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Sent: Monday, June 25, 2012 1:23 PM
To: Allen, William
Cc: Sherman, Robert; Sharp, Loren; Baldwin, Thomas (DCPP); Arroyo, Roberto
Subject: REVISED FSAR PAGE
Attachments: CR 4-01-markup.doc; CR 4-01-clean.doc

Chris,

Per our conversation last week, attached is revised HB ISFSI FSAR page 5.1-7, both as a markup and clean version. The change reflects the deletion of the proposed sentence that incorrectly referred to the tech specs and FSAR section 10.2. Let me know if your reviewers have any additional questions or concerns. Thank you.

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CHAPTER 5

ISFSI OPERATIONS

This chapter describes the operations associated with the Humboldt Bay Independent Spent Fuel Storage Installation (ISFSI). Fuel movement and cask handling operations in the Humboldt Bay Power Plant (HBPP) Refueling Building (RFB) are performed in accordance with the HBPP 10 CFR 50 license. On-site cask handling outside the RFB and storage activities associated with the ISFSI are performed in accordance with the 10 CFR 72 Humboldt Bay ISFSI license. As indicated in previous chapters, the Humboldt Bay ISFSI, in its final storage configuration, is a totally passive installation. Periodic surveillance is required only to check the material condition of the casks and vault interior. No degradation of the cask or vault interior is expected.

The operations described in this chapter relate to the loading and preparation of the multi-purpose canisters (MPCs) and the overpacks and transport of the loaded overpacks from the RFB to the ISFSI storage vault. Also described is the process for off-normal event recovery, including unloading of fuel from a loaded overpack. An overview of activities occurring in the HBPP RFB is provided. Specific licensing of the components and activities is provided in the 10 CFR 50 license amendment request (LAR) associated with dry spent fuel storage.

5.1 OPERATION DESCRIPTION

The methods and sequences described below provide an overview of the operational controls that the personnel performing spent fuel loading, MPC and overpack preparation for storage, cask transfer, onsite handling, and storage activities implement to ensure safe, reliable, long-term spent fuel storage at the ISFSI storage site. Site-specific procedures are used to implement these activities, including the use of existing procedures, revision of existing procedures, and the creation of new procedures, as necessary. The specific number, wording, and sequence of site procedural steps may vary from the guidance provided here as long as the steps comply with assumptions and inputs in the governing, design-basis analyses.

Operations to load and place the HI-STAR HB System at the storage location in the ISFSI vault are performed both inside and outside the HBPP RFB. MPC fuel loading and handling operations are performed inside the RFB using existing HBPP systems and equipment for radiation monitoring, decontamination, and auxiliary support, augmented as necessary by ancillary equipment specifically designed for MPC fuel loading and handling functions. This includes the use of the davit crane and cask transfer rail dolly for heavy lifts and other cask movements. The implementing procedures incorporate applicable 10 CFR 50 license conditions and commitments, such as those governing heavy loads and fuel movements in the spent fuel pool (SFP). MPC installation in the overpack and movement of the loaded overpack to the storage location are performed using procedures developed specifically for these operations.

5.1.1 NARRATIVE DESCRIPTION

The following discussion describes the specifics of the integrated operation, including fuel loading, MPC closure operations, overpack closure operations, HI-STAR HB System handling, and placement of the loaded overpack in the ISFSI vault. To the extent practicable, the same operations as used in deploying the generic HI-STAR 100 System are used with the HI-STAR HB System. Certain operating procedures have been customized for site-specific licensing at HBPP and the Humboldt Bay ISFSI.

The MPC is loaded, while in the HI-STAR HB overpack, in the SFP. The MPC is welded and prepared for storage while in the RFB. The MPC is sealed inside the overpack in the RFB and is then transported to the ISFSI vault for storage. Section 5.1.1.1 describes loading operations for damaged fuel. Section 5.1.1.2 describes fuel cask loading and sealing operations. Section 5.1.1.3 describes the operations for transferring the loaded HI-STAR HB System to the ISFSI storage site for storage. Section 5.1.1.4 describes off-normal event recovery operations. Section 5.1.1.5 describes greater-than-class C (GTCC) cask loading and sealing operations, and section 5.1.1.6 describes GTCC cask transfer to the ISFSI storage site.

