CHAPTER 7: OPERATING PROCEDURES

7.0 INTRODUCTION

This chapter outlines the procedures for loading, preparation for shipment, unloading, and preparation for empty cask shipment of the HI-STAR 100 System in accordance with 10CFR71 [7.0.1]. The procedures provided in this chapter are prescriptive in that they provide the basis and general guidance for plant personnel in preparing detailed written site-specific loading, handling, and unloading procedures. Users may add or delete steps in their site-specific implementation procedures provided the intent of these guidelines is met. Section 7.1 provides the guidance for loading the HI-STAR 100 System in the spent fuel pool. Section 7.2 provides the guidance for unloading the HI-STAR 100 System in the spent fuel pool. Section 7.3 provides the guidance for the preparation of the empty HI-STAR 100 for transport. Section 7.4 provides guidance for preparing the HI-STAR 100 Overpack for transport following a period of storage. Equipment specific operating details such as Vacuum Drying System valve manipulation and onsite transporter operation will be provided to users based on the specific equipment selected by the users and the configuration of the site.

Licensees (~~U~~*u*sers) will utilize the procedures provided in this chapter, the conditions of the Certificate of Compliance *(CoC)*, equipment-specific operating instructions, and plant working procedures and apply them to develop the site-specific written loading, handling, unloading and storage procedures. The procedures contained herein describe acceptable methods for performing HI-STAR 100 loading and unloading operations. Users may alter these procedures to allow operations to be performed in parallel or out of sequence as long as the general intent of the procedure is met. In the figures following each section, acceptable configurations of rigging, piping, equipment and instrumentation are shown. *These figures are not intended to restrict users, but to provide examples for users to develop their own site specific procedures.* Users may select alternate equipment, configurations and methodology to accommodate their specific needs. Any deviations to the rigging should be approved by the user's load handling authority.

The loading and unloading procedures in Section 7.1 and 7.2 can also be appropriately revised into written site-specific procedures to allow dry loading and unloading of the system in a hot cell or other remote handling facility. The Dry Transfer Facility (DTF) loading and unloading procedures are essentially the same with respect to loading and vacuum drying, inerting, and leakage testing of the MPC. Section 7.4 provides a synopsis of the regulatory requirements for the HI-STAR 100 package. The dry transfer facility shall develop the appropriate site-specific procedures as part of the DTF facility license.

Tables 7.1.1 and 7.1.2, respectively provide *estimates of* 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 7.1.3 provides the HI-STAR 100 System bolt torque and sequencing requirements. Table 7.1.4 provides an operational description of the HI-STAR 100 System ancillary equipment and its safety designation. Licensee's may make alterations or substitutions to this equipment to ~~meet their~~ accommodate their specific needs. Fuel assembly selection and verification shall be performed by the licensee in accordance with written, approved procedures

~~which~~*that* ensure that only SNF assemblies authorized in the Certificate of Compliance are loaded into the HI-STAR 100 System.

Users will be required to develop or modify existing programs and procedures to account for the transport operation of the HI-STAR 100 and future potential storage at an ISFSI. Written procedures will be required to be developed or modified to account for such things as nondestructive examination (NDE) of the MPC welds, handling and storage of items and components identified as ~~I~~*i*mportant to ~~S~~*s*afety, heavy load handling, specialized instrument calibration, special nuclear material accountability, fuel handling procedures, training, equipment and process qualifications. Users shall implement controls to ensure that the lifted weights do not exceed the HI-STAR 100 *lifting* trunnion design limits. Users shall implement controls to monitor the time limit from the removal of the HI-STAR 100 from the spent fuel pool to the commencement of MPC draining to prevent boiling. Chapter 3 of this SAR provides examples of time limits based on representative spent fuel pool temperatures and design basis heat loads. Users shall also implement controls to ensure that the HI-STAR 100 overpack cannot be subjected to a fire in excess of design limits during loading operations.

Table 7.1.5 summarizes the instrumentation necessary to load and unload the HI-STAR 100 System. Tables 7.1.6 and 7.1.7 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 CoC, shall be loaded in DFCs.

7.0.1 Technical and Safety Basis for Loading and Unloading Procedures

The procedur*al guidelines*~~es~~ herein (7.1 through 7.3) are developed for the loading, unloading, and empty (after initial transport) transport of the HI-STAR 100 System. The activities involved in loading of spent fuel in a canister system, if not carefully performed, may present personnel hazards and radiological impact. The design of the HI-STAR 100 System, including these ~~procedures~~ *guidelines* and the ancillary equipment *was performed* to minimize risks and mitigate consequences of potential events. The primary objective is to reduce the risk of occurrence and/or to mitigate the consequences of the event. The procedures contain ~~N~~*n*otes, ~~W~~*w*arnings, and ~~C~~*c*autions to notify the operators to upcoming situations and provide additional information as needed. The ~~N~~*n*otes, ~~W~~*w*arnings and ~~C~~*c*autions are purposely bolded and boxed, and immediately precede the applicable steps.

In the event of an extreme abnormal condition (e.g., cask drop or tip-over event) the user shall have appropriate procedural guidance to respond to the situation. As a minimum, the procedures shall address establishing emergency action levels, implementation of emergency action program, establishment of personnel exclusion zones, monitoring of radiological conditions, actions to mitigate or prevent the release of radioactive materials, and recovery planning and execution.

7.1 PROCEDURE FOR LOADING THE HI-STAR 100 SYSTEM IN THE SPENT FUEL POOL AND PREPARATION FOR SHIPMENT

7.1.1 Overview of Loading Operations

The HI-STAR 100 System is used to load and transport 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 transport and to ship the HI-STAR 100 System. The HI-STAR 100 overpack may be transported off-site using a rail car or a specially designed heavy haul trailer, or any other load handling equipment designed for such applications. Users shall develop detailed written procedures to control on-site transport operations. Section 7.1.2 provides the general procedures for handling of the HI-STAR 100 overpack and MPC *both with and without fuel loaded inside.*

Figure 7.1.1 shows a flow diagram of the HI-STAR 100 System loading operations. Figure 7.1.2 illustrates some of the major HI-STAR 100 System loading operations. The HI-STAR 100 overpack and empty MPC may arrive together or separately. The procedures provided assume that these components arrive separately. If the HI-STAR 100 overpack and MPC arrive together, certain steps of the procedure may be omitted.

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 7.1.2 for the following description. The HI-STAR 100 overpack is received and the personnel barrier is removed. Receipt inspection and radiological surveys are performed. The impact limiters are removed and the HI-STAR 100 overpack is upended. 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 *clean (uncontaminated)* ~~plant demineralized~~ water and the MPC is filled with either spent fuel pool water or *clean* ~~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 the lid retention disk 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~~ *clean* 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 ~~T~~*t*emporary ~~S~~*s*hield ~~R~~*r*ing (if utilized) is installed and filled with water. The inflatable annulus seal is removed, and the annulus shield is installed. The ~~T~~*t*emporary ~~S~~*s*hield ~~R~~*r*ing 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 establish appropriate radiological control.

The MPC water level is lowered slightly, the MPC is vented, and the MPC lid is seal welded using the Automated Welding System *(AWS)* (Box 8), *by manual welding, or a combination of the two*. Visual examinations are performed on the tack welds. Liquid penetrant examinations are performed on the root and final passes. A volumetric examination is performed on the MPC welds to ensure that the completed weld is satisfactory. As an alternative to volumetric examination of the MPC lid-to-shell weld, a multi-layer PT ~~is~~ *may be* performed including ~~one~~ intermediate examination~~s~~ after approximately every three-eighth inch of weld depth. The water level is raised to the top of the MPC and a hydrostatic test is performed on the MPC ~~L~~*l*id-to-~~S~~*s*hell weld~~s~~ to verify structural integrity. A small amount of water is displaced with helium gas for leakage testing. A leakage rate test is performed on the MPC lid-to-shell weld to verify weld integrity and to ensure that leakage rates are within acceptance criteria.

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 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 *VDS*.~~Vacuum Drying System.~~ The internal pressure is reduced to below 3 torr and held for 30 minutes to ensure that all liquid water is removed.

Following the dryness test, the ~~vacuum drying system~~*VDS* is disconnected, the Helium Backfill System *(HBS)* is connected, and the MPC is backfilled with a predetermined pressure of helium gas. The helium backfill ensures adequate heat transfer during transport.~~, and provides the means of future leakage rate testing of the MPC confinement boundary welds for future storage.~~ 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 leakage tested to confirm that they meet the established leakage rate criteria.

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 ~~T~~*t*emporary ~~S~~*s*hield ~~R~~*r*ing is drained and removed. The MPC lid and accessible areas at the top of the MPC shell are smeared for removable contamination. The HI-STAR 100 overpack closure plate is installed (Box 11) and the bolts are torqued. The HI-STAR 100 overpack annulus is dried and backfilled with helium gas. The HI-STAR 100 overpack mechanical seals are leakage tested to assure they will provide long-term retention of the annulus helium. The HI-STAR 100 overpack vent and drain port cover plates are installed. The HI-STAR 100 overpack is surveyed for removable contamination.

The HI-STAR 100 overpack is moved to the transport location. ~~The HI-STAR 100 is downend on the transport frame.~~ An inspection for signs of impaired condition is performed. Contamination surveys are performed. The HI-STAR 100 overpack is placed on the transport ~~device~~*vehicle*, the ~~tie-down and~~ impact limiters are installed and a shielding effectiveness test is performed to ensure that the HI-STAR 100 shielding has been manufactured and is functioning as designed. Radiation levels are verified to be within acceptable limits. The assembled package is given a final inspection to verify that all conditions for transport have been met (e.g., all mechanical seals have been installed and tested, rupture disks are intact, installed and not covered. The carrier is provided with the appropriate paperwork and the receiver is notified of the impending shipment) and the personnel barrier is installed (Box 12). The package is then labeled, placarded and released for transport.

7.1.2 HI-STAR 100 System Receiving and Handling Operations

> **Note:**
> The HI-STAR 100 overpack may be received and handled in several different configurations and may be transported on-site in a horizontal or vertical orientation. This section provides general guidance for the HI-STAR 100 overpack and MPC rigging and handling. Site-specific procedures shall specify the required operational sequences based on the *design of the overpack (i.e., with or without pocket trunnions) and site capabilities.* ~~cask handling configuration and limitations at the sites.~~

> **Note:**
> Steps 1 through 4 describe the handling operations using a lift yoke. Specialty rigging may be substituted if the lift complies with NUREG-0612 [7.1.1].

1. Vertical Handling of the HI-STAR 100 overpack:

Note:
Prior to performing any lifting operation, the removable shear ring segments under the two lifting trunnions must be removed.

Caution:
Users shall maintain controls to ensure that heights to which the loaded HI-STAR 100 is lifted outside the fuel building are limited to ensure that the structural integrity of the MPC and overpack is not compromised should the overpack be dropped. This also assumes the on-site surfaces over which the loaded overpack will be transported have been designed and constructed consistent with the analysis assumptions provided in the HI-STAR 100 ~~Topical~~*Final* Safety Analysis Report [7.1.2].

a. Verify that the lift yoke load test certifications are current.

b. Visually inspect the lift yoke and the lifting trunnions for gouges, cracks, deformation or other indications of damage.

c. Engage the lift yoke to the lifting trunnions. See Figure 7.1.3.

d. Apply lifting tension to the lift yoke and verify proper engagement of the lift yoke.

Note:
Refer to the site's heavy load handling procedures for lift height, load path, floor loading and other applicable load handling requirements.

e. Raise the HI-STAR 100 overpack and position it accordingly.

2. Upending of the HI-STAR 100 overpack ~~in the transport frame:~~

Warning:
Personnel shall remain clear of the unshielded bottom of the loaded overpack. Users shall coordinate operations to keep the bottom cover installed to the maximum extent practicable whenever when the loaded overpack is downended.

a. Position the HI-STAR 100 overpack under the lifting device. Refer to Step 1, above.

b. Verify that the lift yoke load test certifications are current.

c. Visually inspect the lift yoke and the lifting trunnions for gouges, cracks, deformation or other indications of damage.

d. Place a light layer of Fel-Pro Chemical Products, N-5000, Nuclear Grade Lubricant (or equivalent) on the cask *lifting* trunnions and the palms of the lift yoke.

e. Engage the lift yoke to the lifting trunnions. See Figure 7.1.3.

f. Apply lifting tension to the lift yoke and verify proper engagement of the lift yoke.

g. Slowly rotate the HI-STAR 100 overpack to the vertical position keeping all rigging as close to vertical as practicable. See Figure 7.1.4.

h. Lift the ~~pocket trunnions~~*overpack* clear of the transport ~~frame~~*vehicle.* ~~rotation trunnions.~~

i. Position the HI-STAR 100 overpack per site direction.

3. Downending of the HI-STAR 100 overpack. ~~in the transport frame:~~

a. Position the transport ~~frame~~ *vehicle* under the lifting device.

b. Verify that the lift yoke load test certifications are current.

c. Visually inspect the lift yoke and the lifting trunnions for gouges, cracks, deformation or other indications of damage.

d. Place a light layer of Fel-Pro Chemical Products, N-5000, Nuclear Grade Lubricant (or equivalent) on the cask trunnions and the palms of the lift yoke.

e. *Deleted.*

f. Engage the lift yoke to the lifting trunnions. See Figure 7.1.3.

g. Apply lifting tension to the lift yoke and verify proper lift yoke engagement.

h. *Deleted.*

i. Slowly rotate the HI-STAR 100 overpack to the horizontal position keeping all rigging as close to vertical as practicable.

j. Disengage the lift yoke.

Warning:
Personnel shall remain clear of the unshielded bottom of the loaded overpack. Users shall coordinate operations to keep the bottom cover installed to the maximum extent practicable whenever when the loaded overpack is downended.

k. If necessary for radiation shielding, install the overpack bottom cover. Rigging points are provided. ~~See Figure 7.1.4.~~

4. Horizontal ~~H~~*h*andling of the HI-STAR 100 overpack. ~~in the transport frame:~~

   a. *Deleted.* ~~Secure the transport frame for HI-STAR 100 downending~~.

   b. Downend the HI-STAR 100 overpack ~~on the transport frame~~ per Step 3, if necessary.

   c. ~~Inspect the transport frame lift rigging in accordance with site approved rigging procedures.~~ *Rig the overpack as shown in Figure 7.1.5.*

   d. Position the ~~transport frame~~*overpack* accordingly.

5. Empty MPC Installation in the HI-STAR 100 overpack:

> **Note:**
> To avoid side loading the MPC lift lugs, the MPC must be upended in the MPC Upending Frame (or equivalent). See Figure 7.1.6.

   a. If necessary, remove any MPC shipping covers and rinse off any road dirt with water. Be sure to remove any foreign objects from the MPC internals.

   b. Upend the MPC as follows:

      1. Visually inspect the MPC ~~U~~*u*pending ~~F~~*f*rame for gouges, cracks, deformation or other indications of damage.

      2. Install the MPC on the ~~U~~*u*pending ~~F~~*f*rame. Make sure that the banding straps are secure around the MPC shell. See Figure 7.1.6.

> ~~**Warning:**~~
> ~~The Upending Frame rigging bars are equipped with cleats that prevent the slings from sliding along the bar. The slings must be placed to the outside of the cleats to prevent an out-of-balance condition. The Upending Frame rigging points are labeled.~~

      3. Inspect the ~~U~~*u*pending ~~F~~*f*rame slings in accordance with the site's lifting equipment inspection procedures. Rig the slings ~~around~~ *to* the bar. ~~in a choker configuration to the outside of the cleats.~~ See Figure 7.1.6.

      4. Attach the MPC upper end slings of the ~~U~~*u*pending ~~F~~*f*rame to the main overhead lifting device. Attach the bottom-end slings to a secondary lifting device (or a chain fall attached to the primary lifting device).

      5. Raise the MPC in the ~~U~~*u*pending ~~F~~*f*rame.

> **Warning:**
> The ~~U~~*u*pending ~~F~~*f*rame corner should be kept close to the ground during the upending process.

6. Slowly lift the upper end of the ~~U~~*u*pending ~~F~~*f*rame while lowering the bottom end of the Upending Frame.

7. When the MPC approaches the vertical orientation, release the tension on the lower slings.

8. Place the MPC in a vertical orientation on a level surface.

9. Disconnect the MPC straps and disconnect the rigging.

c. Install the MPC in the HI-STAR 100 overpack as follows:

1. Install the four point lift sling to the lift lugs inside the MPC. See Figure 7.1.7.

Caution:
Be careful not to damage the *overpack* seal seating surface during MPC installation.

2. Raise and place the MPC inside the HI-STAR 100 overpack.

Note:
An alignment punch mark is provided on the HI-STAR 100 overpack and the top edge of the MPC. Similar marks are provided on the MPC lid and closure ring. See Figure 7.1.8.

3. Rotate the MPC so the alignment marks agree and seat the MPC inside the HI-STAR 100 overpack. Disconnect the MPC rigging or the MPC lift rig.

7.1.3 HI-STAR 100 Overpack and MPC Receipt Inspection and Loading Preparation

1. Recover the shipping documentation from the carrier.

a. If necessary, recover the keys to the personnel barrier locks from the carrier.

b. Record the impact limiter security seal serial numbers and verify that they match the corresponding shipping documentation, as applicable.

c. Perform a receipt radiation and contamination survey in accordance with 49CFR173.443 [7.1.3] and 10CFR20.1906 [7.1.4].

2. If necessary, remove the personnel barrier as follows:

Note:
The personnel barrier is a ventilated enclosure cage that fits over the main body of the HI-STAR 100 overpack. The personnel barrier is designed to restrict personnel accessibility to the ~~potentially hot~~ surfaces of the HI-STAR 100 overpack. The personnel barrier in conjunction with the impact limiters restrict accessibility to all surfaces of the HI-STAR 100 overpack during transport. The personnel barrier is equipped with locks to prevent unauthorized access.

a. Remove the locks securing the personnel barrier and remove the personnel barrier. Lifting points and a small bridle sling is provided. See Figure 7.1.9.

b. Remove ~~the pins~~*any fasteners* securing the personnel barrier to the transport frame.

c. Rig the personnel barrier to the lifting device~~ as shown on Figure 7.1.9~~.

d. Remove the personnel barrier *as shown on Figure 7.1.9.*

e. Perform a partial visual inspection of the overpack surfaces to verify that there is no outward indication that would suggest impaired condition of the overpack in accordance with 10CFR71.87(b) [7.0.1]. Identify any significant indications to the cognizant individual for evaluation and resolution and record on the receiving documentation.

3. If necessary, remove the impact limiters as follows:

Note:
To prevent damage to the impact limiters the impact limiter handling frame must be used to remove, install, handle and store the impact limiters.

a. Clip the security seal wires and remove the security seals and wires.

b. Attach the impact limiter handling frame as shown on Figure 7.1.10. The rigging arms secure the impact limiter and maintain it at the proper orientation during rigging.

Caution:
The slings should be preloaded to the impact limiter weight plus the weight of the impact limiter handling frame prior to removal of the impact limiter bolts. (See Table 7.1.1) This will prevent damage to the HI-STAR 100 overpack and impact limiter from excessive lift pressure during removal.

c. Using a load measuring device, apply the correct lift load. See Table 7.1.1 for weights.

d. Remove the bolts securing the impact limiter to the overpack. See Figure 7.1.11.

e. Remove the impact limiter and store the impact limiter and bolts in a site-approved location.

f. Repeat Steps 3.c. through 3.e. for the other impact limiter

g. Remove the alignment pins from the bottom of the HI-STAR 100 overpack. See Figure 7.1.11.

h. Complete the visual inspection to verify that there is no outward indication that would suggest impaired condition of the overpack. (10CFR71.87(b)) [7.0.1]. Identify any significant indications to the cognizant individual for evaluation and resolution.

i. Verify that the HI-STAR 100 overpack neutron shield rupture discs are installed, intact and not covered by tape or other covering.

ALARA Note:
A bottom protective cover may be attached to the HI-STAR 100 overpack bottom or placed in the designated preparation area or spent fuel pool. This will help prevent iembedding contaminated particles in the HI-STAR 100 overpack bottom surface and ease the decontamination effort.

4. Place the HI-STAR 100 overpack in the cask receiving area.

5. If necessary, remove the buttress plate bolts and remove the buttress plate. See Figure 7.1.11. See Figure 7.1.12 for rigging. Store these components in a site-approved storage location.

6. If necessary, remove the HI-STAR 100 overpack closure plate by removing the closure plate bolts and using the dedicated lift sling. See Figure 7.1.12 for rigging.

   a. Place the closure plate on cribbing that protects the seal seating surfaces and allows access for seal replacement.

   b. Store the closure plate and bolts in a site-approved location.

   c. Install the seal surface protector on the HI-STAR 100 overpack seal seating surface. See Figure 7.1.13.

7. Install the MPC inside the HI-STAR 100 overpack as follows:

   a. Rinse off any MPC road dirt with water. Inspect all cavity locations for foreign objects. Remove any foreign objects.

   b. At the site's discretion, perform an MPC receipt inspection and cleanliness inspection in accordance with a site-specific inspection checklist.

   c. Place the HI-STAR 100 overpack in the designated preparation area.

Note:
Upper fuel spacers are fuel-type specific. Not all fuel types require fuel spacers. See Figure 7.1.14. Upper Ffuel spacers may be loaded any time prior to placement of the MPC lid in the spent fuel pool for installation in the MPC.

8. Install the upper fuel spacers in the MPC lid as follows:

Warning:
Never work under a suspended load.

a. Position the MPC lid on supports to allow access to the underside of the MPC lid.

b. Thread the fuel spacers into the holes provided on the underside of the MPC lid. See Figure 7.1.14 and Table 7.1.3 for torque requirements.

c. Install threaded plugs in the MPC lid where and when spacers will not be installed, if necessary. See Table 7.1.3 for torque requirements.

9. At the user's discretion, perform an MPC lid and closure ring fit test:

Note:
It will be necessary to perform the MPC installation and inspection in a location that has sufficient crane clearance to perform the operation.

a. Visually inspect the MPC lid rigging (See Figure 7.1.12).

b. Raise the MPC lid such that the drain line can be installed. Install the drain line to the underside of the MPC lid. See Figure 7.1.15.

c. Align the MPC lid and lift yoke so the drain line will be positioned in the MPC drain location. See Figure 7.1.16. Install the MPC lid. Verify that the MPC lid fit and weld prep are in accordance with the approved design drawings.

