

## 8.1 FUEL LOADING OF THE HI-STAR 100 SYSTEM

### 8.1.1 Information to Support Loading Operations

Tables 8.1.1 and 8.1.2 provide the handling weights for each of the HI-STAR 100 System major components and the loads to be lifted during the operation of the HI-STAR 100 System. Table 8.1.3 provides the HI-STAR 100 System bolt torque and sequencing requirements. Table 8.1.4 provides an operational description of the HI-STAR 100 System ancillary equipment and its safety designation. Fuel assembly selection and verification shall be performed by the licensee in accordance with written, approved procedures which ensure that only SNF assemblies authorized in Appendix B to the Certificate of Compliance are loaded into the HI-STAR 100 System.

In addition to the requirements set forth in the CoC, users will be required to develop or modify existing programs and procedures to account for the operation of an ISFSI. Written procedures are required to be developed or modified to account for such things as nondestructive examination (NDE) of the MPC welds, handling and storage of SSCs identified as Important to Safety, 10CFR72.48 [8.0.2] programs, specialized instrument calibration, special nuclear material accountability at the ISFSI, security modifications, fuel handling procedures, training and emergency response, equipment and process qualifications. Table 8.1.5 summarizes the instrumentation used to load and unload the HI-STAR 100 System. Tables 8.1.6 and 8.1.7 provide sample receipt inspection checklists for the HI-STAR 100 overpack and the MPC, respectively. Users shall develop site-specific receipt inspection checklists, as required. Fuel handling, including the handling of fuel assemblies in the Damaged Fuel Container (DFC) shall be performed in accordance with written site-specific procedures. Damaged fuel and fuel debris, as defined in the Technical Specifications appended to CoC 1008 shall be loaded in DFCs.

### 8.1.2 Overview of Loading Operations

The HI-STAR 100 System is used to load, unload, transfer and store spent fuel. Specific steps are performed to prepare the HI-STAR 100 System for fuel loading, to load the fuel, to prepare the system for storage and to place it in storage at an ISFSI. The HI-STAR 100 overpack may be transferred between the ISFSI and the fuel loading facility using a specially designed transporter, heavy haul transfer trailer, or any other load handling equipment designed for such applications as long as the lifting requirements described in **Chapter 1 and the Technical Specifications are met**. Users shall develop detailed written procedures to control on-site transport operations. Section 8.1.2 provides the general procedures for handling of the HI-STAR 100 overpack and MPC. Figure 8.1.1 shows a flow diagram of the HI-STAR 100 System loading operations. Figure 8.1.2 illustrates some of the major HI-STAR 100 System loading operations.

**Note:**

The procedures describe plant facilities, functions, and processes in general terms. Each site is different with regard to layout, organization and nomenclature. Users shall interpret the nomenclature used herein to suit their particular site, organization, and methods of operation.

Refer to the boxes of Figure 8.1.2 for the following description. At the start of loading operations, an empty MPC is upended (Box 1). The empty MPC is raised and inserted into the

HI-STAR 100 overpack (Box 2). The annulus is filled with plant demineralized water and the MPC is filled with either spent fuel pool water or plant demineralized water (Box 3). An inflatable seal is installed in the annulus between the MPC and the HI-STAR 100 overpack to prevent spent fuel pool water from contaminating the exterior surface of the MPC. The HI-STAR 100 overpack and the MPC are then raised and lowered into the spent fuel pool for fuel loading using the lift yoke (Box 4). Pre-selected assemblies are loaded into the MPC and a visual verification of the assembly identification is performed (Box 5).

While still underwater, a thick, shielded lid (the MPC lid) is installed using either slings attached to the lift yoke or the Lid Retention System (Box 6). The lift yoke remotely engages to the HI-STAR 100 overpack lifting trunnions to lift the HI-STAR 100 overpack and loaded MPC close to the spent fuel pool surface (Box 7). When radiation dose rate measurements confirm that it is safe to remove the HI-STAR 100 overpack from the spent fuel pool, the cask is removed from the spent fuel pool. If the Lid Retention System is being used, the HI-STAR 100 overpack closure plate bolts are installed to secure the MPC lid for the transfer to the cask preparation area. The lift yoke and HI-STAR 100 overpack are sprayed with demineralized water to help remove contamination as they are removed from the spent fuel pool.