Specific procedures identify and control the selection of fuel assemblies and greater than Class C waste (GTCC) for loading into the HI-STAR HB System or GTCC qualified casks, as appropriate. Fuel and GTCC will not be loaded in the same MPC. All HBPP fuel is acceptable for storage in the HI-STAR HB System based on a comparison of the fuel assemblies' physical characteristics against the limits specified in Section 10.2. The selected fuel assemblies are classified as intact fuel or damaged fuel in accordance with the definitions in Section 10.2, and the classification criteria described in Section 3.1.

Fuel assemblies chosen for loading are assigned a specific storage location in the MPC in accordance with the Humboldt Bay ISFSI TS and Section 10.2. The classification of the assembly (that is, intact or damaged) is used to determine the acceptable fuel storage locations for each assembly. Records are kept that track the fuel assembly, its assigned MPC, and its specific fuel storage location. Videotape (or other visual record) is used during fuel loading operations in the SFP to record fuel assembly serial numbers and to provide an independent record of the MPC inventory.

The loading, unloading, and handling operations described in this section were developed based on the Holtec International field experience in loading HI-STORM 100 and HI-STAR 100 dry cask storage systems at other ISFSIs. The equipment and operations used at these sites were evaluated and modified, as necessary, based on this experience to reduce occupational exposures and further enhance the human factors involved in performing the activities needed to successfully deploy the HI-STAR HB System at the Humboldt Bay ISFSI.

5.1.1.1 Damaged Fuel Loading

Damaged fuel containers (DFCs) are used to store damaged fuel assemblies in the MPC-HB in accordance with the requirements of the Humboldt Bay ISFSI TS and Section 10.2. Any qualified fuel assembly that is classified as damaged fuel must be stored in a DFC and be loaded into specific fuel storage locations in an MPC-HB. Two patterns for loading DFCs containing damaged fuel are permitted (see Section 10.2):

- Up to 28 DFCs around the basket periphery, or
- Up to 40 DFCs in a checkerboard pattern throughout the basket.

In both cases, the balance of fuel stored in an MPC must be intact fuel assemblies, optionally stored in DFCs themselves. Storage of damaged fuel in the HI-STAR HB System is discussed in Section 4.2.3.2.2 and the structural analysis of the containers is described in Section 4.3.2.2.10. Figure 4.2-3 shows the pertinent design details of the Humboldt Bay DFC.

5.1.1.2 Fuel Cask Loading and Sealing Operations

This section describes the general sequence of operations to load and seal the fuel cask, including the movement of the HI-STAR HB overpack within the RFB. Site-specific procedures control the performance of the operations, including inspection and testing. At a minimum, these procedures control the performance of activities and alert operators to changes in radiological conditions around the cask. These sequences are controlled by Humboldt Bay ISFSI TS and Section 10.2.

Several components (e.g., the davit crane and cask transfer rail dolly) are used during the cask loading process. A discussion of these items is provided for the sole purpose of describing the loading process. These items, along with their design and use, are described in the HBPP 10 CFR 50 LAR to support ISFSI operations in the RFB.

Placement of loaded HI-STAR HB overpacks in the ISFSI vault is a cyclical process involving the movement of a loaded overpack to the ISFSI and returning the empty cask transporter to the RFB for the next loading process. The operations described herein start at the time the empty MPC is loaded into the overpack and is ready for movement into the RFB.

Prior to bringing the HI-STAR HB overpack into the RFB, the overpack is visually verified to be free of foreign materials and the top lid sealing surface is visually inspected for potential damage. Also, an empty MPC has been cleaned, inspected, and inserted into the overpack. Alignment marks are checked to ensure correct rotational alignment between the MPC and the HI-STAR HB overpack.

The HI-STAR HB overpack containing an empty MPC is brought into the RFB in the vertical orientation through the railroad door on the cask transfer rail dolly that runs from inside the RFB to the Unit 3 yard. The cask transfer rail dolly is used because dimensional limitations of the RFB door prevent access of the cask transporter inside the RFB. After bringing the overpack into the RFB, the overpack is positioned under the davit crane that is configured with the lift yoke and the overpack annulus overpressure system is connected.

