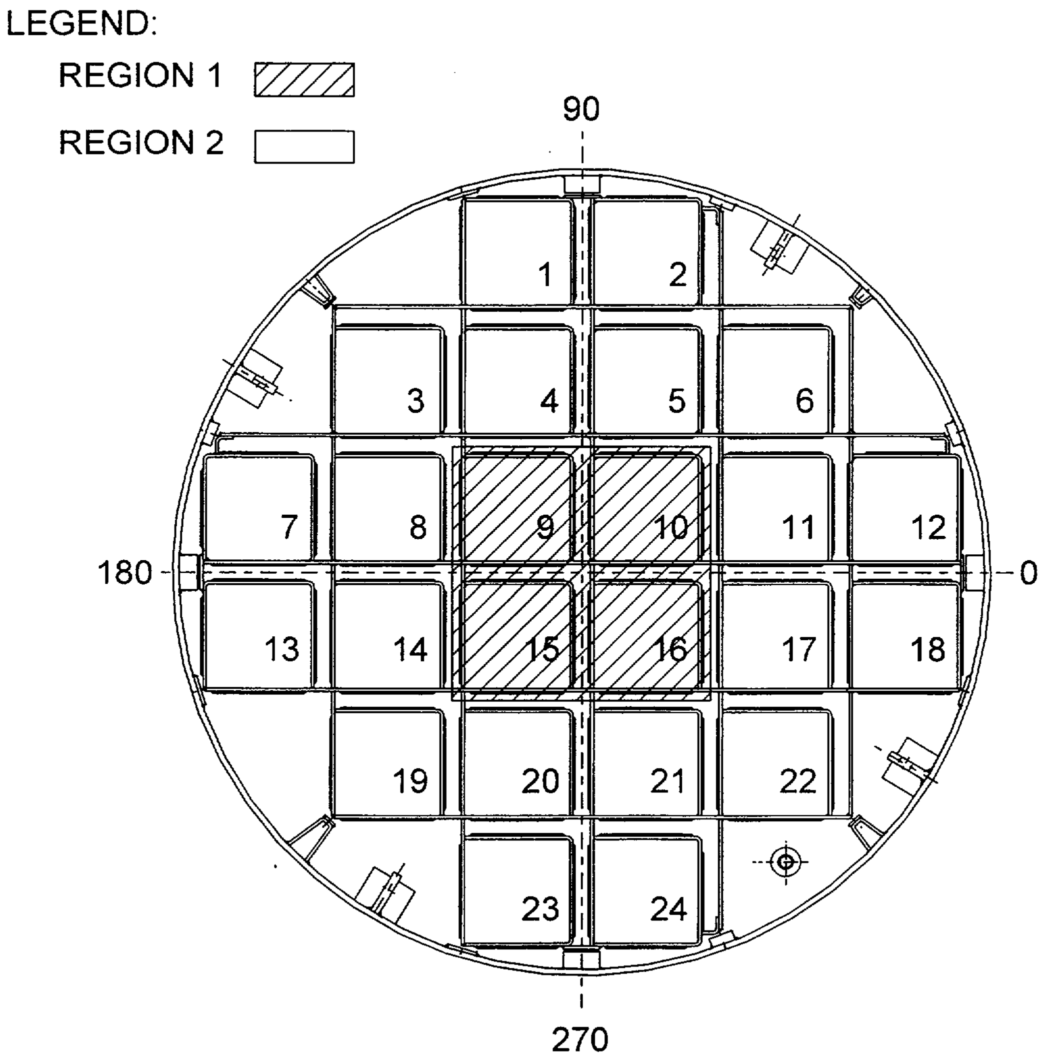
NONFUEL HARDWARE COOLING AND AVERAGE ACTIVATION

Post-Irradiation Cooling Time (years)	BPRA and WABA Burnup (MWD/MTU)	TPD Burnup (MWD/MTU)	RCCA Burnup (MWD/MTU)
≥ 5	NA (Note 3)	NA	≤ 630,000
≥ 6	NA	NA	
≥ 7	NA	NA	
≥ 8	NA	NA	
≥ 9	NA	NA	
≥10	≤ 20,000	NA	
≥ 11	≤ 25,000	≤ 20,000	
≥ 12	≤ 30,000	≤ 25,000	
≥ 13	≤ 40,000	≤ 30,000	-
≥ 14	≤ 45,000	≤ 40,000	-
≥ 15	≤ 50,000	≤ 45,000	-
≥ 16	≤ 60,000	≤ 50,000	-
≥ 17	-	≤ 60,000	-
≥ 18	-	≤ 75,000	-
≥ 19	-	≤ 90,000	-
≥ 20	-	≤ 180,000	-
≥ 21	-	≤ 630,000	-

