9 CONFINEMENT EVALUATION

9.1 Conduct of Review

The staff reviewed the confinement evaluation presented in the Humboldt Bay ISFSI Safety Analysis Report (SAR) (Pacific Gas and Electric Company, 2004a). The Humboldt Bay ISFSI will use the HI-STAR HB system, which is a shortened version of the HI-STAR 100 system approved by the U.S. Nuclear Regulatory Commission (NRC) for use under the general license provisions of 10 CFR Part 72.

This review was conducted in accordance with the guidance presented in Chapter 9 of NUREG–1567 (U.S. Nuclear Regulatory Commission, 2000). This review focused on analyses and results presented and referenced by the applicant in the Humboldt Bay ISFSI SAR.

The review considered how the SAR and related documents address the regulatory requirements of 10 CFR §72.24(c), §72.24(d), §72.24(f), §72.24(g), §72.24(l)(1), §72.44(c)(1)(i), §72.104(a), §72.104(b), §72.104(c), §72.106(b), §72.122(h)(1), §72.122(h)(3), §72.122(h)(4), §72.122(h)(5), §72.122(i), §72.126(c)(1), §72.126(d), §72.128(a)(1), and §72.128(a)(3). Complete citations of these regulations are provided in the Appendix of this Safety Evaluation Report (SER).

9.1.1 Review of Design Features

The application was reviewed for identification of the quantity of radionuclides that hypothetically could be released during normal, off-normal, and accident conditions, including design-basis accidents. The staff reviewed Sections 3.3.1.2, 3.3.1.5, 3.3.1.7, 4.2.3.2, 4.2.3.3, 6.1, 8.1.3, 8.2.8, and Chapter 7 of the SAR. The HI-STAR HB system is designed for interim confinement and dry storage of Humboldt Bay Power Plant spent nuclear fuel and Greater than Class C waste. The design of the HI-STAR HB system is discussed in detail in Section 4.2.3 of the SAR. In Section 4.2.3.3.8 of the SAR, the applicant states that all components of the confinement system are classified as important to safety.

The confinement boundary of the HI-STAR HB system is the sealed MPC-HB that consists of the MPC shell, base plate, lid, vent and drain port cover plates, and the closure ring, which together form a welded canister. The MPC-HB is designed to confine radioactive material during all normal, off-normal, and accident conditions. The welds, including the final closure weld, are described in detail in Section 4.2.3.3.8 of the SAR. Table 4.2-3 of the SAR provides a comparison of the MPC-HB design with the specific requirements of Interim Staff Guidance 18 (ISG–18), (U.S. Nuclear Regulatory Commission, 2003a). The MPC-HB is designed, fabricated, and tested in accordance with the applicable requirements of the ASME Code, Section III, Subsection NB, to the maximum extent practicable (ASME International, 1998). The MPC-HB lid weld ensures that no credible leakage of radioactive materials will occur during normal, off-normal, and accident conditions. The closure ring weld provides a redundant welded boundary. Based on the information on the confinement boundary design presented in the SAR, the staff finds that the requirements of 10 CFR §72.24(c–d) have been met.

The staff has reasonable assurance that the HI-STAR HB system at the Humboldt Bay ISFSI meets the requirements of 10 CFR §72.106(b). The staff concludes that the stainless steel

welded canisters (with redundant welds in the lid enclosure of the canister), which will be manufactured and inspected according to the ASME Code as approved by staff, provide adequate confinement of radioactive materials, thereby meeting the requirements of 10 CFR §72.24(f) §72.24(f)(l)(1), §72.104(a–c), §72.126(d), and §72.128(a)(3).

The staff reviewed the applicable chapters of the SAR and found that the applicant's conclusions were consistent with those in the Holtec HI-STAR 100 System Final Safety Analyses Report (FSAR) (Holtec International, 2002) previously approved by the NRC staff. The staff also reviewed the Humboldt Bay ISFSI technical specifications (Pacific Gas and Electric, 2004b, Attachment C) proposed by the applicant and found those portions related to the confinement integrity of the HI-STAR HB system to be acceptable, with one addition. ISG-18 allows relief from the requirement for a helium leak test for the canister lid-to-shell structural weld; however, it does not relieve the requirement for helium leak tests of other closure welds. Specifically, the vent and drain port cover welds of the MPC-HB must be leak tested in accordance with ANSI –14.5. With the addition of this technical specification requirement to proposed TS 3.1.1, the staff finds that the confinement design of the HI-STAR HB system to be used at the Humboldt Bay ISFSI meets the requirements of 10 CFR §72.24(g), §72.44 (c)(1)(i), §72.122(h)(1), §72.126(d), and §72.128(a)(3).

9.1.2 Confinement Monitoring

The staff reviewed Sections 3.3.1.3, 3.3.1.5, 3.3.1.7, 4.2.3.3, and 6.1 of the SAR. The staff has found that casks closed entirely by welding do not require seal monitoring because there is no known plausible, long-term degradation mechanism that would cause the seal welds to fail.

Based on the staff's assessment of welded cask enclosures consistent with ISG–5 (U.S. Nuclear Regulatory Commission, 2003b), the MPC-HB, which is the confinement system for the HI-STAR HB system, provides reasonable assurance that no effluents will be released and, therefore, requires no monitoring of the MPC-HB for leakage. The seal welds will be inspected and tested as described in Section 4.2.3.3.8 of the SAR.

