3 OPERATION SYSTEMS

3.1 Conduct of Review

This chapter of the Safety Evaluation Report (SER) evaluates the descriptions of all operations presented in the Safety Analysis Report (SAR) (Pacific Gas and Electric Company, 2004a) including systems, equipment, and instrumentation for clarity and completeness. Particular emphasis was placed on how operation systems relate to handling and storing spent nuclear fuel (SNF), confining nuclear material, and managing expected and potential radiological dose. The review of the operation systems included selected sections of Chapters 3, "Principal Design Criteria;" 4, "ISFSI Design;" 5, "ISFSI Operations;" 8, "Accident Analysis;" 9, "Conduct of Operations;" and 10, "Operating Controls and Limits" of the SAR and documents cited in the SAR.

On-site cask handling outside the refueling building (RFB) and storage activities associated with the proposed Humboldt Bay Independent Spent Fuel Storage Installation (ISFSI) are operations to be covered by the 10 CFR Part 72 Humboldt Bay ISFSI license and are part of this review.

Certain fuel movement and cask handling operations in the Humboldt Bay Power Plant (HBPP) RFB are operations covered by a separate HBPP 10 CFR Part 50 license amendment request (Pacific Gas and Electric Company, 2004b). These activities are not part of this review.

The dry-cask storage system to be used at the proposed facility is the HI-STAR HB System, which is a modified version of the HI-STAR 100 cask system (Holtec International, 2002). The U.S. Nuclear Regulatory Commission (NRC) has certified the HI-STAR 100 cask system for use by 10 CFR Part 50 licensees under the general license provisions of 10 CFR §72.210 (U.S. Nuclear Regulatory Commission 2001a). Thus, where applicable, the staff relied on the review carried out during the certification process of that cask system, as documented in the HI-STAR 100 Cask System SER (U.S. Nuclear Regulatory Commission, 2001b). The HI-STAR HB system consists of the MPC-HB, which is a seal-welded canister containing 80 Humboldt Bay SNF assemblies; optional damaged fuel containers, which can be inserted into an MPC-HB and can hold an intact fuel assembly or damaged fuel; and the HI-STAR HB storage overpack (or cask).

The review considered how the SAR and related documents address the regulatory requirements of 10 CFR §72.24(b), §72.24(f), §72.40(a)(3), §72.40(a)(5), §72.40(a)(13), §72.44(c)(1), §72.44(c)(2), §72.44(c)(3), §72.104(b), §72.104(c), §72.122(f), §72.122(h)(1), §72.122(h)(4), §72.122(i), §72.122(j), §72.122(k), §72.122(l), §72.126(a), §72.126(b), §72.126(c), §72.128(a)(1), §72.150, and §72.166. Complete citations of these regulations are provided in the Appendix of this SER.

3.1.1 Operation Description

The staff reviewed Section 5.1 of the SAR, which describes the general operating functions to be performed during preparation for storage, transfer, actual storage, and potential unloading operations of the HI-STAR HB dry cask spent fuel storage system.

The Humboldt Bay ISFSI will be located on the site of the HBPP. The operation of the Humboldt Bay ISFSI will use facilities and personnel that are part of the HBPP, and ISFSI operations will be conducted in conjunction with the operations of the power plant. The Humboldt Bay ISFSI will use structures, systems, and components (SSCs) that are designed, fabricated, constructed, and used in accordance with accepted industry standards during the operation sequence for cask system loading, sealing, testing, and onsite transfer and handling. These practices, along with the passive nature of the spent fuel storage system, ensure that the Humboldt Bay ISFSI operations will not pose an undue risk to the safe conduct of activities at the HBPP.

Figure 5.1-1 of the SAR shows the operation sequence flowchart for cask system loading, sealing, testing, and storage operations. Upon receipt, the HI-STAR HB overpack is verified to be free of foreign material, and the top lid sealing surface is visually inspected for damage. A clean and empty multi-purpose canister (MPC-HB) is then inserted into the overpack, and the HI-STAR HB overpack is transferred to the RFB using the cask transfer rail dolly.