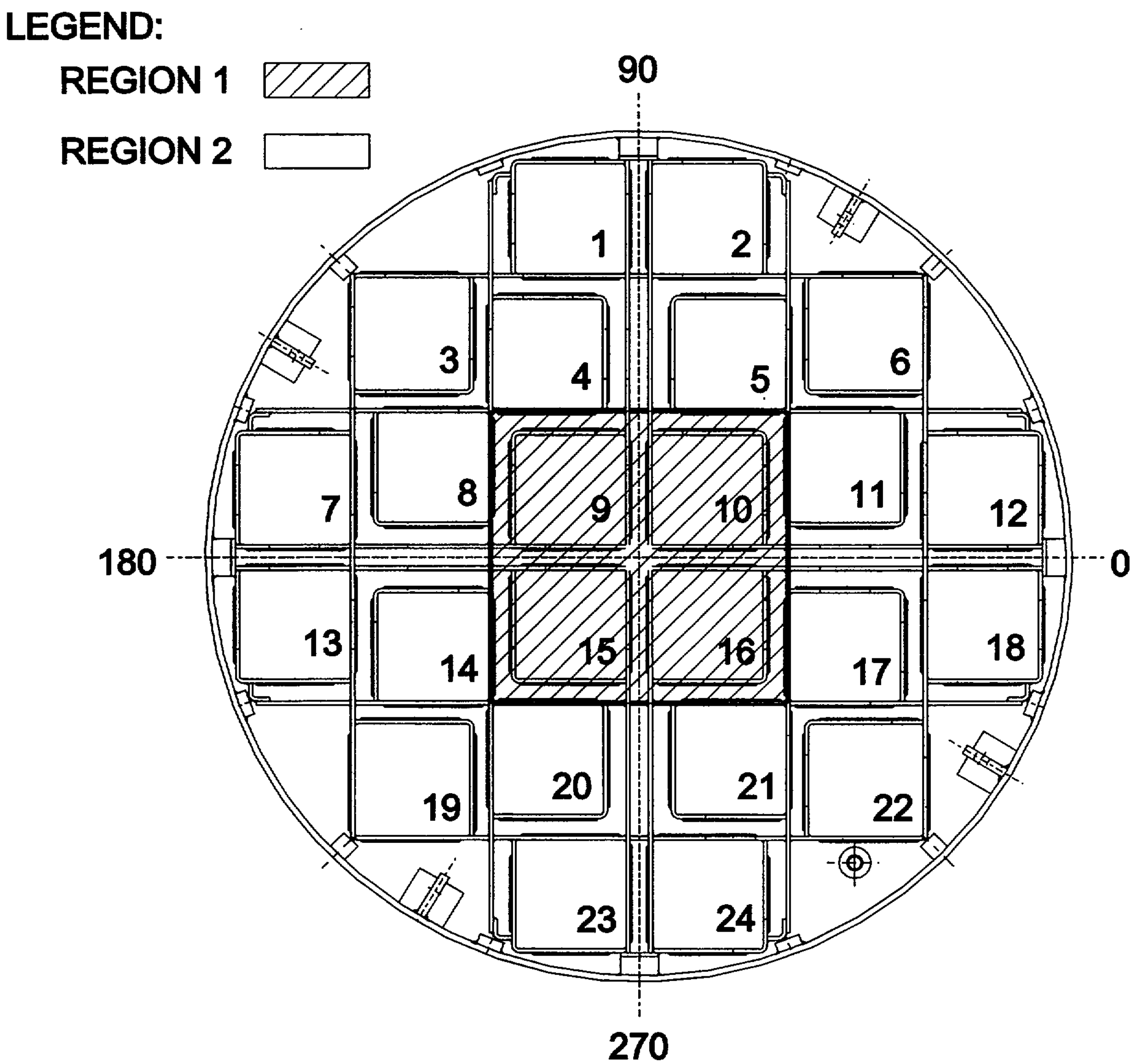
NOTE 1: Linear interpolation between points is permitted, except that TPD burnups > 180,000 MWD/MTU must be cooled ≥ 21 years.

NOTE 2: Applicable to uniform loading and regionalized loading.