ALARA Note:
The closure ring is installed by hand. No tools are required.

d. Install the closure ring.

e. Verify that closure ring fit and weld prep are in accordance with the approved design drawings.

f. Remove the closure ring and the MPC lid. Disconnect the drain line. Store these components in an approved plant storage location.

Note:
Fuel spacers are fuel-type specific. Not all fuel types require fuel spacers. Lower fuel spacers are set in the MPC cells manually. No restraining devices are used. Fuel spacers may be loaded any time prior to insertion of the fuel assemblies in the MPC.

10. Install lower fuel spacers in the MPC (if required for the fuel type). See Figure 7.1.14.

11. Fill the MPC and annulus as follows:

Caution:
Do not use any sharp tools or instruments to install the inflatable seal. Some air in the inflatable seal helps in the installation.

a. Remove the HI-STAR 100 overpack drain port cover and port plug and install the drain connector. Store the drain port cover plate and port plug in an approved storage location.

b. Fill the annulus with ~~plant demineralized~~*clean* water to just below the inflatable seal seating surface.

c. Manually insert the inflatable annulus seal around the MPC. See Figure 7.1.13.

d. Ensure that the seal is uniformly positioned in the annulus area.

e. Inflate the seal to between 30 and 35 psig or as directed by the manufacturer.

f. Visually inspect the seal to ensure that it is properly seated in the annulus. Deflate, adjust and inflate the seal as necessary. Replace the seal as necessary.

ALARA Note:
Waterproof tape placed over empty bolt holes, and bolt plugs may reduce the time required for decontamination.

12. At the user's discretion, install the HI-STAR 100 overpack closure plate bolt plugs and/or apply waterproof tape over any empty bolt holes.

ALARA Note:
Keeping the water level below the top of the MPC prevents splashing during handling.

13. Fill the MPC with either ~~demineralized~~ *clean* water or spent fuel pool water to approximately 12 inches below the top of the MPC shell.

14. Place the HI-STAR 100 overpack in the spent fuel pool as follows:

ALARA Note:
The Annulus Overpressure System is used to provide further protection against MPC external shell contamination during in-pool operations. The Annulus Overpressure System is equipped with design features to prevent inadvertent draining. The reservoir valve must be closed to ensure that the annulus is not inadvertently drained through the Annulus Overpressure System when the cask is raised above the level of the annulus reservoir.

a. If used, fill the Annulus Overpressure System lines and reservoir with ~~demineralized~~ *clean* water and close the reservoir valve. Attach the Annulus Overpressure System to the HI-STAR 100 overpack via the quick disconnect. See Figure 7.1.17.

b. Engage the lift yoke to the HI-STAR 100 overpack lifting trunnions and position the HI-STAR 100 overpack over the cask loading area. ~~with the basket aligned to the orientation of the spent fuel racks.~~

ALARA Note:
Wetting the components that enter the spent fuel pool may reduce the amount of decontamination work to be performed later.

c. Wet the surfaces of the HI-STAR 100 overpack and lift yoke with plant demineralized water while slowly lowering the HI-STAR 100 overpack into the spent fuel pool.

d. When the top of the HI-STAR 100 overpack reaches the elevation of the reservoir, ~~open~~ *start* the Annulus Overpressure System ~~reservoir valve~~ *water flow.* Maintain the reservoir water level at approximately 3/4 full the entire time the cask is in the spent fuel pool.

e. Place the HI-STAR 100 overpack on the floor of the cask loading area and disengage the lift yoke. Visually verify that the lift yoke is fully disengaged. Remove the lift yoke from the spent fuel pool while spraying the crane cables and yoke with plant demineralized water.

7.1.4 MPC Fuel Loading

Note:
An underwater camera or other suitable viewing device may be used for monitoring underwater operations.

1. Perform a fuel assembly selection verification using plant fuel records to ensure that only fuel assemblies that meet all the conditions for loading as specified in the Certificate of Compliance have been selected for loading into the MPC.

2. Load the pre-selected fuel assemblies into the MPC in accordance with the approved fuel loading pattern.

3. Perform a post-loading visual verification of the assembly identification to confirm that the serial numbers match the approved fuel loading pattern.

7.1.5 MPC Closure

Note:
The user may elect to use the optional Lid Retention System (See Figure 7.1.18) to assist in the installation of the MPC lid and attachment of the lift yoke, and to provide the means to secure the MPC lid in the event of a drop or tip-over accident during loaded cask handling operations outside of the spent fuel pool. The user is responsible for evaluating the additional weight imposed on the cask, lift yoke, crane and floor prior to use to ensure that its use does not exceed the crane capacity, heavy loads handling restrictions, or 250,000 pounds. See Tables 7.1.1 and 7.1.2.

1. Visually inspect the MPC lid rigging or Lid Retention System in accordance with site-approved rigging procedures. Attach the MPC lid to the lift yoke so that MPC lid, drain line and trunnions will be in relative alignment. Raise the MPC lid and adjust the rigging so the MPC lid hangs level as necessary.

2. Install the drain line to the underside of the MPC lid. See Figure 7.1.15.

3. Align the MPC lid and lift yoke so the drain line will be positioned in the MPC drain location and the cask trunnions will also engage. See Figure 7.1.16 and 7.1.19.

ALARA Note:
Wetting the components that enter the spent fuel pool may reduce the amount of decontamination work to be performed later.

4. Slowly lower the MPC lid into the pool and insert the drain line into the drain access location and visually verify that the drain line is correctly oriented. See Figure 7.1.16.

5. Lower the MPC lid while monitoring for any hang-up of the drain line. If the drain line becomes kinked or disfigured for any reason, remove the MPC lid and replace the drain line.

Note:
The upper surface of the MPC lid will seat approximately flush with the top edge of the MPC shell when properly installed.

6. Seat the MPC lid in the MPC and visually verify that the lid is properly installed.

7. Engage the lift yoke to the HI-STAR 100 overpack lifting trunnions.

8. Apply a slight tension to the lift yoke and visually verify proper engagement of the lift yoke to the lifting trunnions.

ALARA Note:
Activated debris may have settled on the top face of the HI-STAR 100 overpack and MPC during fuel loading. The cask top surface should be kept under water until a preliminary dose rate scan clears the cask for removal.

9. Raise the HI-STAR 100 overpack until the MPC lid is just below the surface of the spent fuel pool. Survey the area above the cask lid to check for hot particles. Raise and flush the upper surface of the HI-STAR 100 overpack and MPC ~~with the plant demineralized water hoses~~ as necessary to remove any activated particles from the HI-STAR 100 overpack or the MPC lid.

10. Visually verify that the MPC lid is properly seated. Lower the HI-STAR 100 overpack, reinstall the MPC lid, and repeat Step 9, as necessary.

11. If the Lid Retention System is used, inspect the closure plate bolts for general condition. Replace worn or damaged bolts with new bolts.

12. Install the Lid Retention System bolts if the Lid Retention System is used.

Warning:
Cask removal from the spent fuel pool is *typically* the heaviest lift that occurs during HI-STAR 100 loading operations. The HI-STAR 100 trunnions must not be subjected to lifted loads in excess of 250,000 lbs.. Users must ensure that plant-specific lifting equipment is qualified to lift the expected load. Users may elect to pump a measured quantity of water from the MPC prior to removing the HI-STAR 100 from the spent fuel pool. See Table 7.1.1 and 7.1.2 for weight information.

13. If necessary for lifted weight conditions, pump a measured amount of water from the MPC. See Figure 7.1.22 and Tables 7.1.1 and 7.1.2.

14. Continue to raise the HI-STAR 100 overpack under the direction of the plant's radiological control personnel. Continue rinsing the surfaces with ~~demineralized~~ *clean* water. When the top of the HI-STAR 100 overpack reaches the approximate elevation as the reservoir, ~~close~~ *stop* the Annulus Overpressure System ~~reservoir valve~~*water flow*. See Figure 7.1.17.

Caution:
Users are required to take necessary actions to prevent boiling of the water in the MPC. This may be accomplished by performing a site-specific analysis to identify a time limitation to ensure that water boiling will not occur in the MPC prior to the initiation of draining operations. Chapter 3 of this SAR provides some sample time limits for the time to initiation of draining for various spent fuel pool water temperatures using design basis heat loads. These time limits may be adopted if the user chooses not to perform a site-specific analysis. If time limitations are imposed, users shall have appropriate procedures and equipment to take action if time limits are approached or exceeded. One course of action involves initiating an MPC water flush for a certain duration and flow rate. Any site-specific analysis shall identify the methods to respond should it become likely that the imposed time limit could be exceeded.

ALARA Note:
To reduce decontamination time, the surfaces of the HI-STAR 100 overpack and lift yoke should be kept wet until decontamination begins.

15. Remove the HI-STAR 100 overpack from the spent fuel pool while spraying the surfaces with ~~plant demineralized~~*clean* water. Record the time.

ALARA Note:
Decontamination of the HI-STAR 100 overpack bottom should be performed using pole-mounted cleaning devices.

16. Decontaminate the HI-STAR 100 overpack bottom and perform a contamination survey of the HI-STAR 100 overpack bottom. Remove the bottom protective cover, if used.

17. If used, disconnect the Annulus Overpressure System from the HI-STAR 100 overpack. ~~via the quick disconnect.~~ See Figure 7.1.17.

18. Set the HI-STAR 100 overpack in the designated cask preparation area.

19. Disconnect the lifting slings or Lid Retention System (if used) from the MPC lid and disengage the lift yoke. Decontaminate and store these items in an approved storage location.

Warning:
MPC lid dose rates are measured to ensure that dose rates are within expected values. Dose rates exceeding the ~~429 mrem/hour~~ *expected values* could indicate that fuel assemblies not meeting the specifications in the CoC have been loaded.

a. Measure the dose rates at the MPC lid and verify that the combined gamma and neutron dose rate is below ~~429 mrem/hour~~ *the expected values*.

20. Perform decontamination of the HI-STAR 100 overpack.

21. Prepare the MPC for MPC lid welding as follows:

~~**ALARA Note:**~~
~~The Temporary Shield Ring is installed by hand, no tools are required.~~

a. Decontaminate the area around the HI-STAR 100 overpack top flange and install the Temporary Shield Ring, (if used). See Figure 7.1.20.

b. Fill the Temporary Shield Ring with water (if used).

c. Carefully decontaminate the MPC lid top surface and the shell area above the inflatable annulus seal.

d. Deflate and remove the annulus seal.

ALARA Note:
The water in the HI-STAR 100 overpack-to-MPC annulus provides personnel shielding. The level should be checked periodically and refilled accordingly.

22. Attach the drain line to the HI-STAR 100 overpack drain port connector and lower the annulus water level approximately 6 inches.

ALARA Note:

The MPC exterior shell survey is performed to evaluate the performance of the inflatable annulus seal. Indications of contamination could require the MPC to be unloaded. Removable contamination on the exterior surfaces of the Overpack and accessible portions of the MPC shall each not exceed:

a. 2200 dpm/100 cm^2 from beta and gamma sources; and

b. 220 dpm/100 cm^2 from alpha sources.

a. Survey the MPC lid top surfaces and the accessible areas of the top two inches of the MPC shell.

ALARA Note:

The annulus shield is used to prevent objects from being dropped into the annulus and helps reduce dose rates directly above the annulus region. The annulus shield is hand installed and requires no tools.

23. Install the annulus shield. See Figure 7.1.13.

24. Prepare for MPC lid welding as follows:

Note:

The following steps use two identical Remo*te*~~vable~~ Valve Operating Assemblies (RVOAs) (See Figure 7.1.21) to engage the MPC vent and drain ports. The MPC vent and drain ports are equipped with metal-to-metal seals to minimize leakage during vacuum drying, and to withstand the long-term effects of temperature and radiation. The RVOAs allow the vent and drain ports to be operated like valves and prevent the need to hot tap into the penetrations during unloading operations. The RVOAs are purposely not installed until the cask is removed from the spent fuel pool to reduce the amount of decontamination.

Note:

The vent and drain ports are opened by pushing the RVOA handle down to engage the square nut on the cap and turning the handle fully in the counter-clockwise direction. The handle will not turn once the port is fully open. Similarly, the vent and drain ports are closed by turning the handle fully in the clockwise direction. The ports are closed when the handle cannot be turned further.

a. Clean the vent and drain ports to remove any dirt. Install the RVOAs (See Figure 7.1.21) to the vent and drain ports leaving caps open.

ALARA Warning:

Personnel should remain clear of the drain lines any time water is being pumped or purged from the MPC. Assembly crud, suspended in the water, may create a radiation hazard to workers. Controlling the amount of water pumped from the MPC prior to welding keeps the fuel assembly cladding covered with water yet still allows room for thermal expansion.

b. ~~Attach~~ *Connect* the water pump to the drain port (See Figure 7.1.22) and pump between 50 and 120 gallons to the spent fuel pool or liquid radwaste system. The water level is lowered to keep moisture away from the weld region.

c. Disconnect the water pump.

25. Weld the MPC lid as follows:

ALARA Warning:
Grinding of MPC welds may create the potential for contamination. All grinding activities shall be performed under the direction of radiation protection personnel.

Note:
The vacuum source may help improve the weld quality by keeping moist air from condensing on the MPC lid weld area. The vacuum source can be supplied from a wet/dry vacuum cleaner or small vacuum pump.

a. Attach a vacuum source to the vent port (if used)or inert the gas space under the MPC lid.

ALARA Warning:
It may be necessary to rotate or reposition the MPC lid slightly to achieve uniform weld gap and lid alignment. A punch mark is located on the outer edge of the MPC lid and shell. These marks are aligned with the alignment mark on the top edge of the HI-STAR 100 overpack (See Figure 7.1.8). If necessary, the MPC lid lift should be performed using a hand operated chain fall to closely control the lift to allow rotation and repositioning by hand. If the chain fall is hung from the crane hook, the crane should be ~~tagged~~-out of service to prevent inadvertent use during this operation. Continuous radiation monitoring is recommended.

b. If necessary center the lid in the MPC shell using a hand-operated chain fall.

Note:
The MPC is equipped with lid shims that serve to close the gap in the joint for MPC lid closure weld.

c. As necessary, install the MPC lid shims around the MPC lid to make the weld gap uniform.

ALARA Note:
The optional AWS Baseplate shield is used to further reduce the dose rates to the operators working around the top cask surfaces.

d. Install the Automated Welding System baseplate shield (if used). See Figure 7.1.12 for rigging.

e. Install the Automated Welding System Robot (if used). See Figure 7.1.12 for rigging.

f. Tack weld the MPC lid.

g. Visually inspect the tack welds.

h. Lay the root weld.

Note:
The Lid-to-Shell weld may be examined by either volumetric examination (UT) or multi-layer liquid penetrant examination. If volumetric examination is used, it shall be the ultrasonic method and shall include a liquid penetrant (PT) of the root and final weld layers. If PT alone is used, at a minimum, it must include the root and final weld layers and one intermediate PT after approximately every 3/8 inch weld depth. For all liquid penetrant examinations in this procedure, ASME Boiler and Pressure Vessel Code, Section V, Article 6 provides the liquid penetrant examination methods. The acceptance standards for liquid penetrant examination shall be in accordance with ASME Boiler and Pressure Vessel Code, Section III, Subsection NB, Article NB-5350 as specified on the Design Drawings. ASME Code, Section III, Subsection NB, Article NB-4450 provides acceptable requirements for weld repair. NDE personnel shall be qualified per the requirements of Section III and V of the Code or site-specific program. Volumetric examination of the MPC Lid-to-Shell weld by ultrasonic test methods are defined in ASME Boiler and Pressure Vessel Code, Section V, Article 5 and 2 respectively. The acceptance standards for UT examination are per Section III, Subsection NB, Article NB-5332 for UT as defined on the Design Drawings. NDE personnel shall be qualified per the requirements of Section III and V of the Code or site-specific program.

i. Disconnect the vacuum source from the vent port (if used).

j. Perform a liquid penetrant examination of the weld root.

k. Complete the MPC lid welding, performing at least one intermediate layer liquid penetrant examination after approximately every 3/8 inch weld depth.

l. Perform a liquid penetrant examination on the MPC lid final pass and UT (if required).

26. Perform hydrostatic and MPC leakage rate testing as follows:

ALARA Note:
The leakage rates are determined before the MPC is drained for ALARA reasons. A weld repair is a lower dose activity if water remains inside the MPC.

a. Attach the drain line to the vent port and route the drain line to the spent fuel pool or the plant liquid radwaste system. See Figure 7.1.23 for the hydrostatic test arrangement.

ALARA Warning:
Water flowing from the MPC may carry activated particles and fuel particles. Apply appropriate ALARA practices around the drain line.

b. Fill the MPC with either spent fuel pool water or plant demineralized water until water is observed flowing out of the vent port drain hose.

c. Perform a hydrostatic test of the MPC as follows:

1. Close the drain valve and pressurize the MPC to 125 +5/-0 psig.

2. Close the inlet valve and monitor the pressure for a minimum of 10 minutes. The pressure shall not drop during the performance of the test.

3. Following the 10-minute hold period, visually examine the MPC lid-to-shell weld for leakage of water. The acceptance criteria is no observable water leakage.

d. Release the MPC internal pressure, disconnect the water fill line and drain line from the vent and drain port RVOAs leaving the vent and drain port caps open.

1. Repeat Step 25.1

e. Attach a regulated helium supply ~~(pressure set to 10+10/-0 psig)~~ to the vent port and attach the drain line to the drain port as shown on Figure 7.1.24.

f. Verify the correct pressure ~~(pressure set to 10+10/-0 psig)~~ on the helium supply and open the helium supply valve. Drain approximately 5 to 10 gallons.

g. Close the drain port valve and pressurize the MPC to ~~10+10/-0 psig~~*with* helium.

h. Close the vent port.

Note:
The leakage detector may detect residual helium in the atmosphere. If the leakage tests detects a leak, the area should be flushed with nitrogen or compressed air and the location should be retested.

i. Perform a helium sniffer probe leakage rate test of the MPC lid-to shell weld in accordance with the Mass Spectrometer Leak Detector (MSLD) manufacturer's instructions and ANSI N14.5 [7.1.5]. The MPC Helium Leak Rate shall be $\leq$ 5.0E-6 std cc/sec (He) with a minimum test sensitivity less than 2.5E-6 std cc/sec (He).

j. Repair any weld defects in accordance with the site's approved weld repair procedures. Re-perform the Ultrasonic, Liquid Penetrant, Hydrostatic and Helium Leakage tests if weld repair is performed.

27. Drain the MPC as follows:

ALARA Warning:
Dose rates will rise as water is drained from the MPC. Continuous dose rate monitoring is recommended.

a. Attach a regulated helium or nitrogen supply ~~(pressure set to 25+5/-0 psig)~~ to the vent port.

b. Attach a drain line to the drain port shown on Figure 7.1.24.

c. *Deleted.* ~~Verify the correct pressure (pressure set to 25+5/-0) on the gas supply.~~

d. Open the gas supply valve and record the time at the start of MPC draindown.

Note:
An optional warming pad may be placed under the HI-STAR 100 Overpack to replace the heat lost during the evaporation process of vacuum drying. This may be used at the user's discretion for older and colder fuel assemblies to reduce vacuum drying times.

e. Start the warming pad, if used.

f. Blow the water out of the MPC until water ceases to flow out of the drain line. Shut the gas supply valve.

g. Disconnect the gas supply line from the MPC.

h. Disconnect the drain line from the MPC.

28. Vacuum ~~D~~*d*ry the MPC as follows:

Note:
Vacuum drying is performed to remove moisture and oxidizing gasses from the MPC. This ensures a suitable environment for long-term storage of spent fuel assemblies and ensures that the MPC pressure remains within design limits. The vacuum drying process reduces the MPC internal pressure in stages. Dropping the internal pressure too quickly may cause the formation of ice in the fittings. Ice formation could result in incomplete removal of moisture from the MPC. The vacuum stages are intermediate steps and should be considered approximate values.

a. Attach the Vacuum Drying System (VDS) to the vent and drain port RVOAs. See Figure 7.1.25.

Note:
The Vacuum Drying System may be configured with an optional fore-line condenser to increase vacuum pump efficiency. Water may need to be periodically drained. The volume of condensed water should be measured and added to the water volume measured during MPC draining.

b. Reduce the MPC pressure to approximately 100 torr and throttle the VDS suction valve to maintain this pressure for approximately 15 minutes.

c. Reduce the MPC pressure to approximately 70 torr and throttle the VDS suction valve to maintain this pressure for approximately 15 minutes.

d. Reduce the MPC pressure to approximately 50 torr and throttle the VDS suction valve to maintain this pressure for approximately 15 minutes.

e. Reduce the MPC pressure to approximately 30 torr and throttle the VDS suction valve to maintain this pressure for approximately 15 minutes.

Note:
The Vacuum Drying System pressure will remain at about 30 torr until most of the liquid water has been removed from the MPC.

f. When the MPC pressure begins to drop (without any operator action), completely open the VDS suction valve and reduce the MPC pressure to below 3 torr.

g. Shut the VDS valves and verify a stable MPC pressure on the vacuum gage.

Note:
The MPC pressure may rise due to the presence of water in the MPC. The dryness test may need to be repeated several times until all the water has been removed. Leaks in the Vacuum Drying System, damage to the vacuum pump, and improper vacuum gauge calibration may cause repeated failure of the dryness verification test. These conditions should be checked as part of the corrective actions if repeated failure of the dryness verification test is occurring.

h. Perform the MPC dryness verification test. The MPC cavity shall hold stable vacuum drying pressure of ≤ 3 torr for ≥ 30 minutes.

i. Close the vent and drain port valves.

j. Disconnect the VDS from the MPC.

k. Stop the warming pad, if used.

l. Close the drain port RVOA cap and remove the drain port RVOA.