Cask handling, SNF loading, and MPC-HB and overpack preparation for storage all take place in the RFB. Some of these activities are governed by the 10 CFR Part 50 license. The HI-STAR HB cask will be placed in the cask loading area of the spent fuel pool (SFP) using a davit crane. The transfer of SNF to the MPC-HB will use a combination of fixtures and equipment designed by the cask system vendor and equipment specifically designed for the Humboldt Bay ISFSI. Consistent with the generic requirements of the HI-STAR 100 Final Safety Analysis Report (FSAR) (Holtec International, 2002) and in accordance with the site specific requirements of the Humboldt Bay ISFSI technical specifications (Pacific Gas and Electric Company, 2004c, Attachment C), SNF assemblies chosen for loading are assigned specific storage locations in the MPC-HB. Damaged fuel will only be placed in the MPC-HB in damaged fuel containers. Fuel loading and verification of correct fuel assembly placement in the MPC-HB will be conducted in accordance with approved fuel handling procedures (Holtec International, 2002; Pacific Gas and Electric Company, 2004c). The potential for misloading the MPC-HB is discussed in Chapters 8 and 15 of this SER. Records will be kept to track each fuel assembly, its assigned MPC-HB, and its specific fuel storage location. Accountability and control of SNF will be maintained at all times during loading, transfer, and storage operations. The Humboldt Bay ISFSI will be treated as a separate material balance area from the HBPP.

After the insertion of SNF assemblies into the MPC-HB, the HI-STAR HB cask will be removed from the SFP and placed on the cask transfer rail dolly. The MPC-HB and cask closure welding, draining, drying, and helium inerting operations will be performed within the RFB. These operations are controlled in accordance with the Humboldt Bay ISFSI technical specifications (Pacific Gas and Electric Company, 2004c, Attachment C).

The HI-STAR HB cask will be transferred outside the RFB on the cask transfer rail dolly. The HI-STAR HB lifting trunnions will be attached to the transporter lift links, and the loaded overpack will be lifted off the cask transfer rail dolly. A restraining strap will be used to secure the overpack to the transporter. As identified in Section 5.4 of the SAR, SNF transfer from the RFB to the ISFSI storage vault will be accomplished using a specifically designed transporter that is classified as important to safety. The requirements for the pretransfer evaluation and control of the transfer operation are identified in the Humboldt Bay ISFSI technical specifications (Pacific Gas and Electric Company, 2004c), and these activities will be conducted exclusively on the HBPP site. At the storage vault, the storage cell lid will be removed, and the

HI-STAR HB cask will be lowered into the vault using the transporter. Once the HI-STAR HB cask is properly positioned in the storage cell, seismic shims will be attached at the top of the cask, and the storage cell lid will be installed. The system is then configured for storage.

As identified in Section 4.4.3 of the SAR, the HI-STAR HB overpack does not require any periodic maintenance during storage in the vault. Provisions for visual inspection of the vault interior are included in the design. During the initial period of storage, the air temperature in the storage cell will be monitored to ensure that the design temperatures are not exceeded as identified in Section 4.4.3.7 of the SAR. Operations that will be performed during storage to ensure that the facility does not endanger public health and safety are described. These activities include the following:

(1) Storage vault drainage systems and vault interiors are inspected for evidence of water intrusion as identified in Section 4.4.3.8 of the SAR.

(2) Security personnel control access to the storage area and identify/assess off-normal and emergency events as identified in Chapter 9 of the SAR.

(3) Health physics personnel ensure that contamination levels are consistent with as low as is reasonably achievable (ALARA) requirements and within limits as identified in Chapter 9 of the SAR.

(4) Maintenance personnel maintain the facilities, including the storage vault, HI-STAR HB casks, and transfer systems, as identified in Chapter 5 of the SAR.

(5) Personnel will inspect the cask transporter prior to each loading campaign as identified in Section 4.3.2.1.4 of the SAR.

(6) Inventory documentation management will be conducted as identified in Chapter 5 of the SAR.

The Humboldt Bay ISFSI storage configuration is a passive installation, and periodic surveillance is required only to check the material condition of the casks and vault interior. Prior to loading each MPC-HB, radioactive contamination will be removed from the exterior and interior of the HI-STAR HB overpack and the exterior of the MPC-HB. In addition, radioactive contamination will be removed from the exterior of the HI-STAR HB cask prior to storage. The HI-STAR HB cask is designed such that there is no credible leakage. The staff, therefore, concludes that there will be no effluent generated during storage for normal, off-normal, and accident conditions.