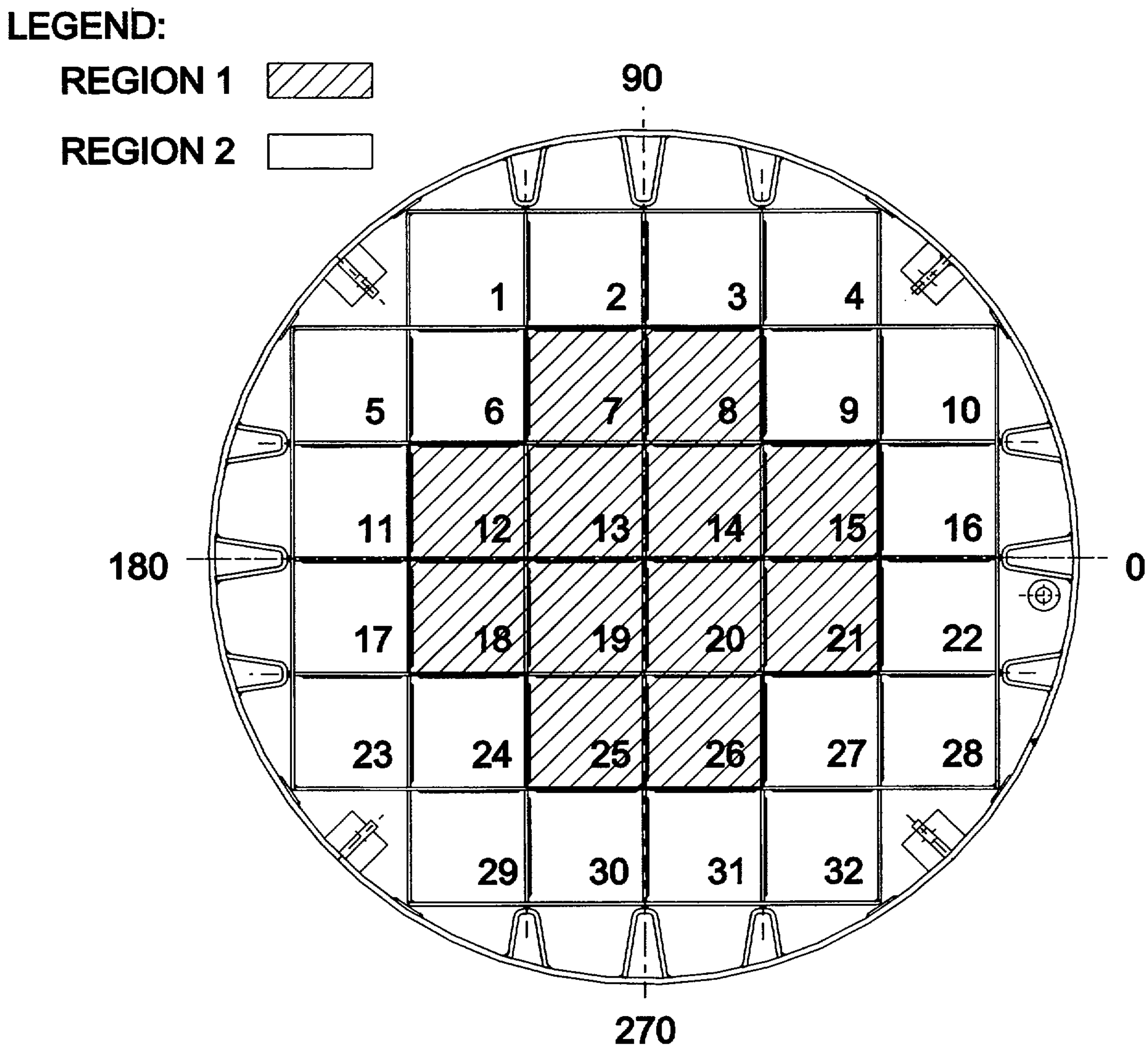
NOTE 3: NA means not authorized for loading.