29. Backfill the MPC as follows:

Note:
Helium backfill requires 99.995% (minimum) purity.

a. Set the helium bottle regulator pressure to 70+5/-0 psig.

b. Purge the Helium Backfill System to remove oxygen from the lines.

c. Attach the Helium Backfill System (HBS) to the vent port as shown on Figure 8.1.23 and open the vent port.

d. Slowly open the helium supply valve while monitoring the pressure rise in the MPC.

~~Note:~~
~~If helium bottles need to be replaced, the bottle valve needs to be closed and the entire regulator assembly transferred to the new bottle.~~

e. Carefully backfill the MPC to between 0 (atmospheric) and 30 psig.

f. Disconnect the HBS from the MPC.

g. Close the vent port RVOA and disconnect the vent port RVOA.

30. Weld the vent and drain port cover plates as follows:

a. Wipe the inside area of the vent and drain port recesses to dry and clean the surfaces.

b. Place the cover plate over the vent port recess.

c. *Deleted.*~~Raise the edge of the cover plate and insert the nozzle of the helium supply into the vent port recess to displace the oxygen with helium.~~

Note:
~~Helium gas is required to be injected into the port recesses to ensure that the leakage test is valid.~~*The vent and drain port cover plates are provided with two small threaded holes with set screws for the injection of helium. The set screws may be installed or removed during welding.*

d. *Deleted.*~~Displace the air in the recess using the helium nozzle and immediately close the cover plate.~~

e. Tack weld the cover plate.

f. Visually inspect the tack welds.

g. Weld the root pass on the vent port cover plate.

Note:
ASME Boiler and Pressure Vessel Code [7.1.6], Section V, Article 6 provides the liquid penetrant inspection methods. The acceptance standards for liquid penetrant examination shall be in accordance with ASME Boiler and Pressure Vessel Code, Section III, Subsection NB, Article NB-5350 as specified on the Design Drawings. ASME Code, Section III, Subsection NB, Article NB-4450 provides acceptable requirements for weld repair. NDE personnel shall be qualified per the requirements of Section V of the Code or site-specific program.

h. Perform a liquid penetrant examination on the vent port cover plate root weld.

i. Complete the vent port cover plate welding.

> **Note:**
> ASME Boiler and Pressure Vessel Code [7.1.6], Section V, Article 6 provides the liquid penetrant inspection methods. The acceptance standards for liquid penetrant examination shall be in accordance with ASME Boiler and Pressure Vessel Code, Section III, Subsection NB, Article NB-5350 as specified on the Design Drawings. ASME Code, Section III, Subsection NB, Article NB-4450 provides acceptable requirements for weld repair. NDE personnel shall be qualified per the requirements of Section V of the Code or site-specific program.

j. Perform a liquid penetrant examination on the vent port cover weld.

k. Repeat Steps 30.a through 30.j for the drain port cover plate.

31. Perform a leakage test of the MPC vent and drain port cover plates as follows:

> **Note:**
> The leakage detector may detect residual helium in the atmosphere from the helium injection process. If the leakage tests detects a leak, the area should be blown clear with compressed air or nitrogen and the location should be retested. *The following process provides a high concentration of helium gas into the cavity. Other methods that ensure a high concentration of helium gas are also acceptable.*

a. *If necessary, remove the cover plate set screws.*

b. *Flush the cavity with helium to remove the air and immediately install the set screws recessed ¼-inch below the top of the cover plate.*

c. *Plug weld the recess above each set screw to complete the penetration closure welding.*

d. *Perform a liquid penetrant examination on the plug weld.*

e. Flush the area around the vent and drain cover plates with compressed air or nitrogen to remove any residual helium gas.

~~b.~~*f.* Perform a helium leakage rate test of vent and drain cover plate welds in accordance with the Mass Spectrometer Leak Detector (MSLD) manufacturer's instructions and ANSI N14.5 [7.1.5]. The MPC Helium Leak Rate shall be ≤ 5.0E-6 std cc/sec (He) with a minimum test sensitivity less than 2.5E-6 std cc/sec (He).

~~c.~~*g.* Repair any weld defects in accordance with the site's approved code weld repair procedures. Re-perform the leakage test as required.

32. Weld the MPC closure ring as follows:

ALARA Note:
The closure ring is installed by hand. No tools are required. The closure ring may be provided as a complete ring or in two halves. In the case of the single ring, no radial connecting welds are needed.

a. Install and align the closure ring. See Figure 7.1.8.

b. Tack weld the closure ring to the MPC shell and the MPC lid.

c. Visually inspect the tack welds.

d. Lay the root weld between the closure ring and the MPC shell if necessary.

e. Lay the root weld between the closure ring and the MPC lid if necessary.

f. Lay the root weld connecting the two closure ring segments, if necessary.

Note:
ASME Boiler and Pressure Vessel Code [7.1.6], Section V, Article 6 provides the liquid penetrant inspection methods. The acceptance standards for liquid penetrant examination shall be in accordance with ASME Boiler and Pressure Vessel Code, Section III, Subsection NB, Article NB-5350 as specified on the Design Drawings. ASME Code, Section III, Subsection NB, Article NB-4450 provides acceptable requirements for weld repair. NDE personnel shall be qualified per the requirements of Section V of the Code or site-specific program.

g. Perform a liquid penetrant examination on the closure ring root welds.

h. Complete the closure ring welding.

Note:
ASME Boiler and Pressure Vessel Code [7.1.6], Section V, Article 6 provides the liquid penetrant inspection methods. The acceptance standards for liquid penetrant examination are contained in the ASME Boiler and Pressure Vessel Code, Section III, Subsection NB, Article NB-5350. ASME Code, Section III, Subsection NB, Article NB-4450 provides acceptable requirements for weld repair. NDE personnel shall be qualified per the requirements of Section V of the Code or site-specific program.

i. Perform a liquid penetrant examination on the closure ring final weld.

j. Remove the Automated Welding System.

k. If ~~necessary~~*used*, remove the AWS baseplate shield. See Figure 7.1.12 for rigging.

7.1.6 Preparation for Transport

1. Remove the annulus shield and seal surface protector and store it in an approved plant storage location

ALARA Warning:
Dose rates will rise around the top of the annulus as water is drained from the annulus. Apply appropriate ALARA practices.

2. Attach a drain line to the HI-STAR 100 overpack drain connector and drain the remaining water from the annulus to the spent fuel pool or the plant liquid radwaste system (See Figure 7.1.17).

3. Install the overpack closure plate as follows:

   a. Remove any waterproof tape or bolt plugs used for contamination mitigation.

   b. Clean the closure plate seal seating surface and the HI-STAR 100 overpack seal seating surface and install new overpack closure plate mechanical seals.

   c. Remove the test port plug and store it in a site-approved location. Discard any used metallic seals.

Note:
Care should be taken to protect the *overpack* seal seating surface from scratches, nicks or dents.

   d. Install the closure plate (see Figure 7.1.12). Disconnect the closure plate lifting eyes and install the bolt hole plugs in the empty bolt holes (See Table 7.1.3 for torque requirements).

   e. Install and torque the closure plate bolts. See Table 7.1.3 for torque requirements.

   f. Remove the vent port cover plate and remove the port plug and seal. Discard any used mechanical seals.

4. Dry the overpack annulus as follows:

   a. Disconnect the drain connector from the overpack.

   b. Install the drain port plug with a new seal and torque the plug. See Table 7.1.3 for torque requirements. Discard any used metallic seals.

Note:
Preliminary annulus vacuum drying may be performed using the test cover to improve flow rates and reduce vacuum drying time. Dryness testing and helium backfill shall use the backfill tool.

c. Load the backfill tool with the HI-STAR 100 overpack vent port plug and the vent port with a new plug seal. Attach the backfill tool to the HI-STAR 100 overpack vent port with the plug removed. See Figure 7.1.28. See Table 7.1.3 for torque requirements.

d. Evacuate the HI-STAR 100 overpack pressure to approximately 100 torr and hold the pressure for approximately 15 minutes.

e. Evacuate the HI-STAR 100 overpack pressure to approximately 50 torr and hold the pressure for approximately 15 minutes.

f. Evacuate the HI-STAR 100 overpack pressure to approximately 30 torr and hold the pressure for approximately 15 minutes.

g. Throttle the VDS suction valves to maintain about 30 torr and hold the pressure for approximately 15 minutes.

Note:
The Vacuum Drying System pressure will remain at about 30 torr until most of the liquid water has been removed from the overpack.

h. Continue to operate the Vacuum Drying System at about 30 torr while monitoring the HI-STAR 100 overpack pressure.

i. When the HI-STAR 100 overpack pressure begins to drop (without any operator action), completely open the Vacuum Drying System suction valve and reduce the HI-STAR 100 overpack pressure to below 3 torr.

Note:
The annulus pressure may rise due to the presence of water in the HI-STAR 100 overpack. The dryness test may need to be repeated several times until all the water has been removed. Leaks in the Vacuum Drying System, damage to the vacuum pump, and improper vacuum gauge calibration may cause repeated failure of the dryness verification test. These conditions should be checked as part of the corrective actions if repeated failure of the dryness verification test is occurring.

j. Perform a HI-STAR 100 overpack Annulus Dryness Verification. The overpack annulus shall hold stable vacuum drying pressure of $\leq$ 3 torr for $\geq$ 30 minutes.

5. If necessary, perform a leakage test of the MPC-68F/*24EF* as follows:

a. Evacuate the annulus per the MSLD manufacturer's instructions and isolate the vacuum pump from the overpack test cover.

b. Perform a leakage rate test of MPC-68F/*24EF* per the MSLD manufacturer's instructions. The overpack Helium Leak Rate shall be $\leq$ 5.0E-6 std cc/sec (He) with a minimum test sensitivity less than 2.5E-6 std cc/sec (He).

6. Backfill, and leakage test the overpack as follows:

   a. Attach the helium supply to the backfill tool.

   b. Verify the correct pressure on the helium supply (pressure set to10+4/-0 psig) and open the helium supply valve.

   c. Backfill the HI-STAR 100 overpack annulus to $\geq$ 10 psig and $\leq$ 14 psig.

   d. Install the overpack vent port plug and torque. See Table 7.1.3 for torque requirements.

   e. Disconnect the overpack backfill tool from the vent port.

   f. Flush the overpack vent port recess with compressed air to remove any standing helium gas.

   g. Install the overpack test cover to the overpack vent port as shown on Figure 7.1.27. See Table 7.1.3 for torque requirements.

   h. Evacuate the test cavity per the MSLD manufacturer's instructions and isolate the vacuum pump from the overpack test cover.

   i. Perform a leakage rate test of overpack vent port plug per the MSLD manufacturer's instructions. The overpack Helium Leak Rate shall be $\leq$ 4.3E-6 std cc/sec (He) with a minimum test sensitivity less than 2.15E-6 std cc/sec (He).

   j. Remove the overpack test cover and install a new metallic seal on the overpack vent port cover plate. Discard any used metallic seals.

   k. Install the vent port cover plate and torque the bolts. See Table 7.1.3 for torque requirements.

   l. Repeat Steps 6.f through 6.k for the overpack drain port.

7. Leak test the overpack closure plate inner mechanical seal as follows:

   a. Attach the closure plate test tool to the closure plate test port with the and MSLD attached. See Figure 7.1.29. See Table 7.1.3 for torque requirements.

   b. Evacuate the closure plate test port tool and closure plate inter-seal area per the MSLD manufacturer's instructions.

   c. Perform a leakage rate test of overpack closure plate inner mechanical seal in accordance with the MSLD manufacturer's instructions. The overpack Helium Leak Rate shall be $\leq$ 4.3E-6 std cc/sec (He) with a minimum test sensitivity less than 2.15E-6 std cc/sec (He).

d. Remove the closure plate test tool from the test port and install the test port plug with a new mechanical seal. See Table 7.1.3 for torque requirements. Discard any used metallic seals.

8. Drain the Temporary Shield Ring (Figure 7.1.20), if used. Remove ~~the ring segments~~ and store ~~them~~ in an approved plant storage location.

ALARA Warning:
For ALARA reasons, decontamination of the overpack bottom shall be performed using pole-mounted cleaning tools or other remote leaning devices.

ALARA Warning:
If the overpack is to be downended on the transport frame, the bottom shield should be installed quickly. Personnel should remain clear of the bottom of the unshielded overpack.

7.1.7 Placement of the HI-STAR 100 Overpack on the Transport ~~Frame~~ *Vehicle*

1. Position the transport ~~frame~~ *vehicle* under the overhead lifting device.

2. Install the HI-STAR 100 overpack buttress plate on the HI-STAR 100 overpack. See Figure 7.1.11 and 7.1.12 for rigging. See Table 7.1.3 for torque requirements.

3. Downend the HI-STAR 100 overpack ~~in the transport frame~~. See Section 7.1.2.

4. Install the removable shear ring segments. See Table 7.1.3 for torque requirements.

5. Install the impact limiters as follows:

a. Install the alignment pins in the bottom of the HI-STAR 100 overpack. See Figure 7.1.11. See Table 7.1.3 for torque requirements.

b. Using the impact limiter handling frame, raise and position the impact limiter over the end of HI-STAR 100. See Figure 7.1.10.

c. Install the impact limiter bolts. See Table 7.1.3 for torque requirements.

d. Repeat for the other impact limiter.

6. *Place the overpack in the transport vehicle. See Figure 7.1.5*

~~5.~~ *7.* Perform a final inspection of the HI-STAR 100 overpack as follows:

ALARA Warning:
Dose rates around the unshielded bottom end of the HI-STAR 100 overpack may be higher that other locations around the overpack. Workers should exercise appropriate ALARA controls when working around the bottom end of the HI-STAR 100 overpack.

Note:
Prior to shipment of the HI-STAR 100 package, the accessible external surfaces of the HI-STAR 100 packaging (HI-STAR 100 overpack, impact limiters, personnel barrier, ~~tie-down, transport frame~~ and transport vehicle) shall be surveyed for removable radiological contamination and show less than 2200 dpm/100 cm^2 from beta and gamma emitting sources, and 220 dpm/100 cm^2 from alpha emitting sources.

a. Perform a final decontamination of the HI-STAR 100 overpack, and survey for removable contamination.

b. Perform a visual inspection of the HI-STAR 100 overpack to verify that there are no outward visual indications of impaired physical condition. Identify any significant indications to the cognizant individual for evaluation and resolution and record on the shipping documentation.

c. Verify that the HI-STAR 100 overpack neutron shield rupture discs are installed, intact and not covered by tape or other covering.

~~6.~~*8.* *Deleted.* ~~Install the tie-down over the HI-STAR 100 overpack and secure the tie-down bolts. See Table 7.1.3 for torque requirements.~~

~~7. Install the impact limiters as follows:~~

~~a. Install the alignment pins in the bottom of the HI-STAR 100 overpack. See Figure 7.1.11. See Table 7.1.3 for torque requirements.~~

~~b. Using the impact limiter handling frame, raise and position the impact limiter over the end of HI-STAR 100. See Figure 7.1.10.~~

~~c. Install the impact limiter bolts. See Table 7.1.3 for torque requirements.~~

~~d.~~*a.* ~~Repeat for the other impact limiter.~~

Note:
The impact limiters cover all the HI-STAR 100 penetrations. The security seals are used to provide tamper detection.

~~e.~~*b.* Install a security seal (one each) through the threaded hole in the top and bottom impact limiter bolts. Record the security seal number on the shipping documentation.

~~f.~~*c.* Perform final radiation surveys of the package surfaces per 10CFR71.47 [7.0.1] and SAR Section 8.1.5.2 and 49CFR173.443 [7.1.3]. Record the results on the shipping documentation.

~~8.~~*9.* Install the personnel barrier as follows:

a. Rig the personnel barrier as shown in Figure 7.1.9 and position the personnel barrier over the frame.

b. Remove the personnel barrier rigging and install the personnel barrier locks.

c. Transfer the personnel barrier keys to the carrier.

~~9.~~10. Perform a final check to ensure that the package is ready for release as follows:

a. Verify that required radiation survey results are properly documented on the shipping documentation.

b. Perform a HI-STAR 100 overpack surface temperature check. The accessible surfaces of the HI-STAR 100 Package (impact limiters and personnel barrier) shall not exceed 185 °F when measured in the shade in still air.

c. Verify that all required leakage testing has been performed and the acceptance criteria has been met and document the results on the shipping documentation.

d. Verify that the receiver has been notified of the impending shipment and that the receiver has the appropriate procedures and equipment is available to safely receive and handle the HI-STAR 100 System (10CFR20.1906(e)) [7.1.4].

e. Verify that the carrier has the written instructions and a list of appropriate contacts for notification of accidents or delays.

f. Verify that the carrier has written instructions that the shipment is to be Exclusive Use in accordance with 49CFR172.443 [7.1.3].

g. Verify that route approvals and notification to appropriate agencies have been completed.

h. Verify that the appropriate labels have been applied in accordance with 49CFR172.403.

i. Verify that the appropriate placards have been applied in accordance with 49CFR172.500.

j. Verify that all required information is recorded on the shipping documentation.

~~10.~~11. Release the HI-STAR 100 System for transport.

Table 7.1.1

ESTIMATED HI-STAR 100 SYSTEM COMPONENT AND HANDLING WEIGHTS

Component	Weight (lbs)			Case Applicability †			
	MPC-24/24E/24EF	*MPC-32*	MPC-68/*68F*	1	2	3	4
Empty HI-STAR Overpack (without Closure Plate)	145,726	*145,726*	145,726	1	1	1	1
HI-STAR Closure Plate (without rigging)	7,984	*7,984*	7,984		1	1	1
Empty MPC (without Lid or Closure Ring)	*30,996* ~~29,075~~	*24,625* ~~24,503~~	*27,283* ~~28,502~~	1	1	1	1
MPC Lid (without Fuel Spacers or Drain Line)	9,677	*9,677*	*10,113* ~~10,194~~	1	1	1	1
MPC Closure Ring	145	*145*	145		1	1	1
MPC ~~Lower~~ Fuel Spacers ††	*1,256* ~~401~~	*1,440*	*1,904* ~~258~~	1	1	1	1
~~MPC Upper Fuel Spacers ††~~	~~144~~		~~315~~	1	1	1	1
MPC Drain Line	50	*50*	50	1	1	1	1
Fuel *and non-fuel components* (Design Basis)	*40,320* ~~36,360~~	*53,760*	*47,600* ~~42,092~~	1	1	1	1
~~Non-Fuel Components~~	~~3,960~~		~~5,440~~				
Damaged Fuel Container (Dresden 1)	~~0~~*N/A*	*N/A*	150				
Damaged Fuel Container (Humboldt Bay)	~~0~~*N/A*	*N/A*	120				
Damaged Fuel Container (Trojan)	*276*	*N/A*	*N/A*				
MPC Water ††† (with Fuel in MPC)	17,630	*17,630*	16,957	1			
Annulus Water	280	*280*	280	1			
HI-STAR Lift Yoke (with slings)	3600	*3600*	3600	1	1		
Annulus Seal	50	*50*	50	1			
Lid Retention System	2300	*2300*	2300				
Transport Frame	9000	*9000*	9000			1	
Temporary Shield Ring	2500	*2500*	2500				
Automated Welding System Baseplate Shield	2000	*2000*	2000				
Automated Welding System Robot	1900	*1900*	1900				
Top Impact Limiter (without Buttress Plate)	*19,187* ~~16,667~~	*19,187*	*19,187* ~~16,667~~			1	1
Bottom Impact Limiter	17,231	*17,231*	17,231			1	1
Impact Limiter Handling Frame	1980	*1980*	1980				
Buttress Plate	2520	*2520*	2520			1	1
Tie-Down	995	*995*	995			1	
Personnel Barrier	1500	*1500*	1500			1	

Note: These weights are estimated from the design drawings and assuming maximum design weight in each fuel cell location. Actual weights will vary based on component as-built conditions and actual contents of each fuel cell location (i.e., fuel assembly, non-fuel hardware, DFC, etc.). Licensees shall confirm weights for lifting and handling operations. MPC-24/24E/24EF weights are bounding for Trojan design MPC-24E/EF.

† See Table 7.1.2.

†† The fuel spacers referenced in this table are for the heaviest fuel assembly for each MPC. This yields the maximum weight of fuel assemblies and spacers.

††† Varies by fuel type and loading configuration. Users may opt to pump some water from the MPC prior to removal from the spent fuel pool to reduce the overall lifted weight.

TABLE 7.1.2
ESTIMATED MAXIMUM HANDLING WEIGHTS
HI-STAR 100 SYSTEM

Caution:
The maximum weight supported by the HI-STAR 100 overpack lifting trunnions (not including the lift yoke) cannot exceed 250,000 lbs. Users should determine their specific handling weights based on the MPC contents and the expected handling modes.

Note:
The weight of the fuel spacers and the damaged fuel container are less than the weight of the design basis fuel assembly for each MPC and are therefore not included in the maximum handling weight calculations.

Case No.	Load Handling Evolution	Weight (lbs)		
		MPC-24/24E/24EF	MPC-32	MPC-68/*68F*
1	Loaded HI-STAR Removal from Spent Fuel Pool	*249,585* ~~242,993~~	*256,848*	*253,563* ~~248,024~~
2	Loaded HI-STAR During Movement through Hatchway	*239,754* ~~233,162~~	*247,017*	*244,405* ~~238,866~~
3	Weight on Transport Vehicle	*286,587* ~~277,475~~	*293,850*	*291,238* ~~283,179~~
4	Gross HI-STAR 100 Package Weight	*275,092* ~~265,980~~	*282,355*	*279,743* ~~271,684~~

Note: These weights are estimated from the design drawings. Actual weights may vary based on as-built conditions. Licensee shall confirm weights based on actual equipment received. MPC-24/24E/24EF weights are bounding for Trojan design MPC-24E/EF.