The overpack-to-MPC annulus is filled with clean water and the inflatable annulus seal is installed in the top part of the annulus to minimize the risk of contaminating the external shell of the MPC. The MPC internal cavity is filled with SFP water or water from another suitable source to prevent splash-back when the cask is lowered into the SFP. The lift yoke engages the overpack lifting trunnions and is used to raise and lower the overpack during loading operations inside the RFB.

The HI-STAR HB overpack is raised by the davit crane, positioned over the cask loading area of the SFP, and lowered using the davit crane hoist until the top the overpack is nearly level with the water level in the annulus overpressure system. The annulus overpressure system supply line to the overpack is opened and the overpack is lowered to the bottom of the SFP. The annulus overpressure system applies a slight overpressure to the annulus to protect the MPC external shell from contamination from the SFP water in the event there is a leak in the annulus seal. When the cask is fully lowered to the bottom of the cask loading area in the SFP, the lift yoke is remotely disconnected from the overpack and moved out of the way to allow fuel loading into the cask.

Fuel-loading and post-loading verification of correct fuel assembly placement in the MPC (i.e., assembly identification and storage cell location) is conducted in accordance with approved fuel-handling procedures. For damaged fuel assemblies, the assembly is loaded into the DFC, and the DFC is loaded into the MPC. Optionally, an empty DFC may be first loaded into the appropriate fuel storage location in the MPC and then the damaged fuel assembly may be loaded into the DFC. Intact fuel assemblies may be stored in DFCs at Pacific Gas and Electric's (PG&E) discretion.

The MPC lid, with the drain line attached, is placed in position in the MPC after the completion of fuel loading and verification, while the HI-STAR HB overpack is in the SFP. The lift devices are detached from the MPC lid allowing the lift yoke, which is attached to the davit crane, to be lowered to the overpack to engage the lifting trunnions. The overpack and lift yoke are raised until the top of the MPC and overpack break the water surface. The annulus overpressure supply line is closed and the overpressure system is disconnected. Initial decontamination of the overpack may be performed as the overpack emerges from the SFP or in any other manner approved by the Radiation Protection (RP) Department. The overpack is raised completely out of the SFP. The overpack is placed onto the cask transfer rail dolly in the cask washdown area. The lid retention device is attached. The lift yoke is disconnected and removed from the area.

The MPC water volume is reduced to provide enough space between the water surface and the lid to avoid a water-weld interaction. The inflatable annulus seal is removed and the annulus water level is lowered. Once the top edge of MPC shell is surveyed and found to be in satisfactory condition, the annulus shield is installed. The lid retention device remains in place until a sufficient number of tack welds are applied, and is then removed to allow room for the automatic weld system to be installed.

The space under the MPC lid is exhausted or purged during welding operations to prevent combustible gas concentrations that may result from the oxidation of the neutron absorber panels in the water. Appropriate monitoring for combustible gas concentrations is performed prior to and during MPC lid welding operations. The MPC lid-to-shell weld, including liquid penetrant inspections after the root pass, each approximately 3/8-inch of weld depth, and after the final pass, is then completed.

Once the lid-to-shell weld is complete, the MPC undergoes a pressure test for leaks in accordance with the ASME Code. The lid-to-shell weld is liquid penetrant inspected after the pressure test. Either prior to, or following successful completion of the pressure test (depending on whether a hydrotest or pneumatic test is performed), the RVOAs are installed and the remaining MPC water is displaced from the MPC by pumping or blowing pressurized nitrogen or helium gas into the MPC. The water may be drained from the overpack annulus and vacuum drying or the Forced Helium Dehydration (FHD) System is used to remove the remaining liquid water from the MPC and to ultimately reduce the moisture content of the MPC cavity to an acceptable level.

Following the successful completion of moisture removal from the MPC, the MPC is backfilled with helium to within the required pressure range. Helium backfill to the required pressure range ensures that the conditions for heat transfer inside the MPC are consistent with the thermal analyses and provides an inert atmosphere to ensure long-term fuel integrity. After successful helium backfill operations, the RVOAs are removed and the MPC vent and drain port cover plates are installed, welded, and examined. The MPC closure ring is then installed, welded, and examined.