SAFETY ANALYSIS REPORT
DIABLO CANYON ISFSI
FIGURE 10.2-1 FUEL LOADING REGIONS MPC-24



SAFETY ANALYSIS REPORT
DIABLO CANYON ISFSI
FIGURE 10.2-2 FUEL LOADING REGIONS MPC-24E/24EF



SAFETY ANALYSIS REPORT
DIABLO CANYON ISFSI
FIGURE 10.2-3 FUEL LOADING REGIONS MPC-32

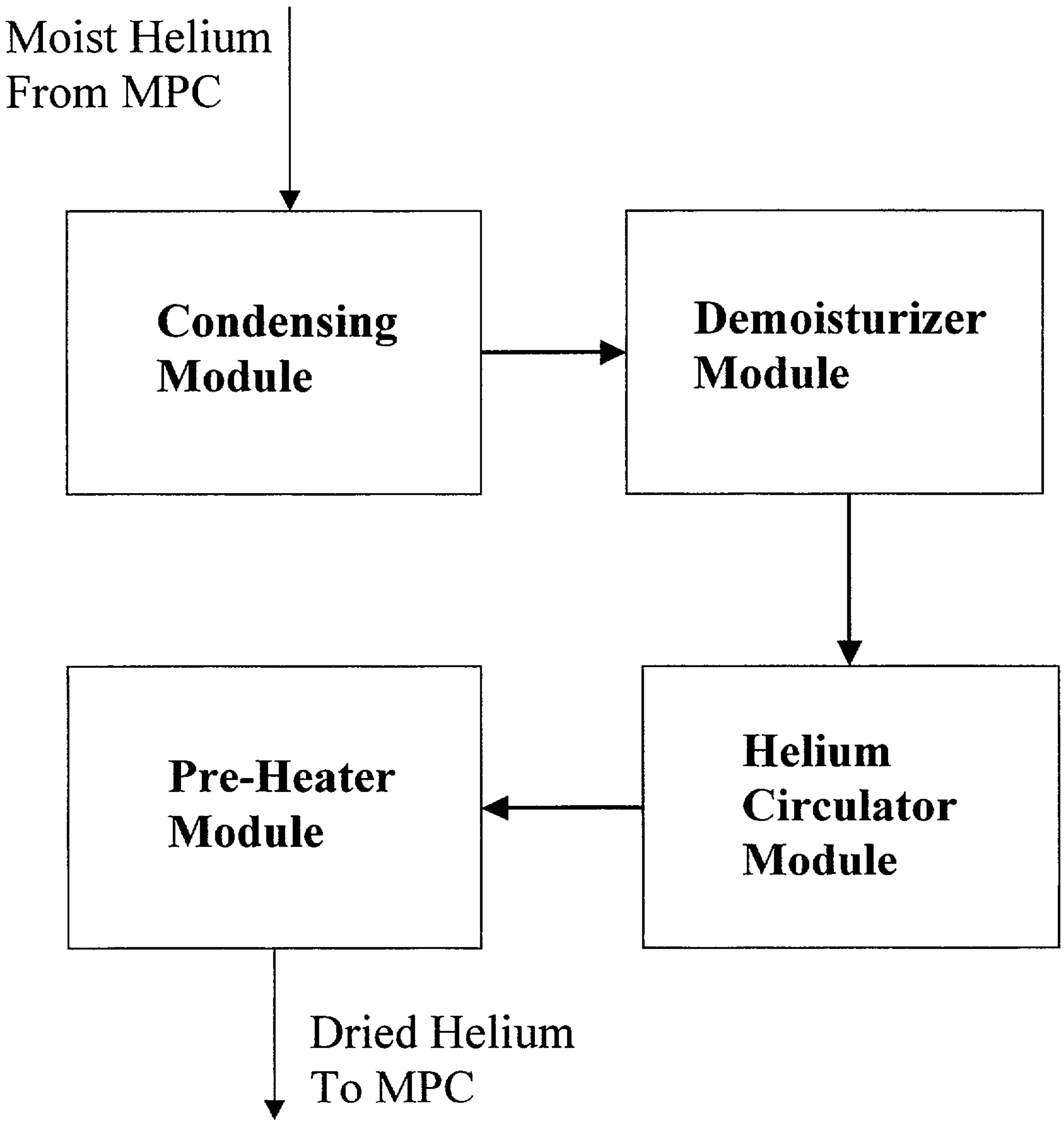


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FIGURE 10.2-4
SCHEMATIC DIAGRAM OF THE
FORCED HELIUM DEHYDRATION
SYSTEM

DIABLO CANYON ISFSI
SAFETY ANALYSIS REPORT

CHAPTER 11

QUALITY ASSURANCE

CONTENTS

CHAPTER 11

QUALITY ASSURANCE

10 CFR 72.140(b) states that each licensee shall establish, maintain, and execute a quality assurance program satisfying each of the applicable criteria of Subpart G. Paragraph (d) of 10 CFR 72.140 states that a Commission-approved quality assurance program that satisfies the applicable criteria of Appendix B of Part 50 and which is established, maintained, and executed with regard to an ISFSI will be accepted as satisfying the requirements of 10 CFR 72.140(b).