Table 7.1.3
HI-STAR 100 SYSTEM TORQUE REQUIREMENTS

Fastener	Torque (ft-lbs)	Pattern
Overpack Closure Plate Bolts†, ††	First Pass – Hand Tight Second Pass – Wrench Tight Third Pass – *700 +50/-50* ~~860+25/-25~~ Fourth Pass –*1400 +100/-100* ~~1725+50/-50~~ Final Pass - *2000 +250/-0* ~~2895+90/-90~~	Figure 7.1.30
Overpack Vent and Drain Port Cover Plate Bolts††	12+2/-0	X-pattern
Overpack Vent and Drain Port Plugs	45+5/-0	None
Closure Plate Test Port Plug	45+5/-0	None
Backfill Tool Test Cover Bolts††	16+2/-0	X-pattern
Shear Ring Segments	22+2/-0	None
Overpack Bottom Cover Bolts	200+20/-0	None
Pocket Trunnion Plugs	Hand Tight	None
Threaded Fuel Spacers	Hand Tight	None
MPC Lid Threaded Plugs	Hand Tight	None
Impact Limiter Alignment Pin	Hand Tight	None
Top Impact Limiter Attachment Bolt	256+10/-0	None
Bottom Impact Limiter Attachment Bolt	1500+45/-0	None
Buttress Plate Bolts	150 +10-0	None
~~Tie-Down Bolts~~	~~250+20/-0~~	~~None~~
~~Transport Frame Bolts~~	~~250+20/-0~~	~~None~~

† Detorquing shall be performed by turning the bolts counter-clockwise in 1/3 turn +/- 30 degrees increments per pass according to Figure 7.1.30 for three passes. The bolts may then be removed.

†† Bolts shall be cleaned and inspected for damage or excessive wear (replaced if necessary) and coated with a light layer of Fel-Pro Chemical Products, N-5000, Nuclear Grade Lubricant (or equivalent).

Table 7.1.4
HI-STAR 100 SYSTEM ANCILLARY EQUIPMENT OPERATIONAL DESCRIPTION

Equipment	Important To Safety Classification	Reference Figure	Description
Annulus Overpressure System (optional)	Not Important To Safety	7.1.17	The Annulus Overpressure System is used for supplemental protection against spent fuel pool water contamination of the external MPC shell and baseplate surfaces by providing a slight annulus overpressure. The Annulus Overpressure System consists of the quick disconnects water reservoir, reservoir valve and annulus connector hoses. User is responsible for supplying demineralized water to the location of the Annulus Overpressure System.
Annulus Shield (optional)	Not Important To Safety	7.1.13	A segmented solid shield that is placed at the top of the annulus to provide supplemental shielding to the operators performing cask loading and closure operations. Shield segments are installed by hand, no crane or tools required.
Automated Welding System (optional)	Not Important To Safety	7.1.2b	Used for remote welding of the MPC lid, vent and drain port cover plates and the MPC closure ring. The AWS consists of the robot, wire feed system, torch system, weld power supply and gas lines.
AWS Baseplate Shield (optional)	Not Important To Safety	7.1.2b	The AWS baseplate shield provides supplemental shielding to the operators during the cask closure operations.
Backfill Tool	Not Important to Safety	7.1.28	Used to dry, backfill the HI-STAR 100 annulus and install the HI-STAR 100 overpack vent and drain port plugs. The backfill tool uses the same bolts as the HI-STAR 100 overpack vent and drain cover plates.
Blowdown Supply System	Not Important To Safety	7.1.24	Gas hose with pressure gauge, regulator used for blowdown of the MPC.
Closure Plate Test Tool	Not Important to Safety	7.1.29	Used to helium leakage test the HI-STAR 100 overpack Closure Plate inner mechanical seal.
Cool-Down System	Not Important To Safety	7.2.5	The Cool-Down System is a closed-loop forced ventilation cooling system used to gas-cool the MPC fuel assemblies down to a temperature water can be introduced without the risk of thermally shocking the fuel assemblies or flashing the water, causing uncontrolled pressure transients. The Cool-Down System is attached between the MPC drain and vent ports The CDS consists of the piping, blower, heat exchanger, valves, instrumentation, and connectors. The CDS is used only for unloading operations.
Drain Connector	Not Important To Safety	7.1.17	Used for draining the annulus water following cask closure operations. The Drain Connector consists of the connector pipe valve, and quick disconnect for adapting to the Annulus Overpressure System.

Table 7.1.4 (Continued)
HI-STAR 100 SYSTEM ANCILLARY EQUIPMENT OPERATIONAL DESCRIPTION

Equipment	Important To Safety Classification	Reference Figure	Description
Four Legged Sling and Lifting Rings	Not Important To Safety (controlled under the user's rigging equipment program)	7.1.12	Used for rigging the HI-STAR 100 overpack upper shield lid, MPC lid, Automated Welding System Baseplate shield, and Automated Welding System Baseplate Shield. Consists of a four legged sling, lifting rings, shackles and a main lift link.
Helium Backfill System	Not Important To Safety	7.1.26	Used for helium backfilling of the MPC. System consists of the gas lines, mass flow monitor, integrator, and valved quick disconnect.
Hydrostatic Test System	Not Important to Safety	7.1.23	Used to hydrostatically test the MPC primary welds. The hydrostatic test system consists of the gauges, piping, pressure protection system piping and connectors.
Impact Limiter Handling Frame	Not Important to Safety	7.1.10	The impact limiter handling frame is used for installing, removing, handling and storing the impact limiters. The impact limiter handling frame consists of the handling frame and rigging.
Impact Limiters	Important to Safety	7.1.11	The impact limiters are used to limit the HI-STAR 100 decelerations to less than 60 g during postulated transportation accidents. The impact limiters consist of the top and bottom impact limiter and the connecting fasteners.
Inflatable Annulus Seal	Not Important To Safety	7.1.13	Used to prevent spent fuel pool water from contaminating the external MPC shell and baseplate surfaces during in-pool operations.
Lid Retention System (optional)	User designated	7.1.18	The Lid Retention System provides three functions; it guides the MPC lid into place during underwater installation, establishes lift yoke alignment with the HI-STAR 100 overpack trunnions, and locks the MPC lid in place during cask handling operations between the pool and decontamination pad. The device consists of the retention disk, alignment pins, lift yoke connector links and lift yoke attachment bolts.
Lift Yoke	User designated	7.1.3	Used for HI-STAR 100 overpack cask handling when used in conjunction with the overhead crane. The lift yoke consists of the lift yoke assembly and crane hook engagement pin(s). The lift yoke is a modular design that allows inspection, disassembly, maintenance and replacement of components.
MPC Fill Pump System (optional)	Not Important To Safety	Not shown	Large pump used for filling the MPC with spent fuel pool water prior to cask insertion into the spent fuel pool. Als o used for emptying of the MPC for unloading operations.
MPC Upending Frame	Not Important to Safety	7.1.6	A welded steel frame used to evenly support the MPC during upending operations. The frame consists of the main frame, MPC support saddles, two rigging bars, wrap around-straps, and strap attachment lugs.

Table 7.1.4 (Continued)
HI-STAR 100 SYSTEM ANCILLARY EQUIPMENT OPERATIONAL DESCRIPTION

Equipment	Important To Safety Classification	Reference Figure	Description
MSLD (Helium Leakage Detector)	Not Important To Safety	Not shown	Used for helium leakage testing of the MPC closure welds.
MSLD Calibration Sources	Not Important To Safety	Not shown	Traceable leakage sources for periodic calibration of the MSLD.
Overpack Bottom Cover (optional)	Not Important to Safety	Not shown	A cup-shaped shield used to reduce dose rates around the HI-STAR 100 overpack bottom end when operated in the horizontal orientation.
Overpack Test Cover	Not Important to Safety	7.1.27	Used to helium leakage test the HI-STAR 100 overpack vent and drain port plug seals.
Personnel Barrier	Not Important to Safety	7.1.9	The personnel barrier is a ventilated enclosure cage that fits over the main body of the HI-STAR 100 overpack. The personnel barrier is designed to restrict personnel accessibility to the potentially hot surfaces of the HI-STAR 100 overpack. The personnel barrier in conjunction with the impact limiters restrict accessibility to all surfaces of the HI-STAR 100 overpack during transport. The personnel barrier is equipped with locks to prevent unauthorized access. The personnel barrier is equipped with a four-legged bridle sling used for installation and removal.
Seal Surface Protector (optional)	Not Important to Safety	7.1.13	Used to protect the HI-STAR 100 overpack mechanical seal seating surface during loading and MPC closure operations.
Small Water Pump (optional)	Not Important To Safety	7.1.22	Used for lowering the MPC water level prior to lid welding. The small water pump consists of the pump, hose and connector fittings.
Temporary Shield Ring (optional)	Not Important To Safety	7.1.20	A water-filled segmented tank that fits on the cask neutron shield around the upper forging and provides supplemental shielding to personnel performing cask loading and closure operations. Shield segments are installed by hand, no tools are required.
Threaded Inserts	Not Important To Safety	Not shown	Used to fill the empty threaded holes in the HI-STAR 100 overpack and MPC.
Tie-Down	Not Important to Safety	7.1.11	The tie-down is a horse-shoe shaped collar that secures the HI-STAR 100 top end to the transport frame. The tie-down is secured by multiple bolts.
Transport Frame	Not Important To Safety	7.1.6	A welded steel frame used to support the HI-STAR 100 overpack during on-site movement ~~and upending/downending operations. The frame consists of the rotation trunnions, main frame beams and front saddle~~.

Table 7.1.4 (Continued)
HI-STAR 100 SYSTEM ANCILLARY EQUIPMENT OPERATIONAL DESCRIPTION

Equipment	Important To Safety Classification	Reference Figure	Description
Transport Vehicle	Not Important to Safety	Not Shown	Any flatbed rail car, heavy haul trailer or other device used to transport the loaded HI-STAR 100 overpack.
Vacuum Drying System	Not Important To Safety	7.1.25	Used for removal of residual moisture from the MPC and HI-STAR 100 Overpack annulus following water draining. Used for evacuation of the MPC to support backfilling operations. Used to support test volume samples for MPC unloading operations. The VDS consists of the vacuum pump, piping, skid, gauges, valves, inlet filter, flexible hoses, connectors, control system.
Vacuum Drying System Fore-Line Condenser (optional)	Not Important to Safety	Not Shown	Optional item used to improve the Vacuum Drying System pump efficiency. The condenser removes water from the vacuum stream prior to the vacuum pump.
Vent and Drain RVOAs (optional)	Not Important To Safety	7.1.21	Used to drain, dry, inert and fill the MPC through the vent and drain ports. The vent and drain RVOAs allow the vent and drain ports to be operated like valves and prevent the need to hot tap into the penetrations during unloading operation.
Warming Pad (optional)	Not Important to Safety	Not Shown	Used to improve vacuum drying time for older and colder fuel assemblies. The pad consists of the heater pad, heater, circulation pump, expansion tank, hoses and fittings. Other configurations are acceptable.
Water Totalizers	Not Important To Safety	7.1.22 and 7.1.24	Used for water pump-down prior to lid welding operations and water removal for MPC helium leakage testing.
Weld Removal System (optional)	Not Important To Safety	7.2.2b	Semi-automated weld removal system used for removal of the MPC to shell weld, MPC to closure ring weld and closure ring to MPC shell weld. The WRS mechanically removes the welds using a high-speed cutter.

Table 7.1.5
HI-STAR 100 SYSTEM INSTRUMENTATION SUMMARY FOR LOADING AND UNLOADING OPERATIONS†

Note:
The following list summarizes the instruments identified in the procedures for cask loading and unloading operations. Alternate instruments are acceptable as long as they can perform appropriate measurements.

Instrument	**Function**
Dose Rate Monitors/Survey Equipment	Monitors dose rate and contamination levels and ensures proper function of shielding. Ensures assembly debris is not inadvertently removed from the spent fuel pool during overpack removal.
Flow Rate Monitor	Monitors the air flow rate during assembly cool-down.
Helium Mass Flow Monitor	Determines the amount of helium introduced into the MPC during backfilling operations. Includes integrator.
Helium Mass Spectrometer Leak Detector (MSLD)	Ensures leakage rates of welds are within acceptance criteria.
Helium Pressure Gauges	Ensures correct helium backfill pressure during backfilling operation.
Volumetric Testing Rig	Used to assess the integrity of the MPC lid-to-shell weld.
Pressure Gauge	Ensures correct helium pressure during fuel cool-down operations.
Hydrostatic Test Pressure Gauge	Used for hydrostatic testing of MPC lid-to-shell weld.
Temperature Gauge	Monitors the state of fuel cool-down prior to MPC flooding.
Temperature Probe	For fuel cool-down operations
Vacuum Gauges	Used for vacuum drying operations and to prepare an MPC evacuated sample bottle for MPC gas sampling for unloading operations.
Water Pressure Gauge	Used for performance of the MPC Hydrostatic Test.
Water Totalizer	Used for water pump-down prior to lid welding operations and water removal for MPC helium leakage testing.

† All instruments require calibration. See figures at the end of this section for additional instruments, controllers and piping diagrams.

Table 7.1.6
HI-STAR 100 OVERPACK SAMPLE INSPECTION CHECKLIST

Note:
This checklist provides the basis for establishing a site-specific inspection checklist for the HI-STAR 100 overpack. Specific findings shall be brought to the attention of the appropriate site organizations for assessment, evaluation and potential corrective action prior to use.

HI-STAR 100 Overpack Closure Plate:

1. Lifting rings shall be inspected for general condition and date of required load test certification.
2. The test port shall be inspected for dirt and debris, hole blockage, thread condition, presence or availability of the port plug and replacement mechanical seals.
3. The mechanical seal grooves shall be inspected for cleanliness, dents, scratches and gouges and the presence or availability of replacement mechanical seals.
4. The painted surfaces shall be inspected for corrosion and chipped, cracked or blistered paint.
5. All closure plate surfaces shall be relatively free of dents, scratches, gouges or other damage.
6. The vent port plug shall be inspected for thread condition, and sealing surface condition (scratches, gouges).
7. Overpack vent port shall be inspected for presence or availability of port plugs, hole blockage, plug seal seating surface condition.
8. Overpack vent port cover plate shall be inspected for cleanliness, scratches, dents, and gouges, availability of retention bolts, availability of replacement mechanical seals.

HI-STAR 100 Overpack Main Body:

1. The impact limiter attachment bolt holes shall be inspected for dirt and debris and thread condition.
2. The mechanical seal seating surface shall be inspected for cleanliness, scratches, and dents or gouges.
3. The drain port plug shall be inspected for thread condition, and sealing surface condition (scratches, gouges).
4. The closure plate bolt holes shall be inspected for dirt, debris and thread damage.
5. Painted surfaces shall be inspected for corrosion and chipped, cracked or blistered paint.
6. Trunnions shall be inspected for deformation, cracks, thread damage, end plate damage, corrosion, excessive galling, damage to the locking plate, presence or availability of locking plate and end plate retention bolts.

Table 7.1.6
HI-STAR 100 OVERPACK SAMPLE INSPECTION CHECKLIST
(continued)

7. *Deleted.* ~~Pocket trunnion recesses shall be inspected for indications of over-stressing (i.e., cracks, deformation, excessive wear).~~
8. Overpack drain port cover plate shall be inspected for cleanliness, scratches, dents, and gouges, availability of retention bolts, availability of replacement mechanical seals.
9. Overpack drain port shall be inspected for presence or availability of port plug, availability of replacement mechanical seals, hole blockage, plug seal seating surface condition.
10. Annulus inflatable seal groove shall be inspected for cleanliness, scratches, dents, gouges, sharp corners, burrs or any other condition that may damage the inflatable seal.
11. The overpack rupture disks shall be inspected for presence or availability and the top surface of the disk shall be visually inspected for holes, cracks, tears or breakage.
12. The nameplate shall be inspected for presence and general condition.
13. The removable shear ring shall be inspected for fit and thread condition.

Table 7.1.7
MPC SAMPLE INSPECTION CHECKLIST

Note:
This checklist provides the basis for establishing a site-specific inspection checklist for MPC. Specific findings shall be brought to the attention of the appropriate site organizations for assessment, evaluation and potential corrective action prior to use.

<u>MPC Lid and Closure Ring:</u>
1. The MPC lid and closure ring surfaces shall be relatively free of dents, gouges or other shipping damage.
2. The drain line shall be inspected for straightness, thread condition, and blockage.
3. Upper fuel spacers (if used) shall be inspected for availability and general condition. Plugs shall be available for non-used spacer locations.
4. Lower fuel spacers (if used) shall be inspected for availability and general condition.
5. Drain and vent port cover plates shall be inspected for availability and general condition.
6. Serial numbers shall be inspected for readability.

<u>MPC Main Body:</u>
1. All visible MPC body surfaces shall be inspected for dents, gouges or other shipping damage.
2. Fuel cell openings shall be inspected for debris, dents and general condition.
3. Lift lugs shall be inspected for general condition.
4. Verify proper MPC basket type for contents.

LOCATION: CASK RECEIVING AREA
REMOVE PERSONNEL BARRIER
PERFORM RECEIPT INSPECTION
SURVEY HI-STAR 100 OVERPACK
REMOVE IMPACT LIMITERS
REMOVE TIE-DOWN
UPEND HI-STAR 100 OVERPACK
REMOVE HI-STAR CLOSURE PLATE
INSTALL MPC
INSTALL UPPER FUEL SPACERS
INSTALL LOWER FUEL SPACERS
FILL MPC AND ANNULUS
INSTALL ANNULUS SEAL
PLACE HI-STAR IN SPENT FUEL POOL
LOCATION: SPENT FUEL POOL
LOAD FUEL ASSEMBLIES INTO MPC
PERFORM ASSEMBLY IDENTIFICATION VERIFICATION
INSTALL DRAIN LINE TO MPC LID
ALIGN MPC LID AND LIFT YOKE
INSTALL MPC LID
REMOVE HI-STAR FROM SPENT FUEL POOL AND PLACE IN PREPARATION AREA
LOCATION: CASK PREPARATION AREA
DECONTAMINATE HI-STAR 100 BOTTOM
SET HI-STAR 100 IN CASK PREPARATION AREA
MEASURE DOSE RATES AT MPC LID
DECONTAMINATE HI-STAR 100 AND LIFT YOKE
INSTALL TEMPORARY SHIELD RING
REMOVE INFLATABLE ANNULUS SEAL
LOWER ANNULUS WATER LEVEL SLIGHTLY
SMEAR MPC LID TOP SURFACES
INSTALL ANNULUS SHIELD
LOWER MPC WATER LEVEL
WELD MPC LID

PERFORM PT ON MPC LID WELD
PERFORM VOLUMETRIC EXAM OF MPC LID WELD
RAISE MPC WATER LEVEL
PERFORM HYDRO TEST ON MPC
PERFORM LEAKAGE TESTING
DRAIN MPC
MEASURE VOLUME OF WATER DRAINED
VACUUM DRY MPC
PERFORM MPC DRYNESS VERIFICATION TEST
BACKFILL MPC
WELD VENT AND DRAIN PORT COVER PLATES
PERFORM NDE ON COVER PLATE WELDS
PERFORM LEAKAGE TEST ON COVER PLATES
WELD MPC CLOSURE RING
PERFORM NDE ON CLOSURE RING WELDS
DRAIN ANNULUS
PERFORM SURVEYS ON HI-STAR
INSTALL HI-STAR CLOSURE PLATE
REMOVE TEMPORARY SHIELD RING
PERFORM FINAL SURVEYS ON HI-STAR
LOCATION: RECEIVING FACILITY
PERFORM SHIELDING EFFECTIVENESS TEST
DOWNEND HI-STAR 100 OVERPACK
INSTALL IMPACT LIMITERS
SURVEY HI-STAR 100 OVERPACK
INSTALL TIE-DOWN
PERFORM FINAL INSPECTION
INSTALL PERSONNEL BARRIER

Figure 7.1.1; Loading Operations Flow Diagram

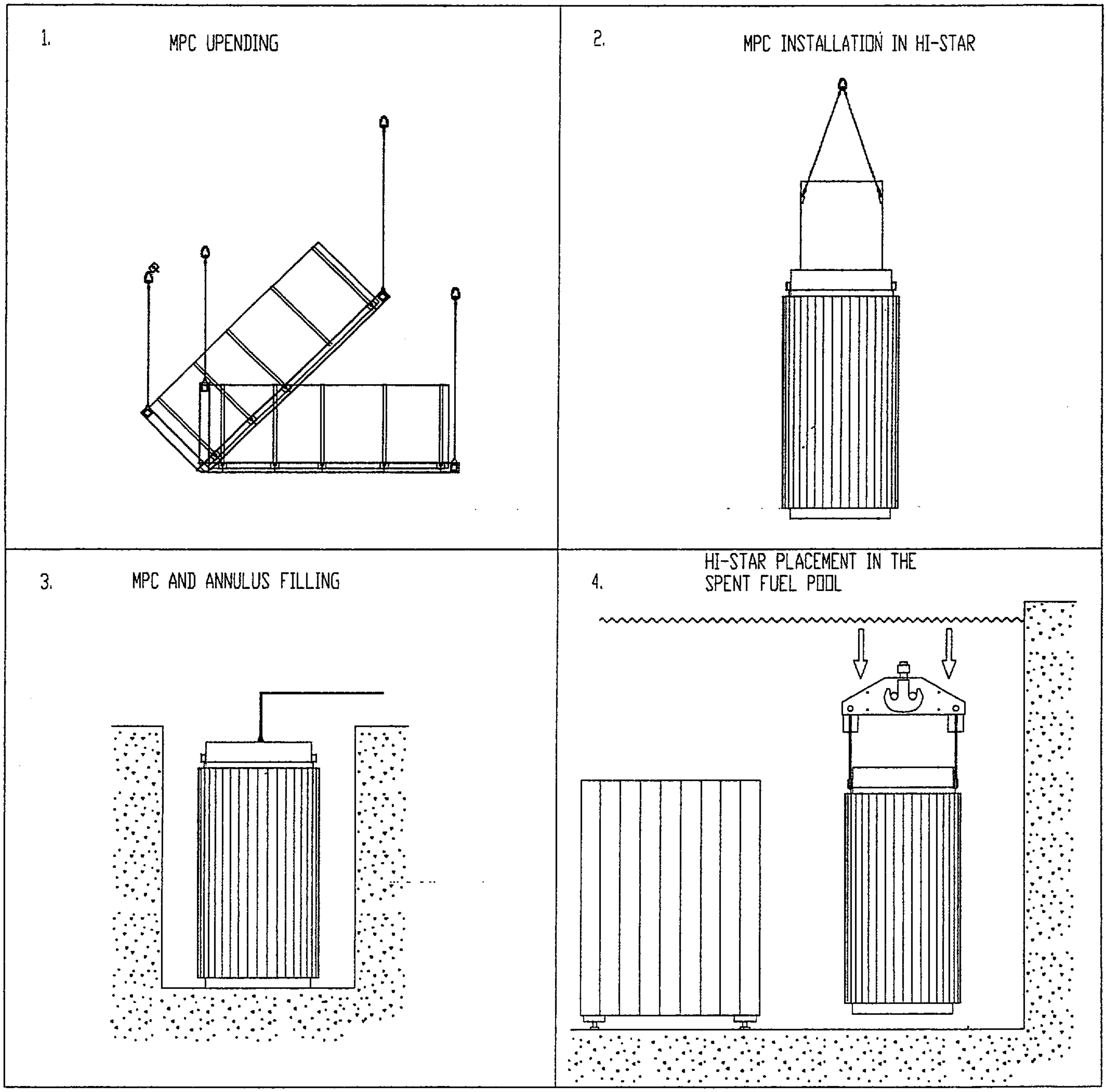


Figure 7.1.2a; Major HI-STAR 100 Loading Operations (Sheet 1 of 3)