Operational procedures for removal of storage casks from the ISFSI and unloading of the SNF are identified in Section 5.1.1.4 of the SAR. Figure 5.1-2 of the SAR shows the operation sequence flow chart for cask system unloading operations. The staff found the general description of operation for the removal of storage casks from the ISFSI and unloading of SNF to be acceptable in compliance with 10 CFR §72.122(l). If it is necessary to return the storage cask to the RFB for unloading, certain activities will be controlled in accordance with the 10 CFR Part 50 license. Requirements to satisfy Technical Specification 3.1.3, “Fuel Cool-Down” (Pacific Gas and Electric Company, 2004c, Attachment C) will be controlled under the 10 CFR Part 72 license.

The evaluations of off-normal and accident events are provided in Chapter 8 of the SAR and are reviewed in Chapter 15 of this SER. The actual cause, consequences, corrective actions, and actions to prevent recurrence for any events will be determined through the HBPP Corrective Action Program on a case-specific basis.

The staff determined that the procedure descriptions for operating, inspecting, and testing are consistent with the operation system. The staff finds the general description of the proposed ISFSI operations to be adequate in compliance with 10 CFR §72.24(b) and §72.24(f). Based on the operational descriptions provided, the staff finds that the Humboldt Bay ISFSI operations can be conducted without endangering activities or personnel at the HBPP and are, therefore, in compliance with 10 CFR §72.40(a)(3). Based on the operational descriptions provided, the staff also concludes that the Humboldt Bay ISFSI operations can be conducted without endangering the health and safety of the public and are, therefore, in compliance with 10 CFR §72.40(a)(5) and §72.40(a)(13). Technical specifications for operations and evaluation findings for 10 CFR §72.44(c)(1), §72.44(c)(2), and §72.44(c)(3) are presented in Chapter 16 of this SER.

The ALARA considerations of the applicant were reviewed, and evaluation findings for 10 CFR §72.104(b) are presented in Chapter 11 of this SER. The shielding evaluation, confinement evaluation, and radiation protection evaluation of the applicant were reviewed, and evaluation findings for 10 CFR §72.104(c) are presented in Chapter 7, 9, and 11, respectively, of this SER.

The staff finds that the HI-STAR HB cask and storage vault comprise a system that can be inspected to satisfy the requirements of 10 CFR §72.122(f). As stated previously, the HI-STAR HB cask system is a modified version of the passive HI-STAR 100 system, which the staff has previously reviewed and found acceptable (U.S. Nuclear Regulatory Commission, 2001a, b). The design for the HI-STAR HB storage system is based on the HI-STAR 100 System FSAR (Holtec International, 2002). Though there are design differences between the HI-STAR 100 and HI-STAR HB cask systems, the staff finds that the HI-STAR HB cask system is also a passive system that complies with the regulatory requirements of 10 CFR §72.122(h)(1) and §72.122(h)(4). Because the HI-STAR HB system is passive, no instrumentation systems are required to monitor its state. The HI-STAR HB system is based on the sealed MPC-HB as the confinement boundary. Although there are geometrical differences between the HI-STAR 100 MPC and the MPC-HB, the applicant has demonstrated that the structural integrity of the MPC-HB confinement boundary is not compromised. The staff evaluation of the design is given in Chapter 5 of this SER. Radiological protection for the HI-STAR HB system is provided by the overpack, which is constructed using the same materials and similar geometry as the HI-STAR 100 overpack. The radiation protection evaluation of the HI-STAR HB system is presented in Chapter 11 of this SER. The thermal characteristics of the HI-STAR HB system are based on passive heat transfer in the same manner as the HI-STAR 100 cask system.

The staff finds that the operational consideration of direct radiation protection systems in Section 5.1 of the SAR satisfy the requirements of 10 CFR §72.126(a–b). Thermoluminescent dosimeters are placed along the security fence of the Humboldt Bay ISFSI to satisfy the direct radiation requirement of 10 CFR §72.126(c)(2). The HI-STAR HB system is based on the sealed MPC-HB with no credible leakage and does not require effluent monitoring. The requirements of 10 CFR §72.126(c)(1), therefore, are not applicable for this facility.