Since PG&E is currently licensed under 10 CFR 50 to operate the Diablo Canyon Power Plant (DCPP), Units 1 and 2, a Commission-approved quality assurance program meeting the requirements of 10 CFR 50, Appendix B, is already in place. The governing document for this program is the DCPP Quality Assurance (QA) Program as described in the DCPP Final Safety Analysis Report (FSAR) Update, Chapter 17 (Reference Docket No. 50-275, OL-DPR-80 and Docket No. 50-323, OL-DPR-82). This QA Program was first submitted as part of the original DCPP FSAR in 1973; was approved by the Commission for use in NRC Supplemental Safety Evaluation Report No. 9, issued in June 1980; and is updated in accordance with 10 CFR 50.54(a). The NRC is periodically notified of changes to the document as required by 10 CFR 50.71. The complete QA Program for the Diablo Canyon ISFSI is included as an attachment to the ISFSI license application.

This QA Program applies to the design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, modification, and decommissioning of ISFSI structures, systems, and components that are important to safety. Section 4.5 of this SAR identifies systems and components that are important to safety. The program also applies to managerial and administrative controls used to ensure safe ISFSI operation.

QA Program implementation is accomplished through separately issued procedures, instructions, and drawings. The objective of the QA Program for the ISFSI is to comply with the criteria established in 10 CFR 50, Appendix B, as amended, and with applicable QA Program requirements for nuclear power plants as referenced in regulatory guides and ANSI standards. The applicable guides and standards are identified in the License Application, Appendix E, "Quality Assurance Program," Table 17.1-1.

The procurement documents are reviewed prior to approval to ensure that the proper criteria have been specified. During the ISFSI design phase, vendor information (drawings, specifications, procedures, etc.) are reviewed to ensure compliance with DCPP's technical and quality requirements. During design, licensing, and fabrication of the cask storage system, PG&E's vendor surveillance representative will visit the suppliers' and fabricators' facilities to ensure compliance with PG&E's requirements.

Vendors and contractors that provide important-to-safety items and services will work to a PG&E-approved quality assurance program that meets the requirements of 10 CFR 72.140.

APPENDIX A

MATERIALS

NRC Interim Staff Guidance (ISG-15), dated January 10, 2001, provides specific guidance for the review of materials selected for dry cask storage systems. Regulatory requirements and review acceptance criteria are presented in Sections X.3 and X.4, respectively, of ISG-15. While there are a large number of requirements and criteria presented, they can be grouped into ten major categories, as follows:

(1) Adequate Description – Structures, systems and components (SSCs) that are important to safety and the materials from which they are constructed must be described in sufficient detail to permit adequate review. (ISG-15 Sections X.3.1.a, X.3.2.d, and X.4.1).

(2) Quality Standards – SSCs important to safety must be designed, build and tested to quality standards adequate for the safety function performed by the SSC. (ISG-15 Section X.3.2.a)

(3) Design Life – The cask design and the materials from which it is constructed must be designed to safely store spent fuel and permit required maintenance for the entire 20-year license period. (ISG-15 Sections X.3.2.e and X.4.2)

(4) Environmental Capability – The cask design and materials from which it is constructed (including coatings) must be compatible with all expected environmental conditions, including wet and dry loading and unloading facilities. Adverse chemical or corrosion reactions that would impact safe operation must be avoided. (ISG-15 Sections X.3.1.b, X.3.2.c, X.3.3, and X.4.1 through X.4.4)

(5) Cladding Integrity – Spent fuel cladding must be protected, under both normal, off-normal, and accident conditions, from temperatures and environments that could cause degradation leading to cladding rupture. (ISG-15 Sections X.3.4.a and X.4.4)

(6) Fire Protection – Noncombustible and heat resistant materials shall be used wherever possible. (ISG-15 Sections X.3.2.f, X.4.3, and X.4.4)

(7) Nuclear Control – Materials used for shielding and criticality functions must be appropriately selected to perform the function adequately and without susceptibility to slumping or other loss of effectiveness. (ISG-15 Sections X.3.2.b and X.4.2)

(8) Confinement Boundary – Confinement of radioactive materials must be maintained under all normal, off-normal, and accident conditions. (ISG-15 Section X.3.2.g)

(9) Offsite Shipment – The cask system must be designed to allow spent fuel to be transported off-site for eventual delivery to a DOE repository. (ISG-15 Section X.3.1.a)

(10) Operating Conditions – Materials used to construct the cask system must maintain acceptable physical and mechanical properties over all operating conditions, including temperature extremes. (ISG-15 Sections X.4.2 and X.4.4)

Each of these ten categories derived from ISG-15 has been evaluated for the dry cask storage system and is discussed below.