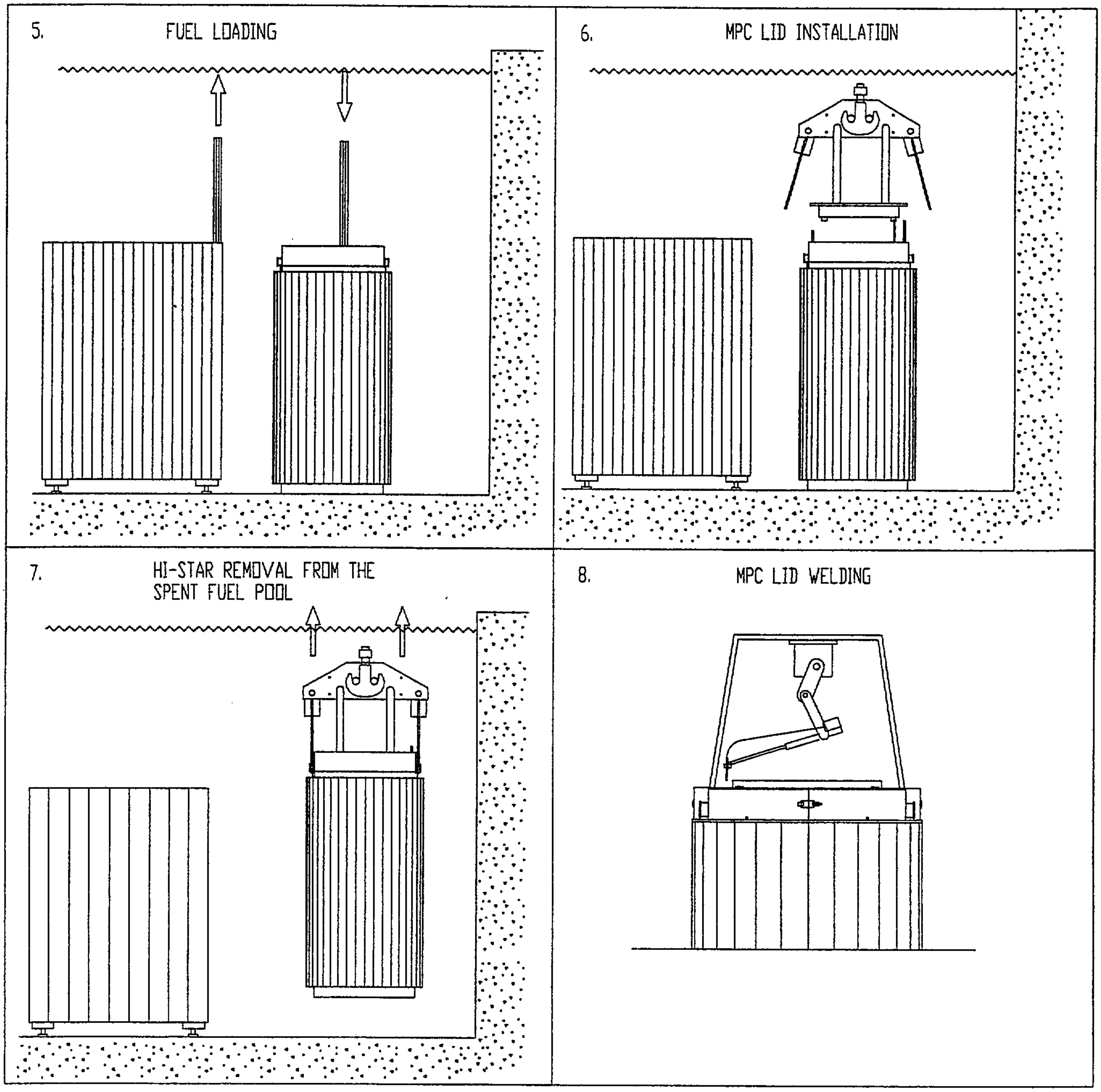


Figure 7.1.2b; Major HI-STAR 100 Loading Operations (Sheet 2 of 3)

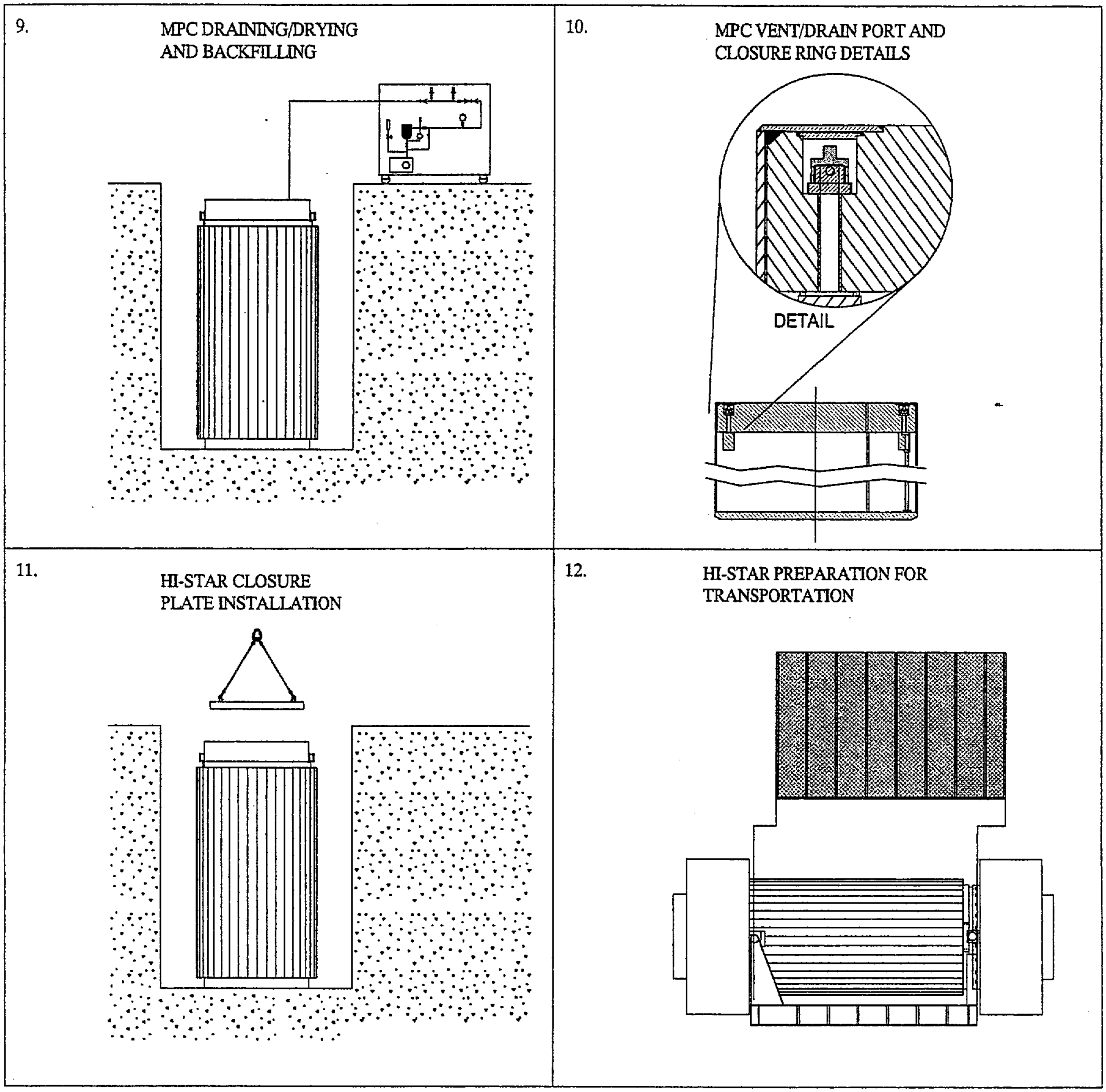


Figure 7.1.2c; Major HI-STAR 100 Loading Operations (Sheet 3 of 3)