The HI-STAR HB overpack and accessible portions of the MPC are checked to ensure any removable contamination is within applicable limits. Additional decontamination and surveys may be performed throughout the loading process. The closure plate is installed on the HI-STAR HB with the redundant mechanical seals, and the bolts are tightened to seat the seals. The overpack annulus is drained, if not previously completed, and dried using the vacuum drying system and the annulus is backfilled with helium in accordance with the Humboldt Bay ISFSI TS and Section 10.2.

The integrity of the closure plate mechanical seals is verified by performing a helium leakage test between the seals using the overpack test port. Upon successful completion of the seal leakage test, a test port plug and cover plate are installed. The overpack vent and drain ports are then sealed with port plugs and the port plugs are helium leakage tested. Upon successful testing of the port plugs, the vent and drain port covers are installed and the cask is ready for transport to the ISFSI storage vault. The loaded overpack is moved out of the RFB along the rail dolly using a winch system or similar device and positioned under the lift beam of the cask transporter with the lift links attached.

5.1.1.3 Fuel Cask Transfer to the ISFSI Storage Site

The cask transporter is positioned outside the RFB doors to receive the HI-STAR HB overpack from the cask transport rail dolly. The transporter will have undergone preoperational testing and maintenance and is operated in accordance with the Cask Transportation Evaluation Program, which evaluates and controls the transportation of loaded overpacks between the HBPP RFB and ISFSI vault. The cask transporter lift links engage the HI-STAR HB lifting trunnions and the overpack is lifted off of the rail dolly. A restraining strap is used to secure the overpack to the transporter. The overpack is transported to the ISFSI vault along the approved transportation route using appropriate administrative controls as described in Section 4.3.3 and shown in Figure 2.2-2.

The cask transporter centers the HI-STAR HB overpack over the open vault storage cell. The restraining strap is released from the overpack. The cask transporter towers are used to lower the overpack down into the vault and the lift links are removed. The cask transporter is driven away from the ISFSI vault, the seismic shims are installed, and the storage cell lid is installed.

5.1.1.4 Off-Normal Event Recovery Operations

The evaluations of off-normal and accident events, as defined in ANSI/ANS-57.9 (Reference 1) and as applicable to the Humboldt Bay ISFSI, are presented in Chapter 8. Each postulated off-normal and accident event evaluated and discussed in Chapter 8 addresses the event cause, analysis, and consequences. Suggested corrective actions are also provided for off-normal events. The actual cause, consequences, corrective actions, and actions to prevent recurrence (if required) will be determined through the HBPP corrective action program on a case-specific basis. All corrective actions will be taken in a timely manner, commensurate with the safety significance of the event. Of primary importance in the early response to any event will be the verification of continued criticality prevention, the protection of fuel cladding integrity (that is, heat removal), and the adequacy of radiation shielding while longer-term corrective actions are developed. This may also involve the need for temporary shielding or cask cooling in accordance with the recommendations of PG&E technical staff personnel, based on the event conditions.

Should the need arise during the loading campaign, the MPC can be returned to the SFP for unloading. To unload a HI-STAR HB overpack, the operations described above are effectively executed in reverse order from the point in the operation at which the event occurred. Once the overpack is back in the RFB, the overpack closure plate is removed, and preparations are made to re-open the MPC in the SFP. This involves first installing the annulus shield and cutting or grinding out the welds to remove the MPC closure ring and vent and drain port cover plates.

Then, the bulk temperature of the gas in the MPC cavity is ensured to be below the maximum value to allow re-flooding. Given the age of the fuel at the time of loading, it is unlikely that the cavity gas will require cooling prior to re-flooding. Nevertheless, the bulk gas temperature will be determined and cooled using appropriate means, if necessary. Appropriate means could include recirculating water in the overpack annulus and/or helium recirculation with the FHD system to cool the MPC to a temperature at or below the maximum allowed temperature for re-flooding in accordance with the Humboldt Bay ISFSI TS and Section 10.2.