Adequate Description

This category requires that those components of the cask system that are important to safety are identified appropriately and that complete and accurate descriptions of those components be provided. SAR Section 4.5 of this SAR identifies equipment and components that are designated as important to safety. SAR Chapters 3 and 4 provide descriptions of the identified important-to-safety components and equipment.

Quality Standards

This category requires ensuring that appropriate governing codes be selected for SSCs important to safety. SAR Tables 3.4-1 through 3.4-5 provide the principle design criteria for the SSCs important to safety.

Design Life

This category requires that the design life of the cask system be specified and be at least 20 years in duration. The design life of the cask system is 40 years, as specified in SAR Table 3.4-2.

Environmental Capability

This category requires that reactions between cask system materials and the environment be avoided, including reactions with the spent fuel pool water and corrosion reactions. The MPC is constructed entirely of austenitic stainless steel and Boral (boron carbide and aluminum). The Boral is passivated prior to use, and any continuing passivation reactions will not result in significant hydrogen production. There are no coatings of any kind in the MPC. The transfer cask is constructed from the following materials: carbon steels; elemental lead; Holtite-A neutron shield material; paint; and brass, bronze or stainless steel appurtenances (pressure relief valves, drain tube, etc.). Exposed surfaces of the transfer cask are coated with an epoxy-based coating material that has been demonstrated not to react with the borated spent fuel pool water. The storage cask, its anchorage, and the cask transfer facility are constructed of carbon steels and concrete, with exposed surfaces coated for exterior service. The dry cask storage system is designed for marine environment service, including current-induced electromagnetic fields.

Cladding Integrity

This category requires that appropriate fuel cladding temperature limits be determined and met and that the fuel cladding be protected from exposure to reacting environments. Section 4.2.6.1 of this SAR describes the determination of allowable fuel cladding types and temperature limits and provides values for the limits. The normal condition limits ensure a probability of cladding breach of less than 0.5 percent over the 40-year design life and the short-term accident cladding temperature limit is in accordance with NRC guidance. Section 4.2.6.2 of this SAR describes that the MPC cavity is backfilled with helium, an inert gas, eliminating any reacting environment within the canister.

Fire Protection

This category requires using only materials that will not ignite when exposed to heat or flame. The MPC is constructed entirely of austenitic stainless steel and Boral (boron carbide and aluminum). The transfer cask is constructed from the following materials: carbon steels; elemental lead; Holtite-A neutron shield material; paint; and brass, bronze or stainless steel appurtenances (pressure relief valves, drain tube, etc.). The storage cask, its anchorage, and the cask transfer facility are constructed of carbon steels and concrete, with exposed surfaces coated for exterior service. None of these materials are known to ignite when exposed to heat or flame.

Nuclear Control

This category requires the use of materials with known radiation shielding and criticality control performance. Materials used for criticality control in the MPC are the Boral panels affixed to the walls of the fuel cells. Boral has been used successfully for many years in wet storage applications and, more recently, in dry storage service in the nuclear industry. Shielding in the transfer cask is provided primarily by lead, steel and water; also commonly used in nuclear applications. A small amount of Holtite-A neutron shield material is used in the lids of the transfer cask. A detailed description of Holtite-A may be found in Section 1.2.1.3.2 of the HI-STORM 100 System FSAR.

Confinement Boundary

This category requires demonstrating that the MPC confinement boundary (that is, stresses and temperatures) are not exceeded. The structural and thermal analyses discussed elsewhere in this SAR provide this information.

Offsite Shipment

This category requires that the cask system or, in the case of canister-based systems, the MPC be designed for transportation. The MPC is designed for transportation under 10 CFR 71 in the Holtec HI-STAR 100 transport cask.

Operating Conditions

This category requires that all materials must be evaluated under all conditions that are reasonable expected to occur during the design life of the cask system. The structural, thermal, criticality and shielding calculations presented in this SAR have evaluated the performance of the cask system materials under bounding conditions of storage and onsite handling including temperature extremes, drops and tipover, tornados, floods, seismic events, lightning, and explosions. All such evaluations have demonstrated the continued performance of the cask system materials.