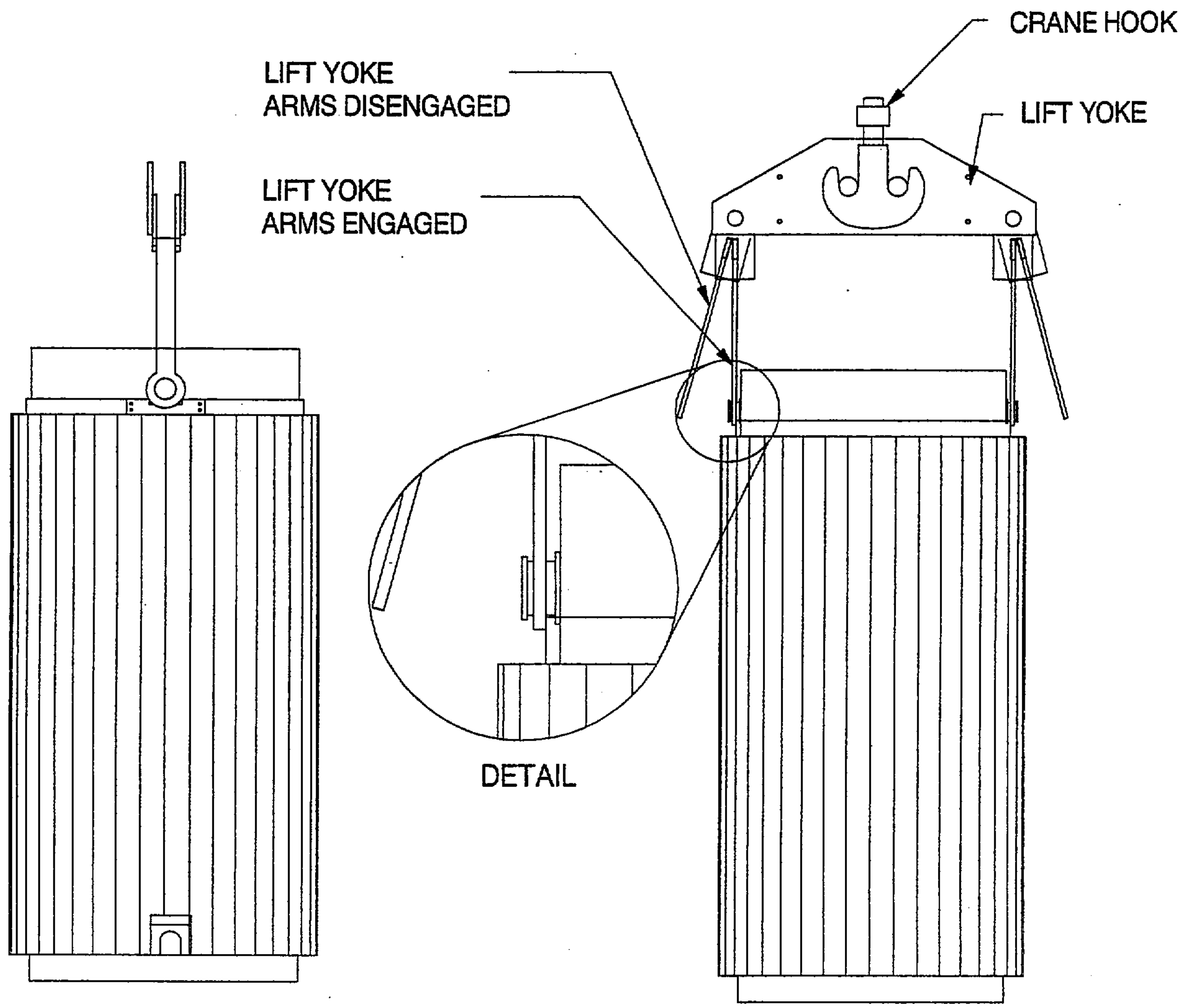


Figure 7.1.3; Lift Yoke Engagement and Vertical HI-STAR Handling

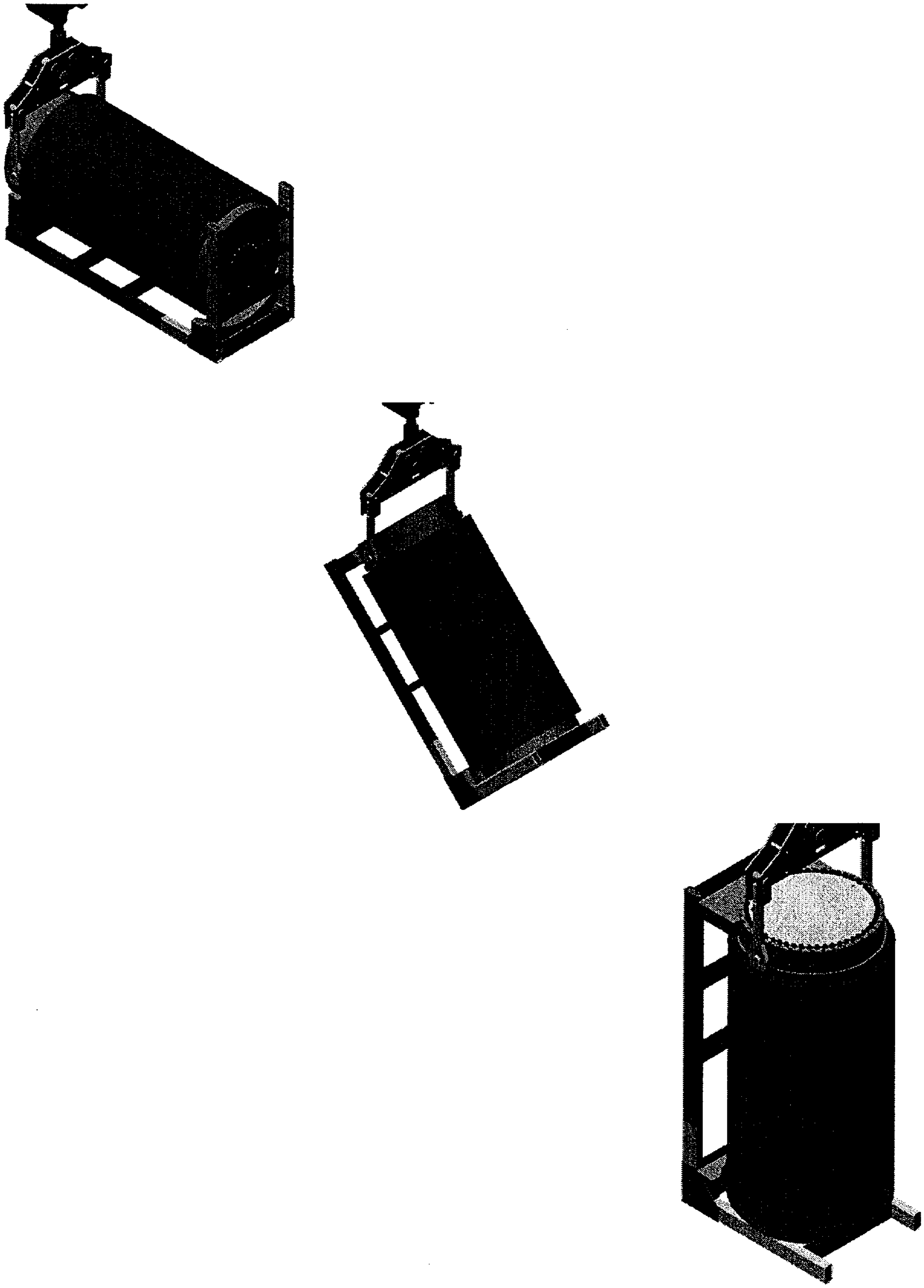


Figure 7.1.4; HI-STAR Upending/Downending

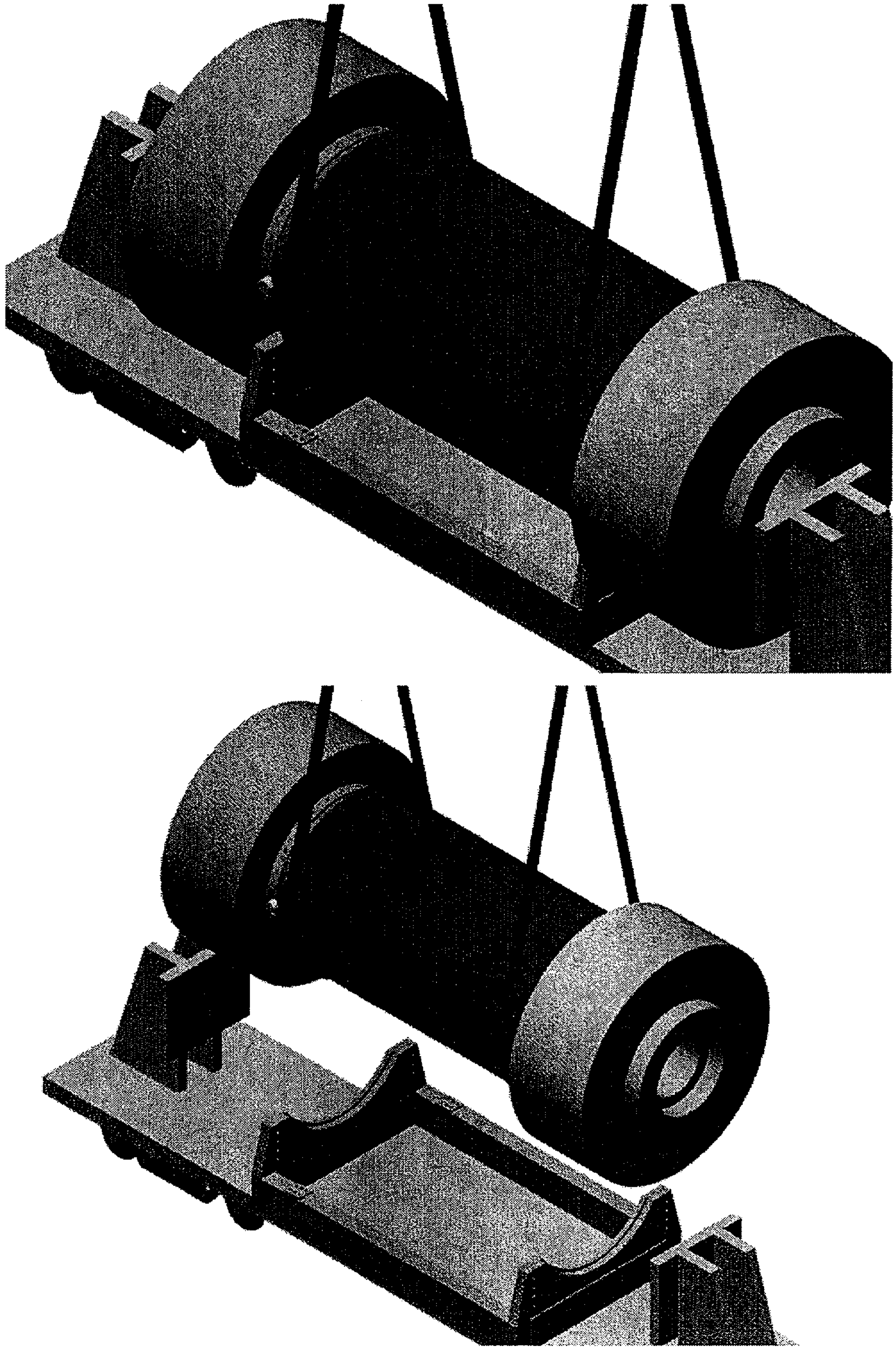


Figure 7.1.5: HI-STAR 100 Overpack Rigging for Horizontal Handling

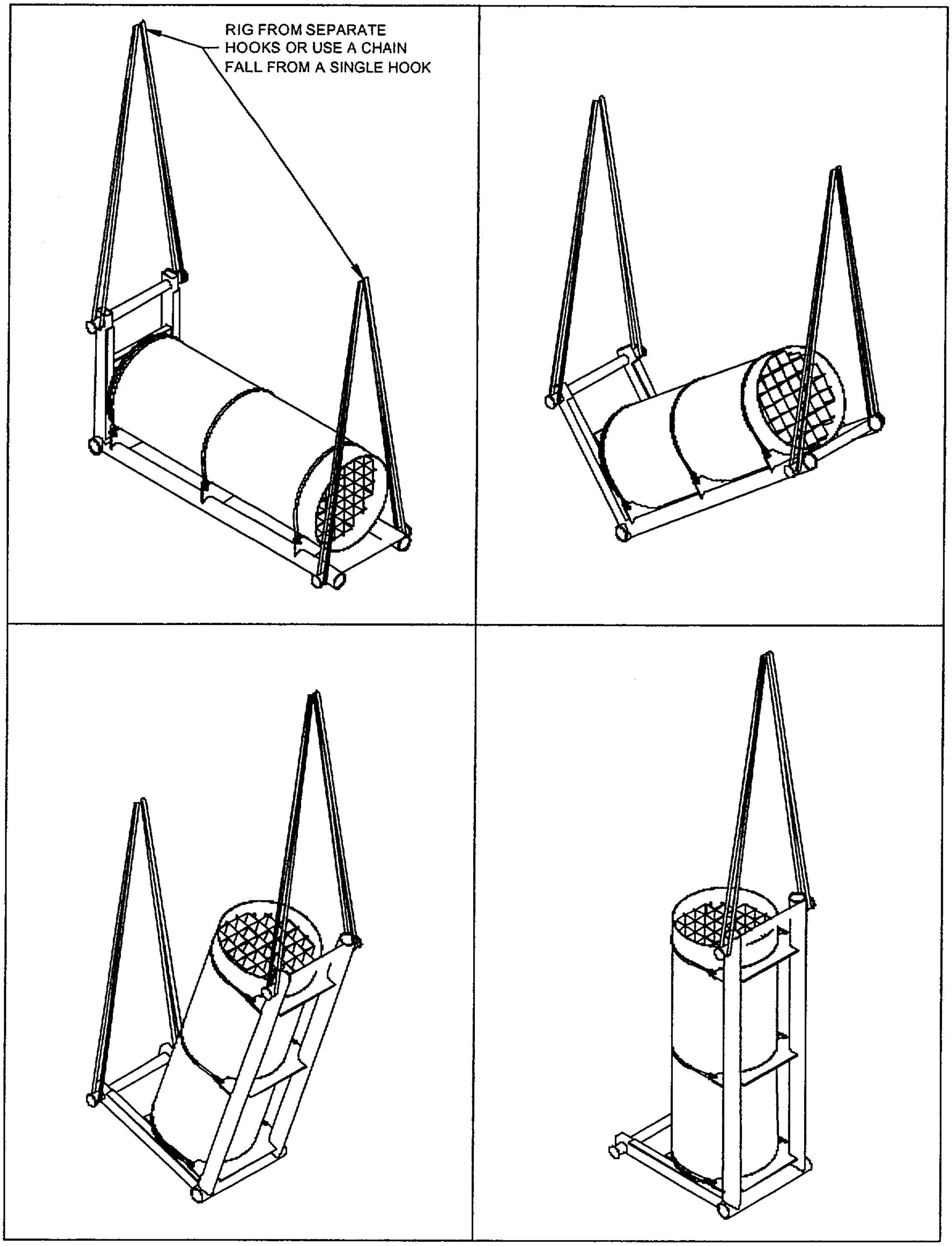


Figure 7.1.6; MPC Upending In The MPC Upending Frame

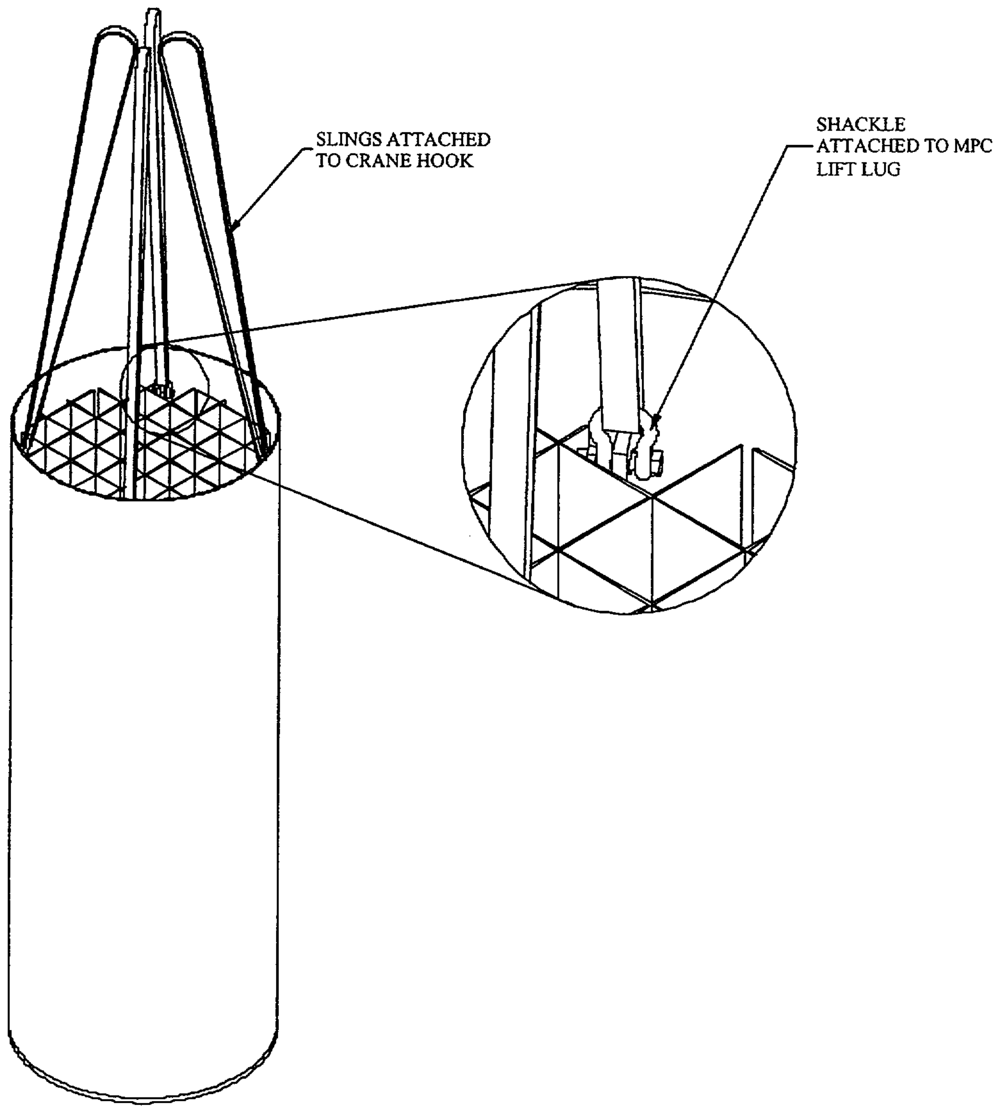


Figure 7.1.7;MPC Rigging For Vertical Lifts

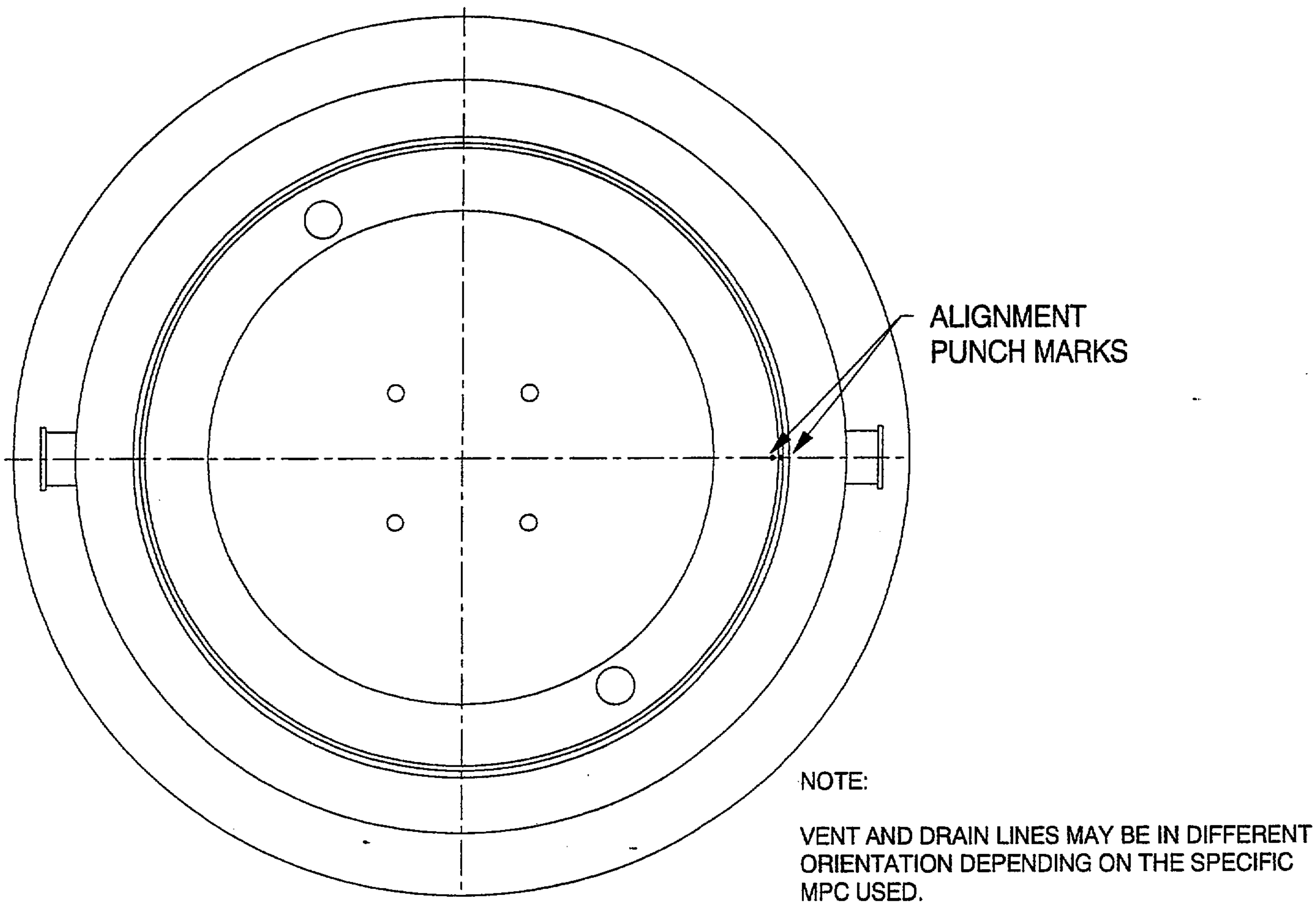


Figure 7.1.8; MPC Alignment in HI-STAR

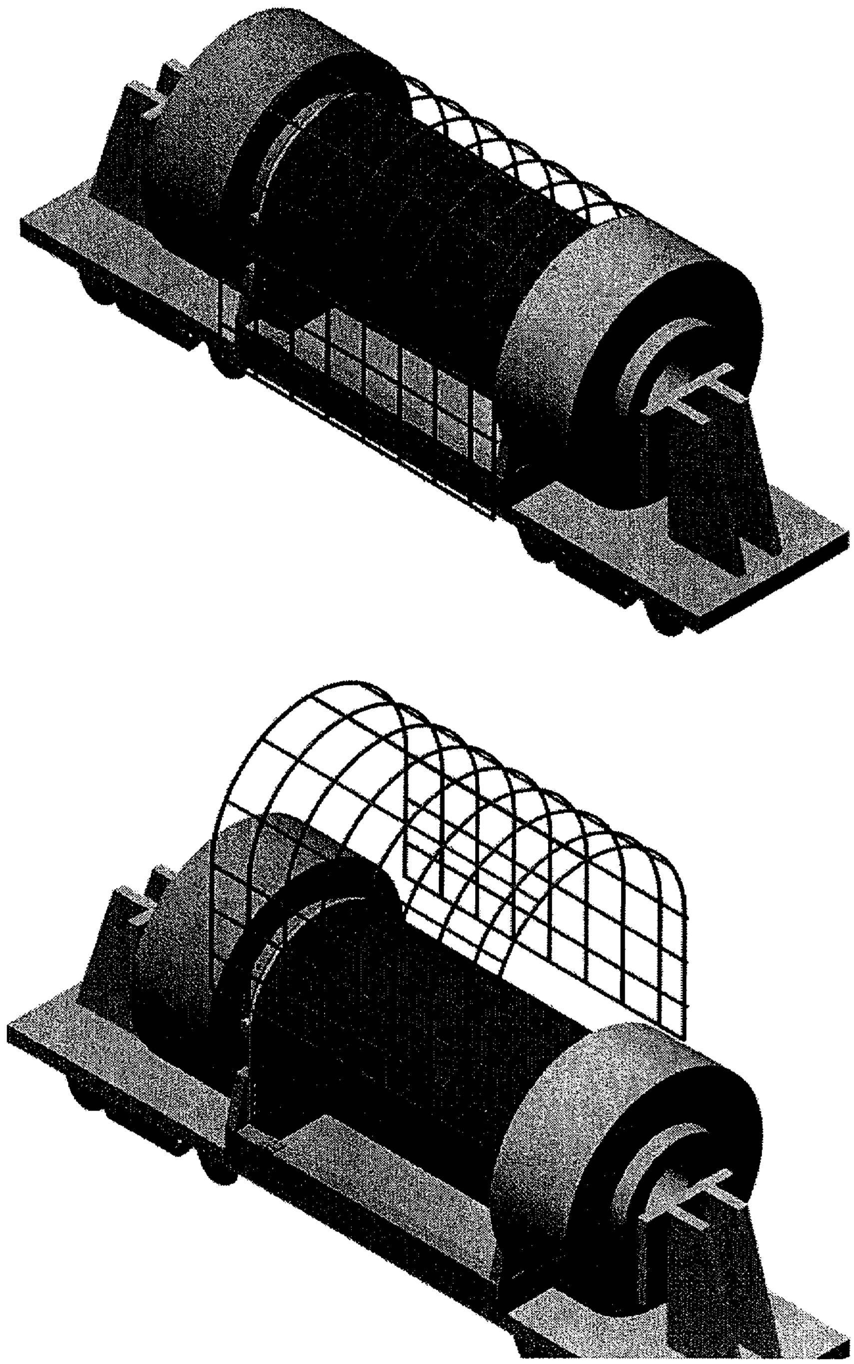


Figure 7.1.9; Personnel Barrier Removal and Installation

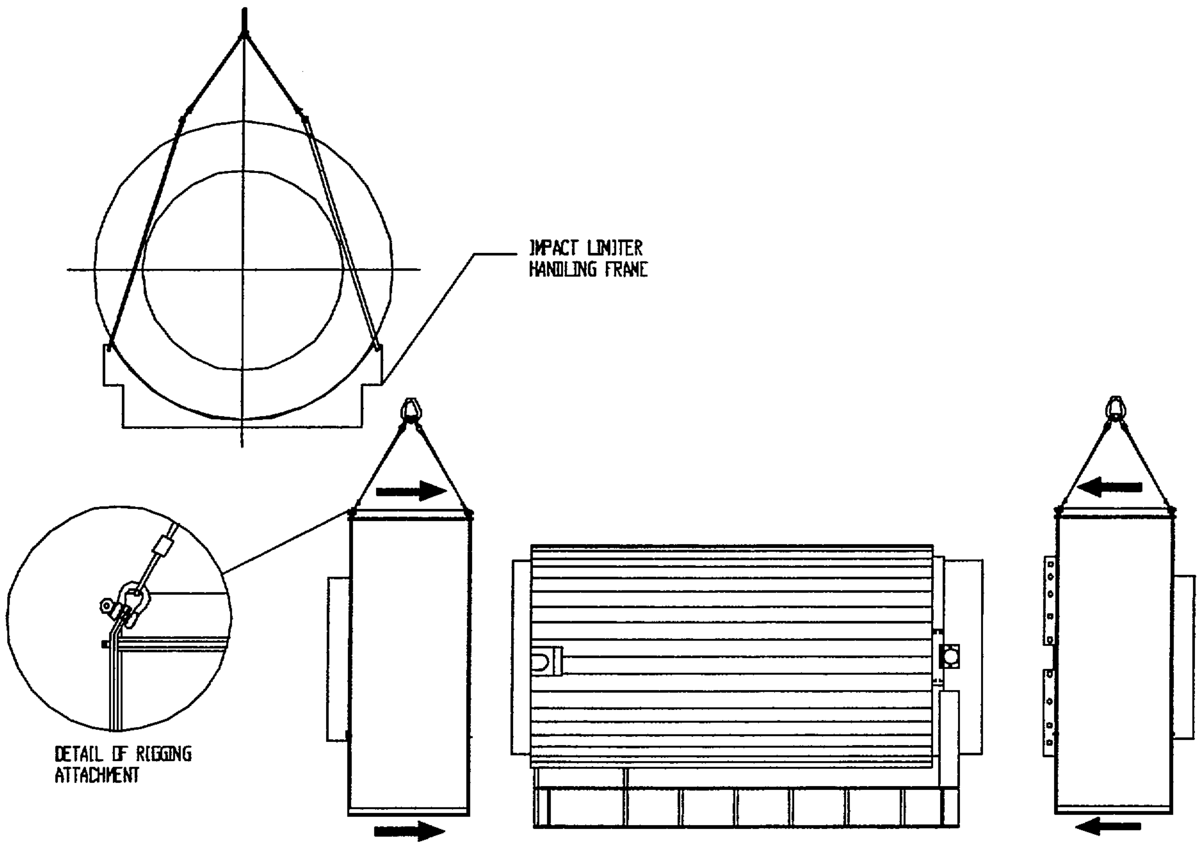


Figure 7.1.10; Impact Limiter Handling

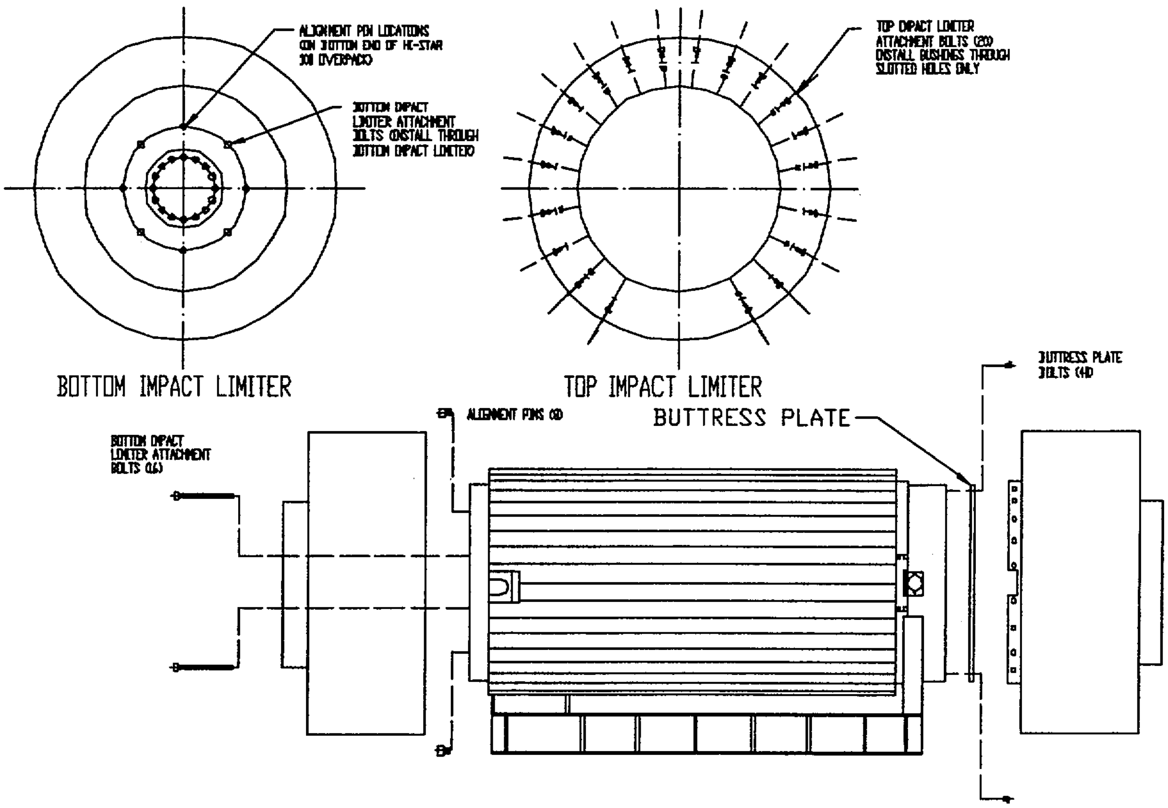


Figure 7.1.11; HI-STAR 100 Impact Limiter and Bolting

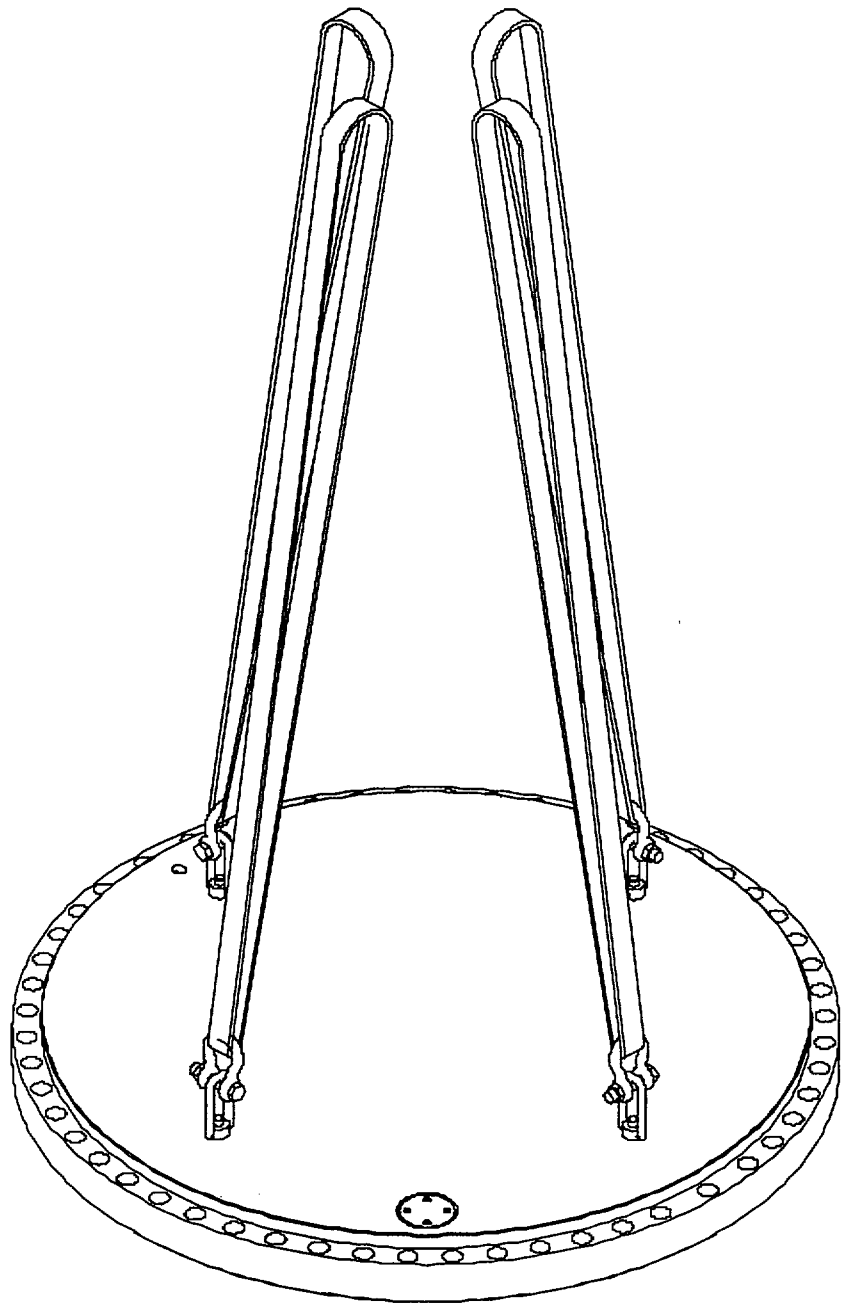
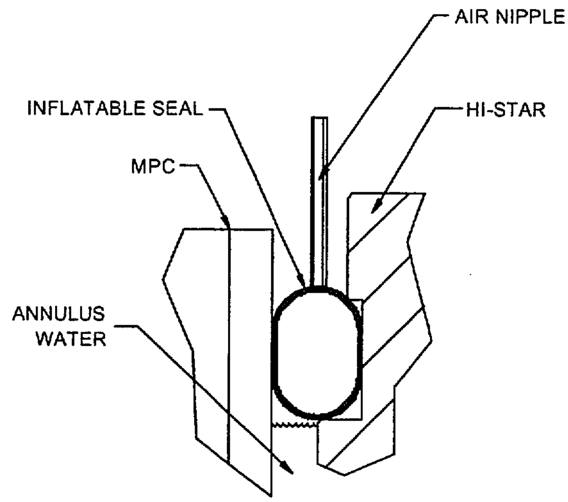
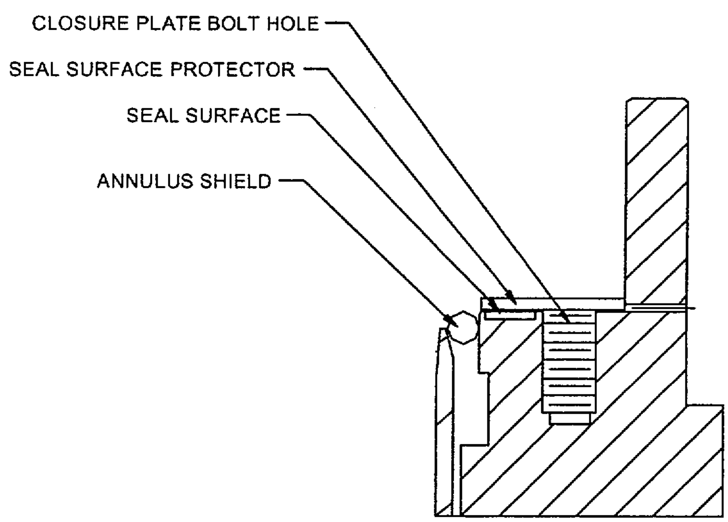