Ensuring the MPC cavity bulk gas temperature to be below the maximum allowed temperature allows the MPC to be re-flooded with water with a minimal amount of flashing and the associated undesirable pressure spikes in the MPC cavity. The weld removal system is used to cut the MPC lid weld. Once the lid weld is removed, the lid retention device is installed.

After re-flooding, appropriate monitoring for combustible gas concentrations shall be performed prior to, and during, MPC lid cutting operations to prevent the build-up of combustible mixtures caused by oxidation of neutron absorber panels contained in the MPC. In addition, the space below the MPC lid shall be exhausted prior to, and during, MPC lid welding operations to provide additional assurance that explosive gas mixtures will not develop in this space.

When the lid weld has been successfully cut, the annulus shield is removed. The annulus is filled with clean water and the annulus overpressure system and annulus seal are installed. The lift yoke is installed on the davit crane and attached to the overpack. The davit crane moves the overpack and MPC over the cask loading area of the SFP and lowers it to the SFP floor. As the top of the HI-STAR HB reaches a level approximately equal to the SFP level, the supply line from the annulus overpressure system is connected and opened. Once in the SFP, the lid retention device and the MPC lid are removed and the spent fuel assemblies are removed from the MPC and placed back into the wet storage racks as necessary.

5.1.1.5 GTCC Cask Loading and Sealing Operations

This section describes the general sequence of operations to load and seal the GTCC cask, including the movement of the HI-STAR HB GTCC overpack within the RFB. Site-specific procedures control the performance of the operations, including inspection and testing. At a minimum, these procedures control the performance of activities and alert operators to changes in radiological conditions around the cask.

Several components (e.g., the RFB crane and cask transfer rail dolly) are used during the cask loading process. A discussion of these items is provided for the sole purpose of describing the loading process.

Prior to bringing the HI-STAR HB GTCC overpack into the RFB, the overpack is visually verified to be free of foreign materials or physical damage. Also, the empty GTCC Waste Container (GWC) is visually verified to have been cleaned, inspected, and inserted into the overpack. Alignment marks are checked to ensure correct rotational alignment between the GWC and the overpack.

The overpack containing an empty GWC is brought into the RFB in the vertical orientation through the railroad door on the cask transfer rail dolly that runs from inside the RFB to the Unit 3 yard. The cask transfer rail dolly is used because dimensional limitations of the RFB door prevent access of the cask transporter inside the RFB. After bringing the overpack into the RFB, the overpack is positioned under the RFB crane that is configured with the lift yoke and the overpack annulus overpressure system is connected.

The overpack-to-GWC annulus is filled with clean water and the inflatable annulus seal is installed in the top part of the annulus to minimize the risk of contaminating the external shell of the GWC. The GWC internal cavity is filled with SFP water or water from another suitable source to prevent splash-back when the cask is lowered into the SFP. The lift yoke engages the overpack lifting trunnions and is used to raise and lower the overpack during loading operations inside the RFB.

The overpack is raised by the RFB crane, positioned over the cask loading area of the SFP, and lowered using the RFB crane hoist until the top the overpack is nearly level with the water level in the annulus overpressure system. The annulus overpressure system supply line to the overpack is opened and the overpack is lowered to the bottom of the SFP. The annulus overpressure system applies a slight overpressure to the annulus to protect the GWC external shell from contamination from the SFP water in the event there is a leak in the annulus seal. When the cask is fully lowered to the bottom of the cask loading area in the SFP, the lift yoke is remotely disconnected from the overpack and moved out of the way to allow GTCC loading into the cask.

GTCC loading (including the process waste container and the irradiated hardware pieces) is conducted in accordance with approved procedures. The GWC lid, with the drain line attached, is placed in position in the GWC after the completion of GTCC loading, while the overpack is in the SFP. The lift devices are detached from the GWC lid allowing the lift yoke, which is attached to the RFB crane, to be lowered to the overpack to engage the lifting trunnions. The overpack and lift yoke are raised until the top of the GWC and overpack break the water surface. The annulus overpressure supply line is closed and the overpressure system is disconnected. Initial decontamination of the overpack may be performed as the overpack emerges from the SFP or in any other manner approved by the Radiation Protection (RP) Department. The overpack is raised completely out of the SFP. The overpack is placed onto the cask transfer rail dolly in the cask washdown area. The lift yoke is disconnected and moved from the area.