The staff finds the applicant's proposal to not provide leakage monitoring of the confinement barrier for the HI-STAR HB system at the Humboldt Bay ISFSI acceptable because the casks will be loaded, welded, inspected, tested, and surveyed in accordance with appropriate cask design requirements, thereby meeting the requirements of 10 CFR §72.24(l)(1), §72.44(c)(1)(i), §72.122(h)(3), §72.122(h)(4), §72.122(i), §72.126(c)(1), and §72.128(a)(1).

9.1.3 Protection of Stored Materials from Degradation

The staff reviewed the application to establish that the fuel cladding will not experience significant degradation during the storage period. The staff reviewed Sections 3.3.1, 4.4.1.1, 4.4.1.2, 5.1.1.2, and Table 3.4-2 of the SAR.

Following the loading of the MPC-HB, the main lid is welded, and a pressure test is performed on the seal weld. The MPC-HB cavity is then dried and filled with helium fill gas. The vent and drain ports are then welded into place, and a helium leak test is conducted on the vent and drain port covers. These steps are described in detail in SAR Section 4.4.1.2.3. The

helium back-fill procedure ensures that the presence of oxidizing gases in the MPC-HB cavity will be minimized.

The thermal analysis of the HI-STAR HB system discussed in Chapter 6 of this SER indicates that the fuel cladding temperature will not exceed the limits established to prevent fuel clad degradation during storage. The staff verified that the SAR was consistent with the information provided in the HI-STAR 100 System FSAR (Holtec International, 2002) and that the staff's previous findings in this area were applicable to the HI-STAR HB system. The staff reviewed the proposed Humboldt Bay ISFSI Technical Specifications (Pacific Gas and Electric, 2004b, Attachment C) and found the conditions to ensure the protection of stored materials from degradation in the HI-STAR HB system to be acceptable, thereby meeting the requirements of 10 CFR §72.24(l)(1), §72.122(h)(1), and §72.122(h)(5).

9.2 Evaluation Findings

For this confinement evaluation, the staff assumed that only the HI-STAR HB system would be used at the Humboldt Bay ISFSI. The staff made the following findings, based on its review of the applicant's submittal and the applicable technical specifications:

- The confinement structures, systems, and components important to safety are described in sufficient detail to permit evaluation of their effectiveness in accordance with 10 CFR §72.24(c–d) and are evaluated in Chapter 4 of this SER.

- The staff concludes that the proposed technical specifications, with the addition of the requirement to perform a leak test of the vent and drain port cover welds, are sufficient to protect the stored materials from degradation in accordance with 10 CFR §72.24(g).

- The design of the MPC-HB provides redundant sealing of the confinement system.

- The design and proposed operation of the ISFSI provide adequate measures for protecting the stored materials from degradation. The SNF cladding is adequately protected from gross ruptures in accordance with 10 CFR §72.122(h)(1).

- The MPC-HB is welded and tested in accordance with acceptable methods, as described in the SAR, and is not expected to leak under normal, off-normal, and accident conditions. Therefore, the staff finds that the requirements of 10 CFR §72.122(h)(3), §72.122(h)(5), §72.126(d), and §72.128(a)(3) have been met.

- The radionuclide confinement analysis for the HI-STAR HB system and the Humboldt Bay ISFSI meets the requirements of 10 CFR §72.24(f) and §72.24(f)(l)(1) by providing a description of how radioactive materials in gaseous and liquid effluents will be controlled such that they are as low as reasonably achievable.

- The staff concludes that the HI-STAR HB system, which uses an entirely redundant closure system, is not expected to leak and, therefore, does not require confinement monitoring. Based on this finding, the requirements of 10 CFR §72.24(l)(1), §72.44(c)(1)(i), §72.122(h)(3), §72.122(h)(4), §72.122(i), §72.126(c)(1), and §72.128(a)(1) have been met.

- The staff concludes that the design of the confinement system of the HI-STAR HB system complies with 10 CFR Part 72 and that the applicable design and acceptance criteria have been satisfied. The evaluation of the confinement system design provides reasonable assurance that the HI-STAR HB system will allow safe storage of SNF. This finding is reached on the basis of a review that considered the regulation itself, appropriate regulatory guides and interim staff guidance, applicable codes and standards, and accepted engineering practices. Based on this finding and the review discussed in Chapter 11 of this SER, the requirements of 10 CFR §72.104(a–c) and §72.106(b) have been met by the confinement system.

9.3 References

ASME International. *ASME Boiler and Pressure Vessel Code, Section III*. New York City, NY: American Society of Mechanical Engineers. 1998.

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

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. *The Design/Qualification of Final Closure Welds on Austenitic Stainless Steel Canisters as Confinement Boundary for Spent Fuel Storage and Containment Boundary for Spent Fuel Transportation*. Interim Staff Guidance 18 (ISG–18). Washington, DC: U.S. Nuclear Regulatory Commission. 2003a.

U.S. Nuclear Regulatory Commission. Interim Staff Guidance 5 (ISG–5), *Confinement Evaluation*. Rev. 1. Washington, DC: U.S. Nuclear Regulatory Commission. 2003b.