The staff finds that the design and operational procedures provide acceptable capability to test components important to safety during cask system loading and sealing activities. Once sealed, the HI-STAR HB cask system is passive and requires no monitoring. Compliance with 10 CFR §72.128(a)(1), therefore, is demonstrated. The quality assurance considerations of the applicant are reviewed in Chapter 12 of this SER, and evaluation findings for 10 CFR §72.150 are discussed in Section 12.2.

The staff finds that Section 5.1 of the SAR, the Technical Specifications (Pacific Gas and Electric Company, 2004b), and the HI-STAR 100 FSAR (Holtec International, 2002) contain sufficient details to satisfy the requirements of 10 CFR §72.166.

3.1.2 Spent Nuclear Fuel Handling Systems

Normal loading and unloading operations will take place in the HBPP RFB under local control and in coordination with the HBPP staff and will be subject to the controls established under the 10 CFR Part 50 and Part 72 licenses, as applicable. Spent fuel handling of the HI-STAR 100 cask system, including the MPC, is described in detail in the HI-STAR 100 Cask System FSAR (Holtec International, 2002), which the staff has previously reviewed and found acceptable (U.S. Nuclear Regulatory Commission, 2001a,b). Based on an assessment of the design difference between the HI-STAR 100 cask system and the HI-STAR HB system, the staff concludes that the handling operations at the Humboldt Bay ISFSI will be consistent with the handling operations described in the HI-STAR 100 FSAR. Specific operating procedures have been customized for the site-specific license at the HBPP and Humboldt Bay ISFSI as identified in the Humboldt Bay ISFSI technical specifications (Pacific Gas and Electric Company, 2004c) and Section 10.2 of the SAR. All the staff conclusions drawn in Section 3.1.1 of this SER are also applicable to the SNF handling systems.

3.1.3 Other Operating Systems

Other operating systems associated with the Humboldt Bay ISFSI include the transporter. This item is classified as important to safety. For the Humboldt Bay ISFSI, those SSCs classified as not important to safety, but having security or operational importance, are identified as controlled under the HBPP 10 CFR Part 50 license.

The staff conclusions drawn in Section 3.1.1 of this SER are also applicable to the other operating systems. The proposed design of the ISFSI does not require utility systems during interim storage. The proposed design of the ISFSI does not include systems and subsystems that require continuous electric power to permit continued functioning. The requirement in 10 CFR §72.122(k) for emergency utility services, therefore, is not applicable for the Humboldt Bay ISFSI.

3.1.4 Operation Support Systems

The operation of the ISFSI is passive and self-contained and requires no permanently installed auxiliary systems. The ISFSI does not require any instrumentation or control systems to ensure safe operation. The staff finds, therefore, that 10 CFR §72.122(i) and §72.122(k) are not applicable for the Humboldt Bay ISFSI.

3.1.5 Control Room and Control Area

The staff reviewed the control room and control areas described in Section 5.2 of the SAR. The staff evaluated sections pertaining to monitoring instruments and limits and controls of the proposed cask system in the SAR. Based on the review, the staff finds that the Humboldt Bay ISFSI requires no permanent control room or control area to ensure safe operation; therefore, the requirements of 10 CFR §72.122(j) are not applicable.

3.1.6 Analytical Sampling

No analytical sampling associated with storage activities of the Humboldt Bay ISFSI is required. The HI-STAR HB system design will preclude the release of effluents generated during interim storage for normal, off-normal, and accident conditions. The waste management evaluation of the applicant was reviewed and an evaluation finding for 10 CFR §72.104(c) is presented in Chapter 14 of this SER.

3.1.7 Shipping Cask Repair and Maintenance

The HI-STAR HB system is both a storage and a transportation system. General maintenance is discussed in Section 3.1.1 of this SER. As identified in Section 4.4.3 of the SAR, the HI-STAR HB system does not require any periodic maintenance during storage operations. If visual inspections reveal the need for repairs or maintenance, these activities will be performed either *in situ* or in another appropriate location, based on the nature of the work to be performed. Radiation protection personnel will provide input and monitor these activities. The staff finds that the requirements of 10 CFR §72.122(f) are satisfied.