The GWC water volume is reduced to provide enough space between the water surface and the lid to avoid a water-weld interaction. The inflatable annulus seal is removed and the annulus water level is lowered. Once the top edge of GWC shell is surveyed and found to be in satisfactory condition, the annulus shield is installed if required by Radiation Protection personnel for dose considerations.

Although no combustible gas is expected, the space under the GWC lid is exhausted or purged during welding operations to prevent combustible gas concentrations from accumulating. Appropriate monitoring for combustible gas concentrations is performed prior to and during GWC lid welding operations. The GWC lid-to-shell weld is then completed, including liquid penetrant inspections after the root pass, each approximately 3/8-inch of weld depth, and after the final pass.

Once the lid-to-shell weld is complete, the GWC undergoes a pressure test for leaks in accordance with the ASME Code. The lid-to-shell weld is liquid penetrant inspected after the pressure test. Either prior to, or following successful completion of the pressure test (depending on whether a hydrotest or pneumatic test is performed), appropriate hoses are installed and the remaining GWC water is displaced from the GWC by pumping or blowing pressurized nitrogen or helium gas into the GWC. The water may be drained from the overpack annulus and the GWC is backfilled with low density grout, or equivalent, to absorb any remaining free water.

After successful grout backfill operations, the connecting hoses are removed and the GWC vent and drain port cover plates are installed, welded, and examined. The GWC closure ring is then installed, welded, and examined.

The overpack and accessible portions of the GWC are checked to ensure any removable contamination is within applicable limits. Additional decontamination and surveys may be performed throughout the loading process. The closure plate is installed on the overpack and the bolts are tightened as specified by the manufacturer. The overpack annulus is drained, if not previously completed, and the cask is ready for transport to the ISFSI storage vault. The loaded overpack is moved out of the RFB along the rail dolly using a winch system or similar device and positioned under the lift beam of the cask transporter with the lift links attached.

5.1.1.6 GTCC Cask Transfer to the ISFSI Storage Site

The cask transporter is positioned outside the RFB doors to receive the HI-STAR HB GTCC overpack from the cask transport rail dolly. The transporter will have undergone preoperational testing and maintenance. The cask transporter lift links engage the HI-STAR HB lifting trunnions and the overpack is lifted off of the rail dolly. A restraining strap is used to secure the overpack to the transporter. Using appropriate administrative controls, the overpack is transported to the ISFSI vault along the approved transportation route as described in Section 4.3.3 and shown in Figure 2.2-2.

The cask transporter centers the HI-STAR HB GTCC overpack over the open vault storage cell. The restraining strap is released from the overpack. The cask transporter towers are used to lower the overpack down into the vault and the lift links are removed. The cask transporter is driven away from the ISFSI vault, the seismic shims are installed, and the storage cell lid is installed.

5.1.2 IDENTIFICATION OF SUBJECTS FOR SAFETY AND RELIABILITY ANALYSIS

5.1.2.1 Criticality Prevention

A summary description of the principal design features, procedures, and special techniques used to preclude criticality in the design and operation of the HI-STAR HB System is provided in Section 3.3.1.4. Additional detail on the criticality design of the storage cask is provided in Section 4.2.3.3.7.

5.1.2.2 Instrumentation

Examples of measuring and test equipment (M&TE) used during the preparation of the cask for storage operations are listed in Table 5.1-1. Additional, or different M&TE, may be used as determined through the development of site-specific operating procedures, including the revision of those procedures as experience in cask loading operations is gained and the state of the art evolves.

No instrumentation is required to detect off-normal operations of the HI-STAR HB System while in its final storage configuration at the ISFSI storage site. The cask system is designed to maintain confinement integrity under all design-basis normal, off-normal, and accident conditions.

5.1.2.3 Maintenance Techniques

No periodic maintenance is required to ensure the safe, long term operation of the Humboldt Bay ISFSI. Any required corrective maintenance will be completed under the work control process.

5.1.3 REFERENCES

1. ANSI/ANS-57.9-1992, Design Criteria for an Independent Spent Fuel Storage Installation (dry type), American National Standards Institute.