Figure 7.1.12; MPC Lid And HI-STAR Accessory Rigging (Closure Plate Shown)

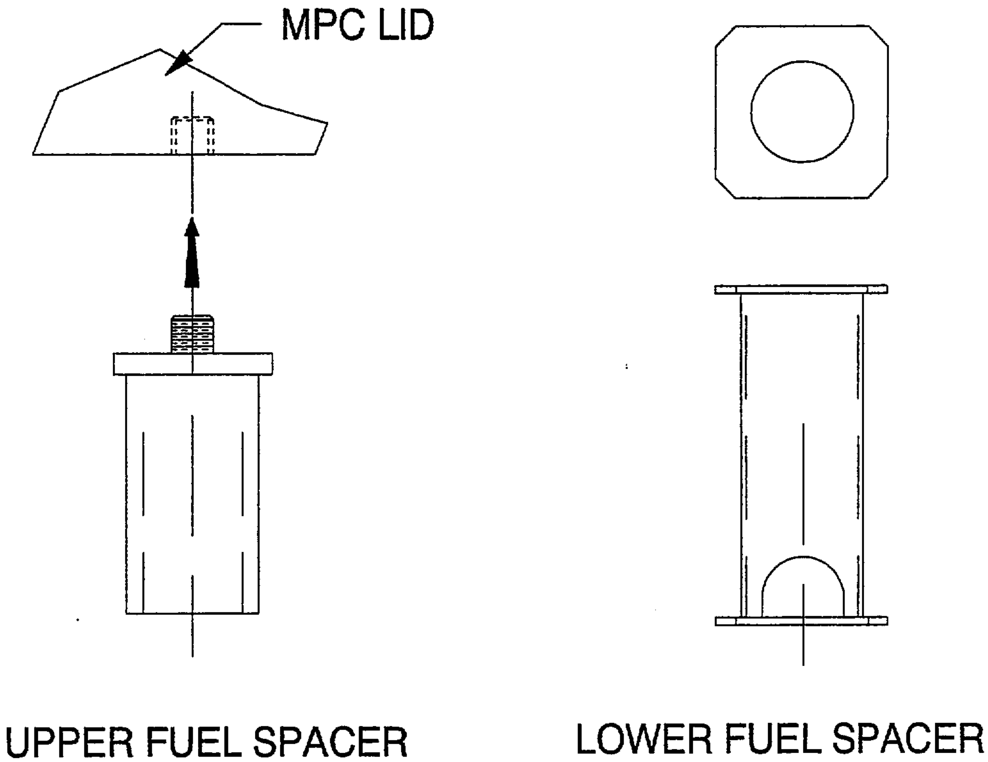


ANNULUS SEAL



ANNULUS SHIELD AND SEAL
SURFACE PROTECTOR

Figure 7.1.13; Annulus Shield/Annulus Seal Surface Protector



Note: Lengths are based on specific fuel assembly type to be stored.