3.1.8 Pool and Pool Facility Systems

The Humboldt Bay ISFSI utilizes dry cask storage technology, which houses SNF inside sealed canisters that have an inert environment rather than in a SFP. Therefore, neither the use of a pool nor any system supporting a pool is incorporated into the Humboldt Bay ISFSI as covered by the 10 CFR Part 72 license. Note that the SNF will be transferred from the SFP into the MPC-HBs within the confines of the RFB. Activities associated with this operation are controlled under the 10 CFR Part 50 and Part 72 licenses, as applicable.

3.2 Evaluation Findings

Based on its review of the information in the SAR, the staff makes the following findings regarding the operation systems of the Humboldt Bay ISFSI:

- The SAR includes acceptable descriptions and discussions of the projected operating characteristics and safety considerations in accordance with 10 CFR §72.24(b) and §72.24(f).

- The Humboldt Bay ISFSI is to be located on the same site as another facility, the HBPP, licensed by the NRC. The potential interactions between these facilities have been evaluated in accordance with 10 CFR §72.40(a)(3).

- The SAR provides reasonable assurance that the operations to be authorized by the license at the Humboldt Bay ISFSI can be conducted without endangering the health and safety of the public in accordance with 10 CFR §72.40(a)(5) and §72.40(a)(13).

- The HI-STAR HB system and storage vault is a passive system that can be inspected in accordance with 10 CFR §72.122(f).

- The descriptions of the proposed Humboldt Bay ISFSI functions and operations systems with regard to retrieval of SNF from storage, in normal, off-normal, and accident conditions are acceptable and are in accordance with 10 CFR §72.122(h)(1), §72.122(h)(4), and §72.122(l).

- The HI-STAR HB system is a passive system with a radiation protection system and direct monitoring provided in accordance with 10 CFR §72.126(a), (b), and (c)(2).

- Acceptable capability to test and monitor components important to safety is provided by the applicant in accordance with 10 CFR §72.128(a)(1).

- The descriptions of the proposed Humboldt Bay ISFSI functions and operation systems with regard to preservation of materials and equipment to prevent damage or deterioration are acceptable and are in accordance with 10 CFR §72.166.

As identified, the evaluation findings addressing compliance with 10 CFR §72.44(c)(1), (c)(2), and (c)(3); §72.104(b–c); and §72.150 are contained in other chapters of this SER.

Because of the design and operational characteristics of the Humboldt Bay ISFSI, the following regulatory requirements identified in NUREG-1567 (U.S. Nuclear Regulatory Commission, 2000) are not applicable: 10 CFR §72.122(i), §72.122(j), §72.122(k), and §72.126(c)(1).

3.3 References

Holtec International. *Final Safety Analysis Report for the Holtec International Storage, Transport, and Repository Cask System* (*HI-STAR 100 Cask System*). Rev. 1. HI-2012610. Docket 72-1008. Marlton, NJ: Holtec International. 2002.

Pacific Gas and Electric Company. *Humboldt Bay Independent Spent Fuel Storage Installation Safety Analysis Report*. Amendment 1. Docket No. 72-27. Avila Beach, CA: Pacific Gas and Electric Company. 2004a.

Pacific Gas and Electric Company. *Humboldt Bay Power Plant Unit 3. License Amendment Request 04-02, Spent Fuel Cask Handling.* Docket No. 50-133. Avila Beach, CA: Pacific Gas and Electric Company. July 9, 2004b.

Pacific Gas and Electric Company. *Humboldt Bay Independent Spent Fuel Storage Installation License Application*. Amendment 1. Docket No. 72-27. Avila Beach, CA: Pacific Gas and Electric Company. 2004c.

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

U.S. Nuclear Regulatory Commission. *10 CFR Part 72 Certificate of Compliance No. 1008, Amendment 2, for the HI-STAR 100 Cask System*. Docket No. 72-1008. Washington, DC: U.S. Nuclear Regulatory Commission. 2001a.

U.S. Nuclear Regulatory Commission. *Holtec International HI-STAR 100 Cask System Safety Evaluation Report, Amendment 2*. Docket No. 72-1008. Washington, DC: U.S. Nuclear Regulatory Commission. 2001b.