The HI-STAR 100 overpack is placed in the designated preparation area and the lift yoke and Lid Retention System retention disk are removed. The next phase of decontamination is then performed. The top surfaces of the MPC lid and the upper flange of the HI-STAR 100 overpack are decontaminated. The Temporary Shield Ring (if utilized) is installed and filled with water. The inflatable annulus seal is removed, and the annulus shield is installed. The Temporary Shield Ring provides additional personnel shielding around the top of the HI-STAR 100 overpack during MPC closure operations. The annulus shield provides additional personnel shielding at the top of the annulus and also prevents small items from being dropped into the annulus. Dose rates are measured at the MPC lid and around the mid-height circumference of the HI-STAR 100 overpack to ensure that the dose rates are within expected values.

The MPC water level is lowered slightly, the MPC is vented, and the MPC lid is seal welded using the Automated Welding System (Box 8). Visual examinations are performed on the tack welds. Liquid penetrant examinations are performed on the root and final passes. An ultrasonic or multi-layer PT examination is performed on the MPC Lid-to-Shell weld to ensure that the weld is satisfactory. As an alternative to volumetric examination of the MPC lid-to-shell weld, a multi-layer PT is performed including one intermediate examination after approximately every three-eighth inch of weld depth. *The MPC welds are then pressure tested followed by an additional liquid penetrant examination performed on the MPC Lid-to-Shell weld to verify structural integrity. To calculate the helium backfill requirements for the MPC (if backfill is based upon helium mass or volume measurements), the free volume inside the MPC must first be determined. This free volume may be determined by measuring the volume of water displaced or any other suitable means.*

**Caution:**

**Inert gas must be used any time the fuel is not covered with water to prevent oxidation of the fuel cladding. The fuel cladding is not to be exposed to air at any time during loading operations.**

The water level is raised to the top of the MPC again and then the MPC water is displaced from the MPC by blowdown of the water using pressurized helium or nitrogen gas introduced into the vent port of the MPC thus displacing the water through the drain line. The Vacuum Drying System (VDS) is connected to the MPC and is used to remove all residual liquid water from the MPC in a stepped evacuation process (Box 9). A stepped evacuation process is used to preclude the formation of ice in the MPC and Vacuum Drying System lines. The internal pressure is reduced to below 3 torr (400 Pa) and held for 30 minutes to ensure that all liquid water is removed.

Following the dryness test, the VDS is disconnected, the Helium Backfill System (HBS) is connected, and the MPC is backfilled with a predetermined pressure of helium gas as specified in the Technical Specification. The helium backfill ensures adequate heat transfer during storage, provides an inert atmosphere for long-term fuel integrity. Cover plates are installed and seal welded over the MPC vent and drain ports and liquid penetrant examinations are performed on the root (for multi-pass welds) and final passes (Box 10). The cover plates are then leak tested.

*Alternatively, the Forced Helium Dehydration System (FHD), licensed by the NRC in several Holtec dockets may be used to remove residual moisture from the MPC. Gas is circulated through the MPC to evaporate and remove moisture. The residual moisture is condensed until no additional moisture remains in the MPC. The temperature of the gas exiting the system demister is maintained below 21°F (-6.11°C) for a minimum of 30 minutes to ensure that all liquid water is removed. The MPC is then backfilled to the required helium backfill pressure. The FHD has been approved by the NRC with MPC-24, -68, and -32 under SER Revision 8, dated October 12, 2010.*

The MPC closure ring is then placed on the MPC and dose rates are measured at the MPC lid to ensure that the dose rates are within expected values. The closure ring is aligned, tacked in place and seal welded providing redundant closure of the MPC confinement boundary closure welds. Tack welds are visually examined, and the root (for multi-pass welds) and final welds are inspected using the liquid penetrant examination technique to ensure weld integrity.

The annulus shield is removed and the remaining water in the annulus is drained. The MPC lid and accessible areas at the top of the MPC shell are smeared for removable contamination and the HI-STAR 100 overpack dose rates are measured to establish compliance with the Technical Specification limits. The HI-STAR 100 overpack closure plate is installed (Box 11) and the bolts are torqued. The HI-STAR 100 overpack annulus is vacuum dried and backfilled with helium gas as specified in the Technical Specification. The HI-STAR 100 overpack mechanical seals are helium leakage tested to assure they will provide long-term retention of the annulus helium. The HI-STAR 100 overpack cover plates are installed. The Temporary Shield Ring is drained and removed. Dose rates are taken on the overpack to ensure that they are below the Technical Specification limits.

The HI-STAR 100 overpack is moved to the ISFSI pad (Box 12). The HI-STAR 100 overpack may be moved using a number of methods as long as the lifting requirements of set forth in Chapter 1 and the Technical Specifications are met.