Figure 7.1.14; Fuel Spacers

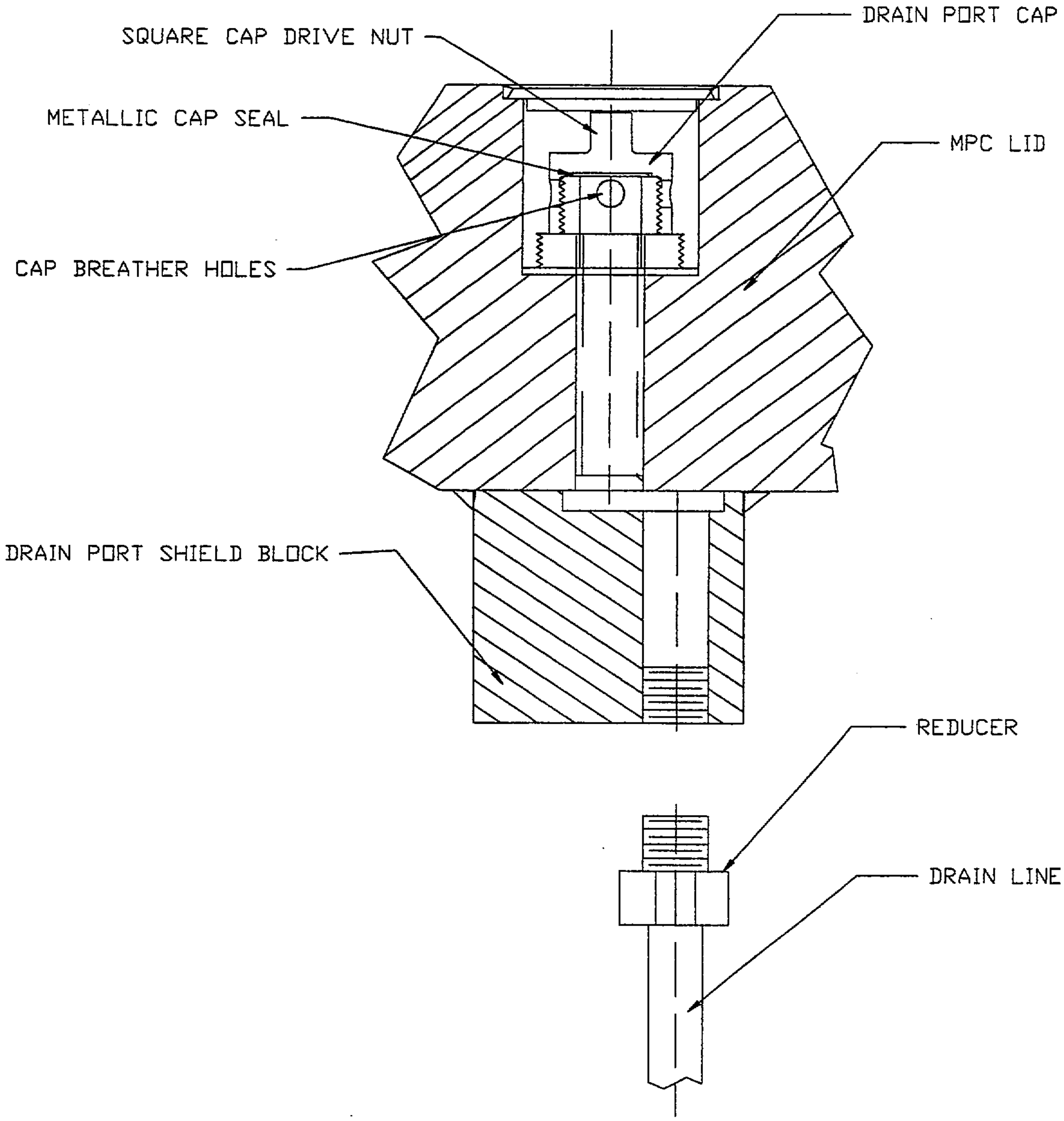


Figure 7.1.15; Drain Port Details

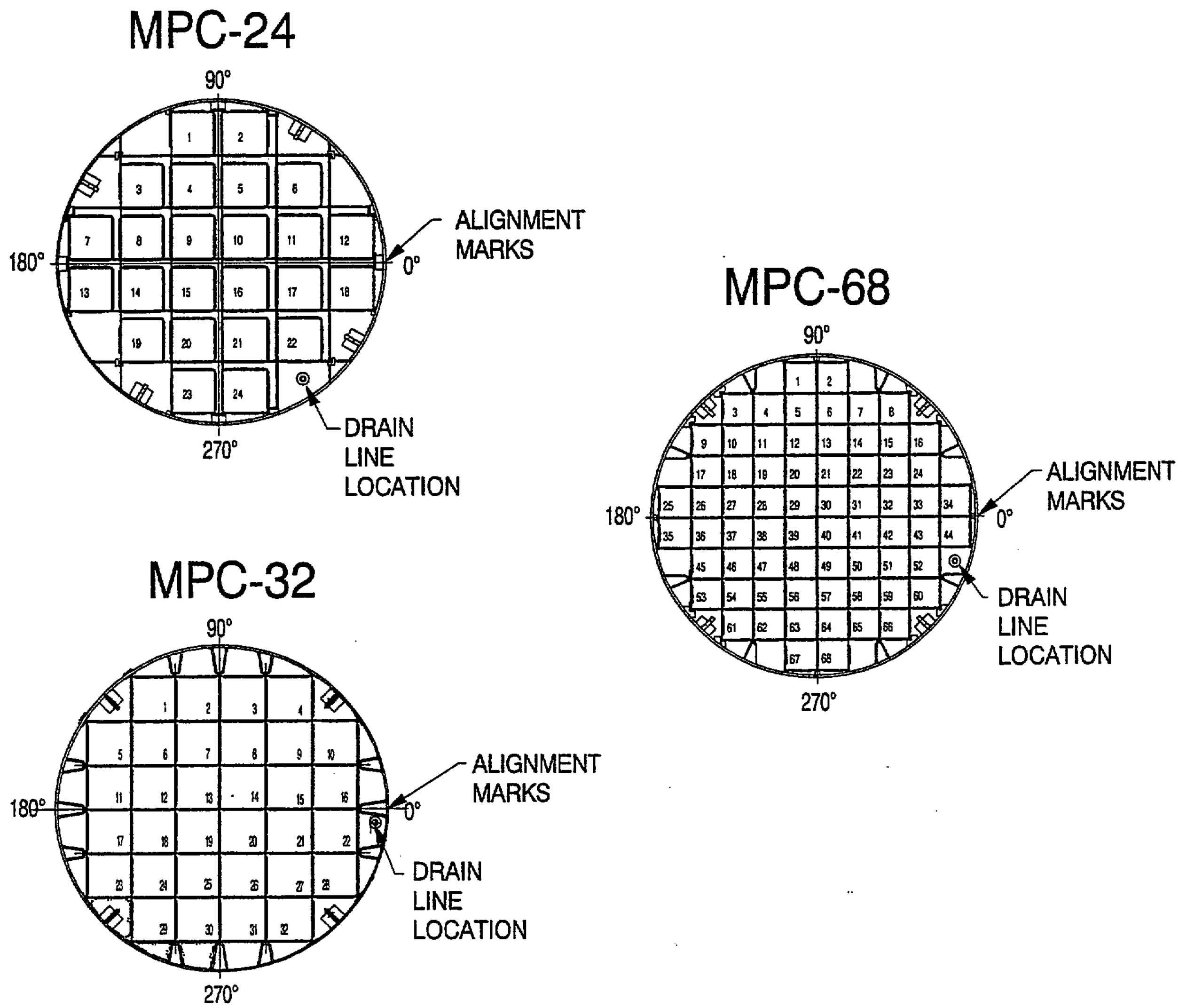


Figure 7.1.16; Drain Line Positioning

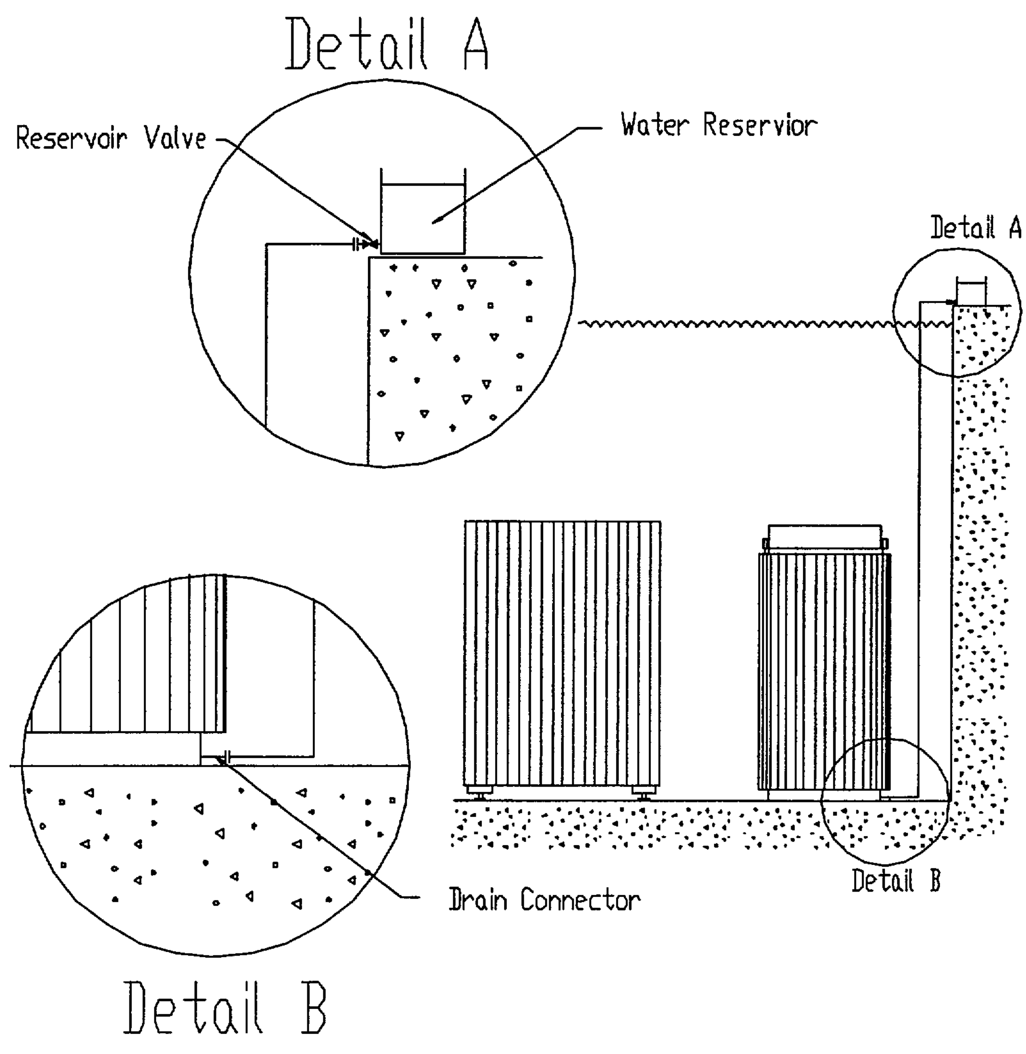


Figure 7.1.17; Annulus Overpressure System

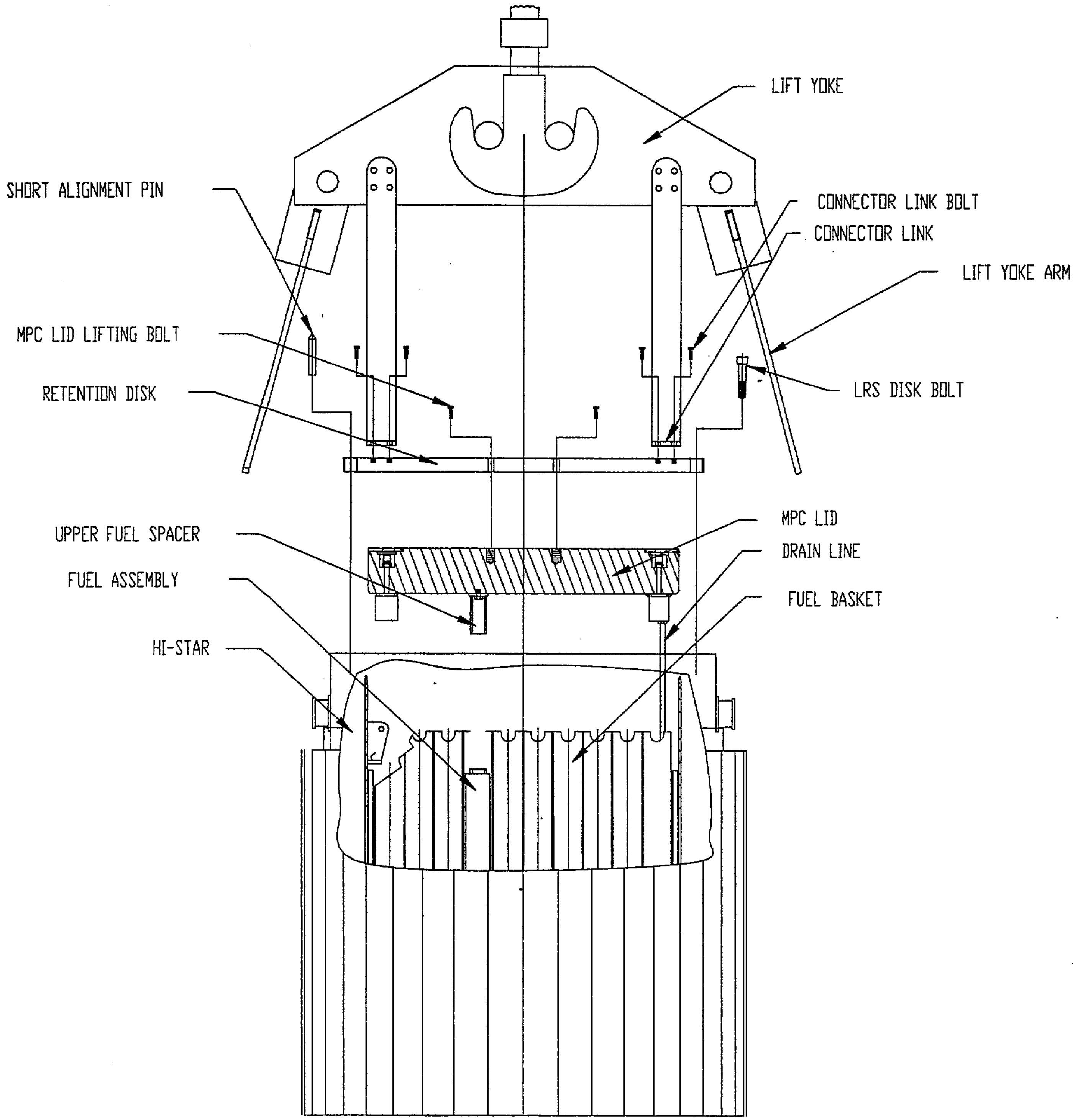


Figure 7.1.18; HI-STAR 100 Lid Retention System in Exploded View

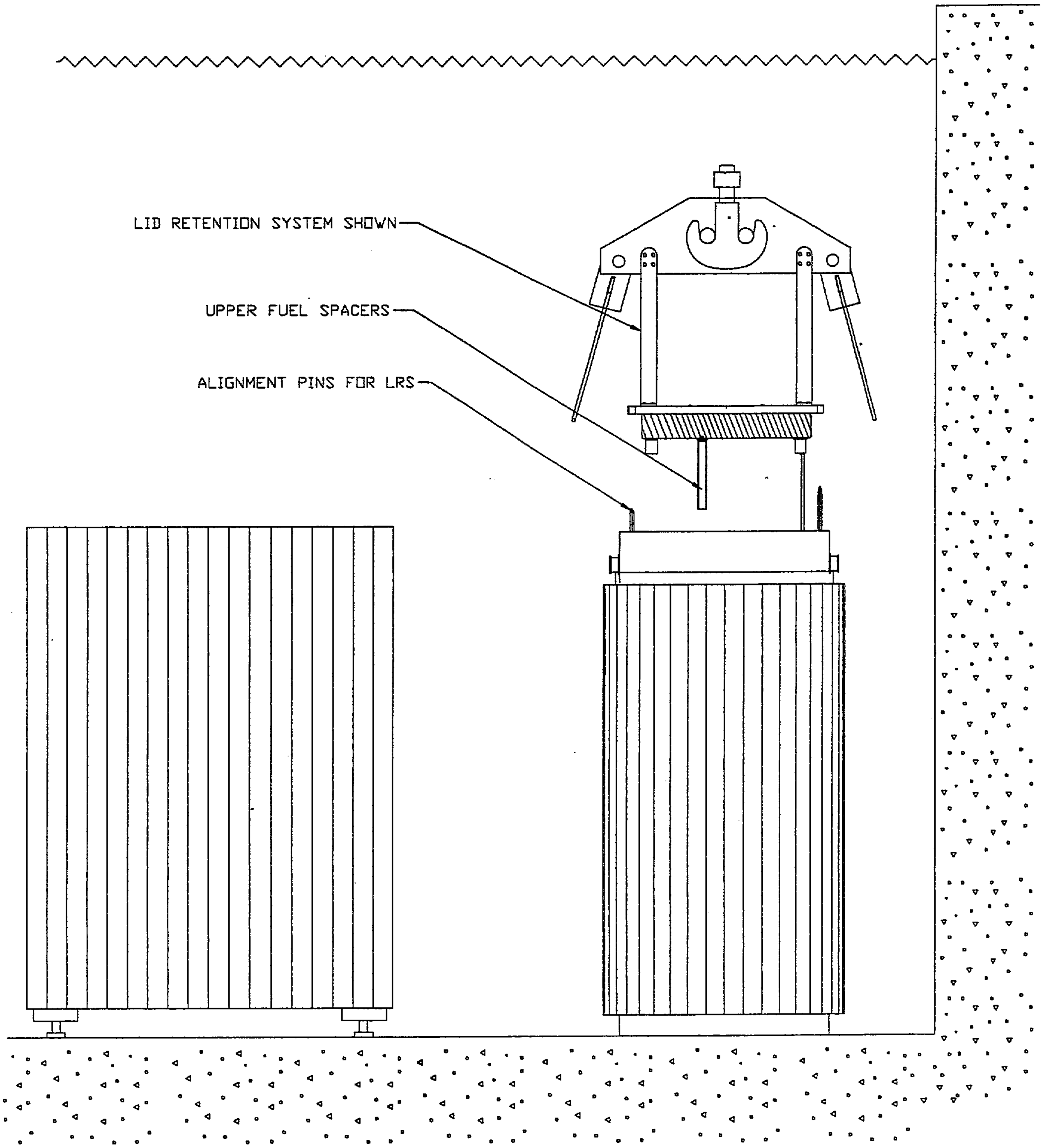


Figure 7.1.19; Drain Line Installation

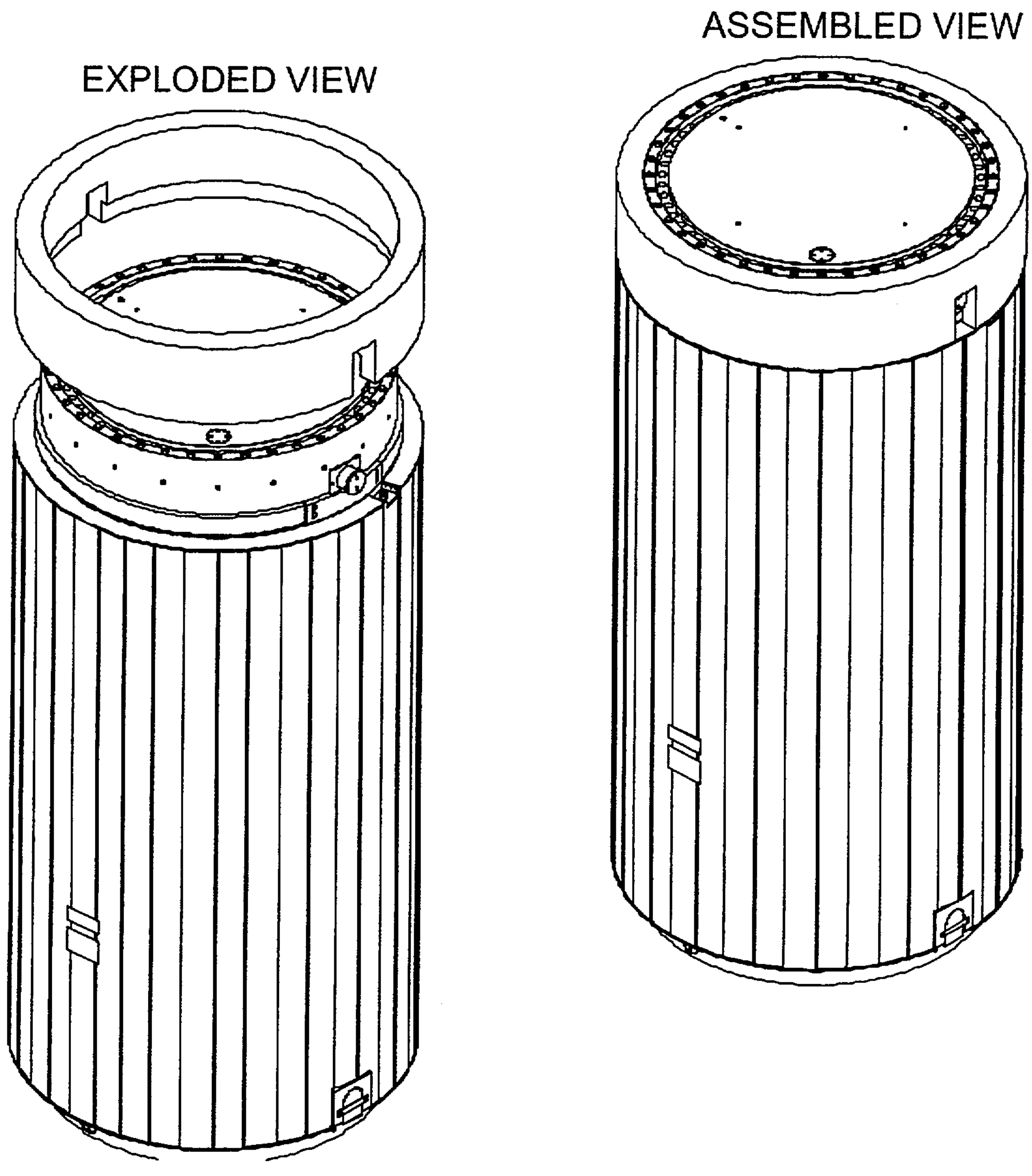


Figure 7.1.20; Temporary Shield Ring

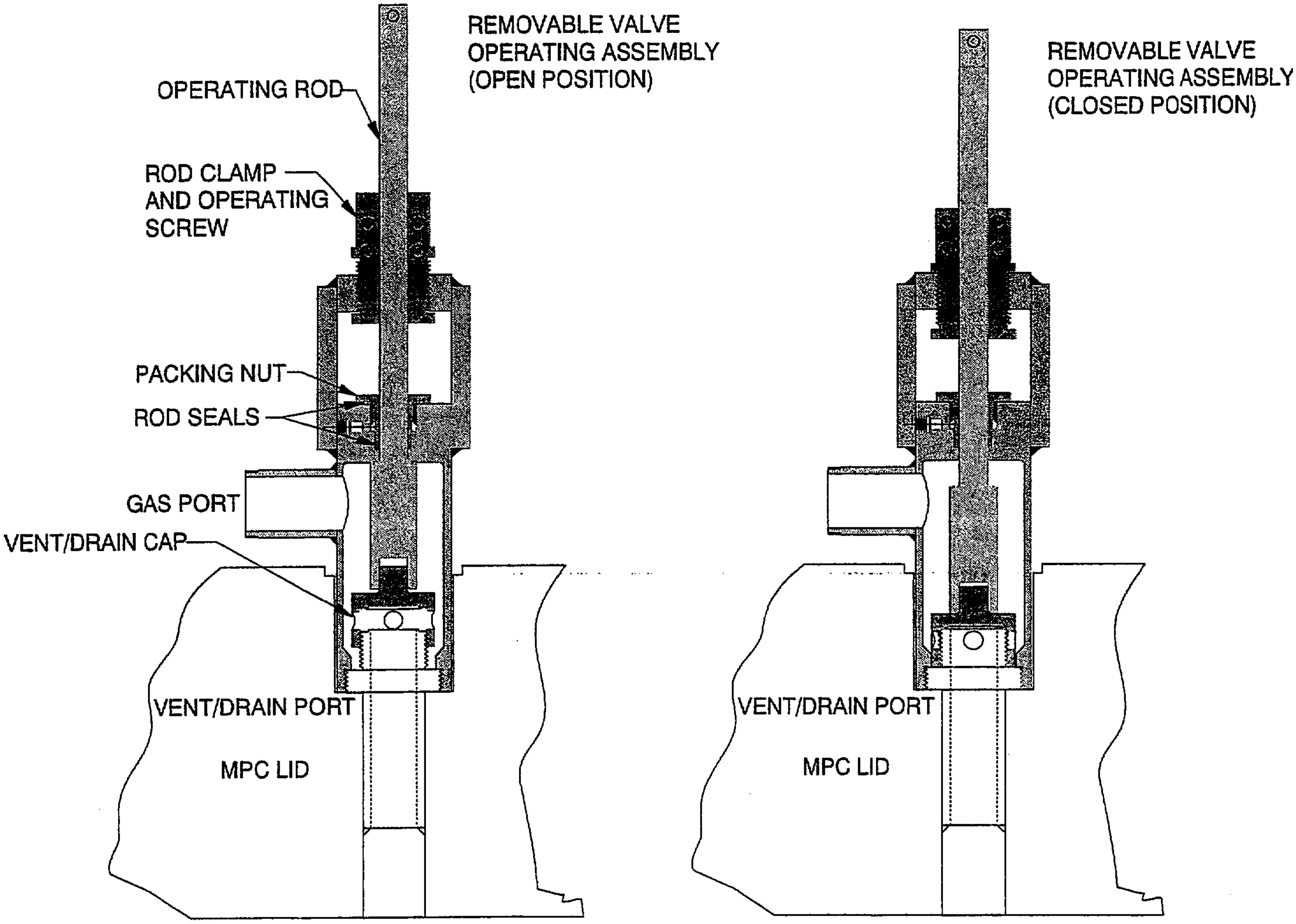


Figure 7.1.21; MPC Vent and Drain Port RVOA Connector

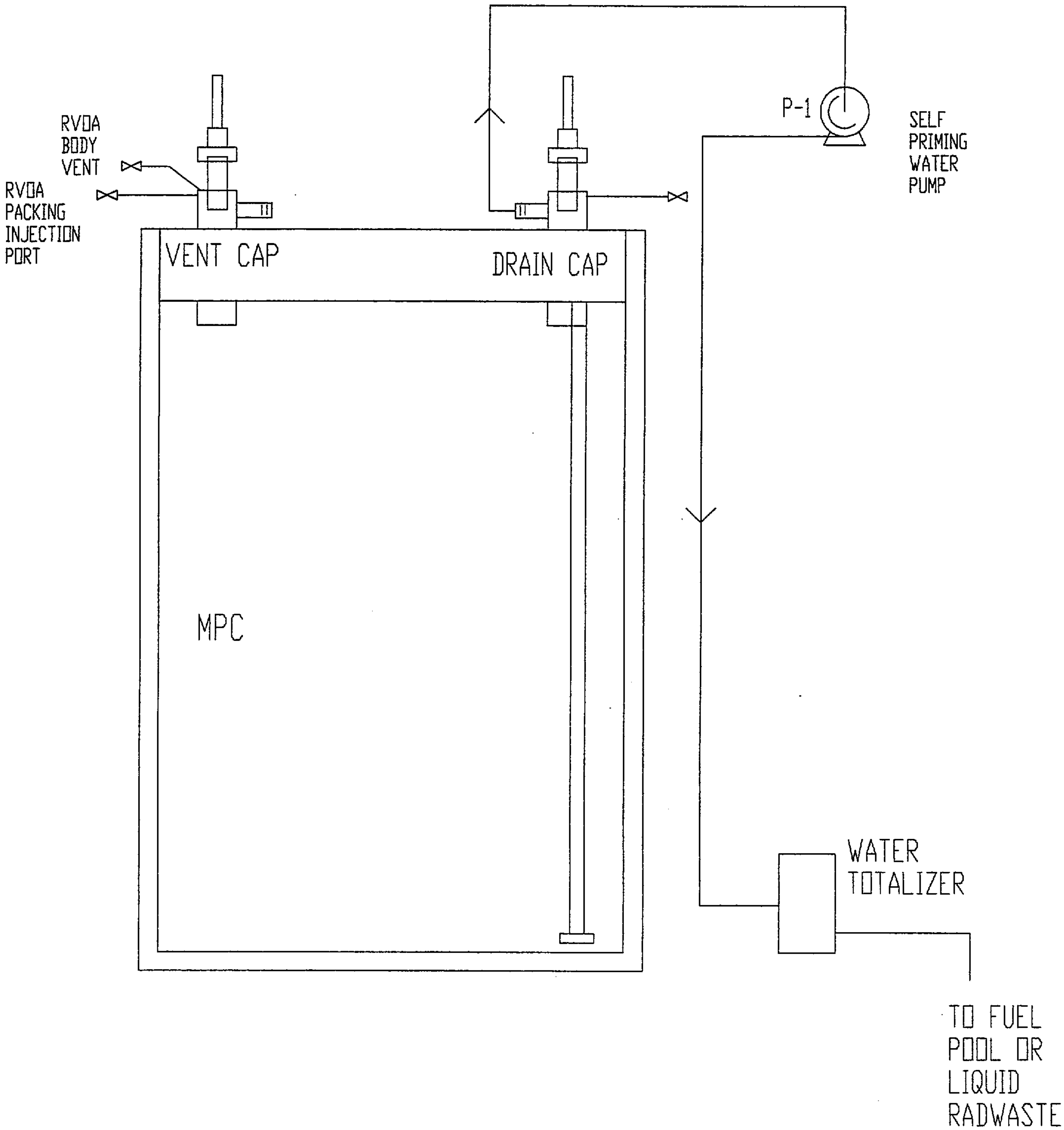


Figure 7.1.22; MPC Water Pump-Down for MPC Lid Welding Operations

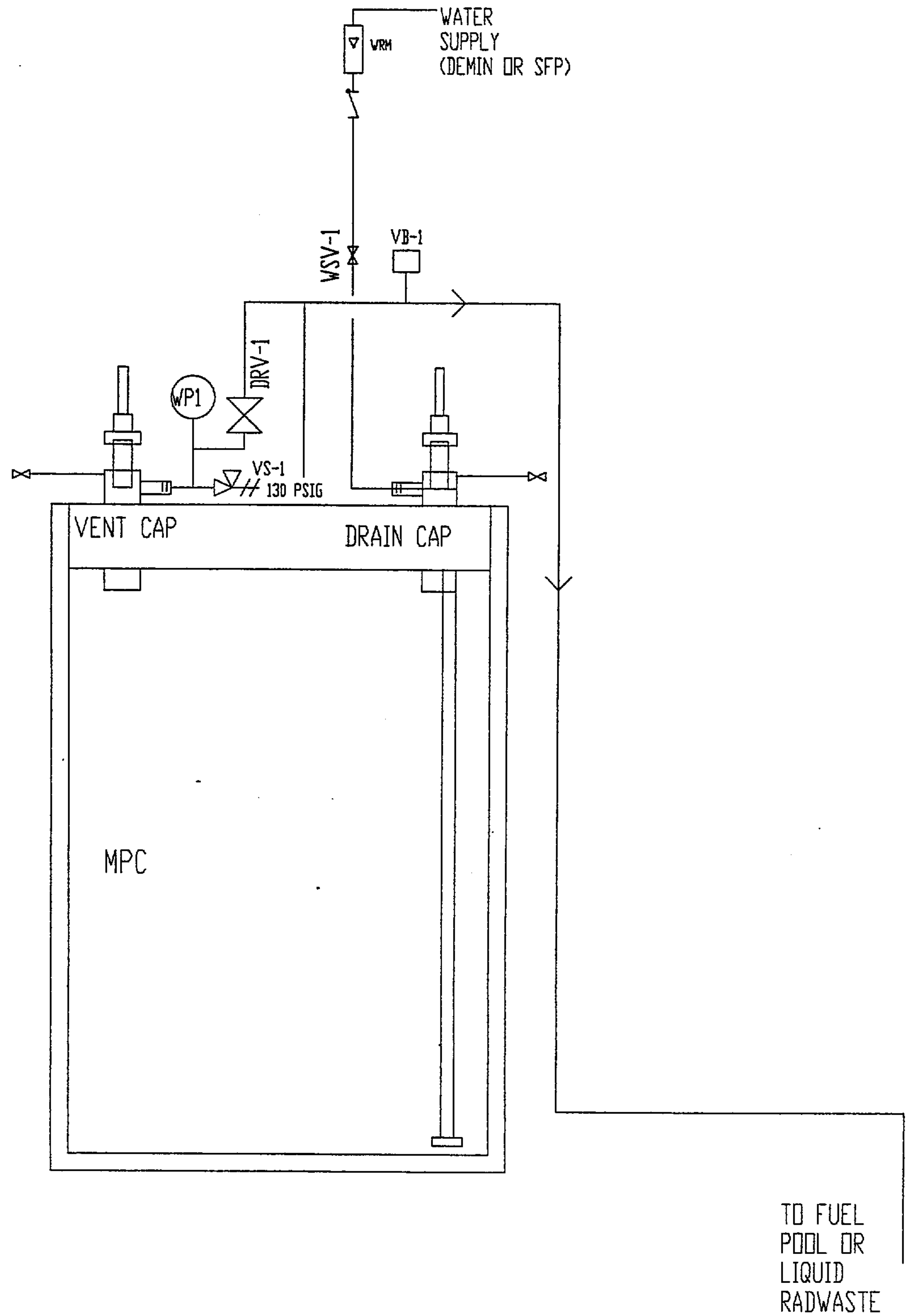


Figure 7.1.23; MPC Air Displacement and Hydrostatic Testing

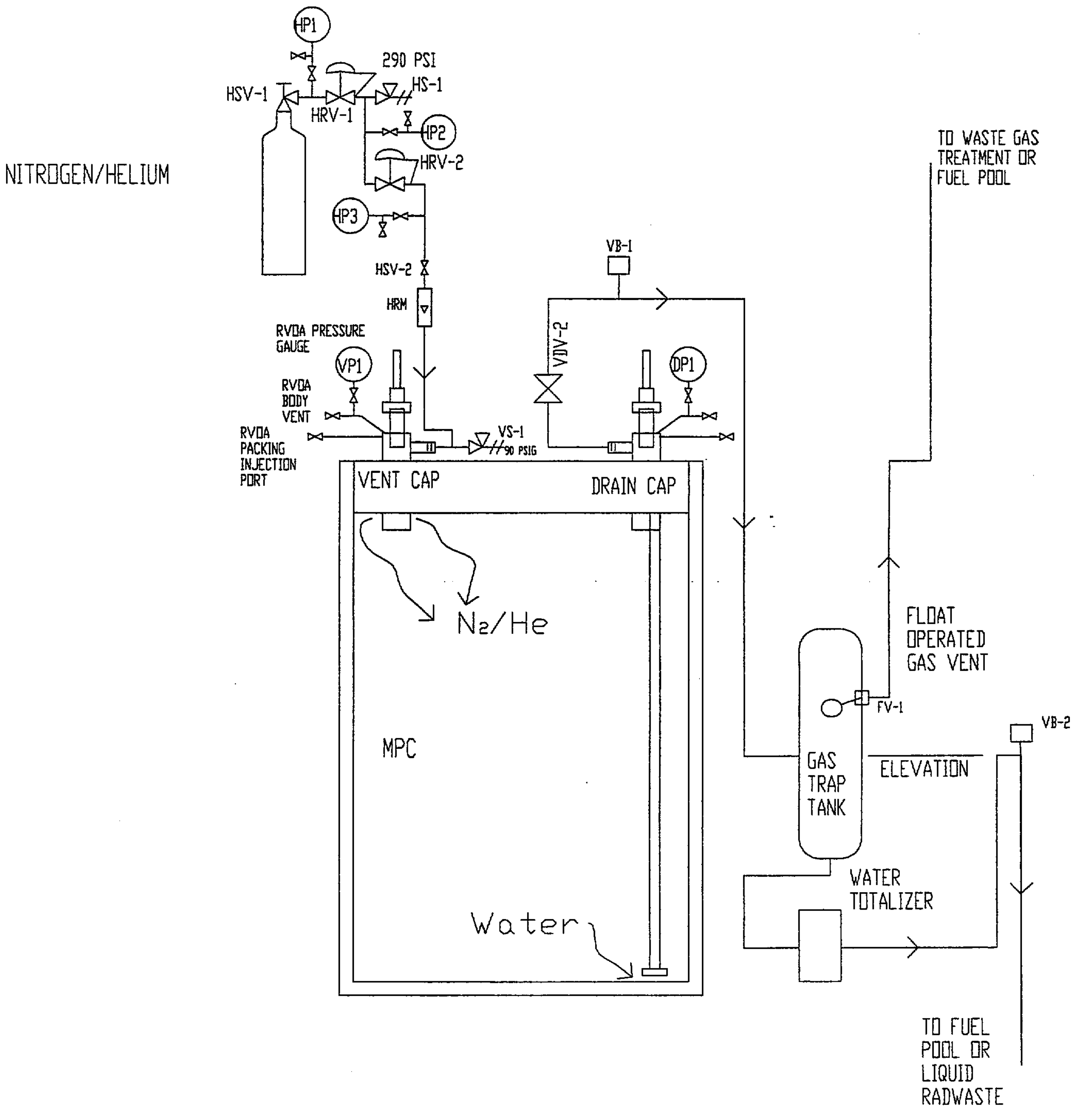


Figure 7.1.24; MPC Blowdown and Helium Injection for Leak Testing

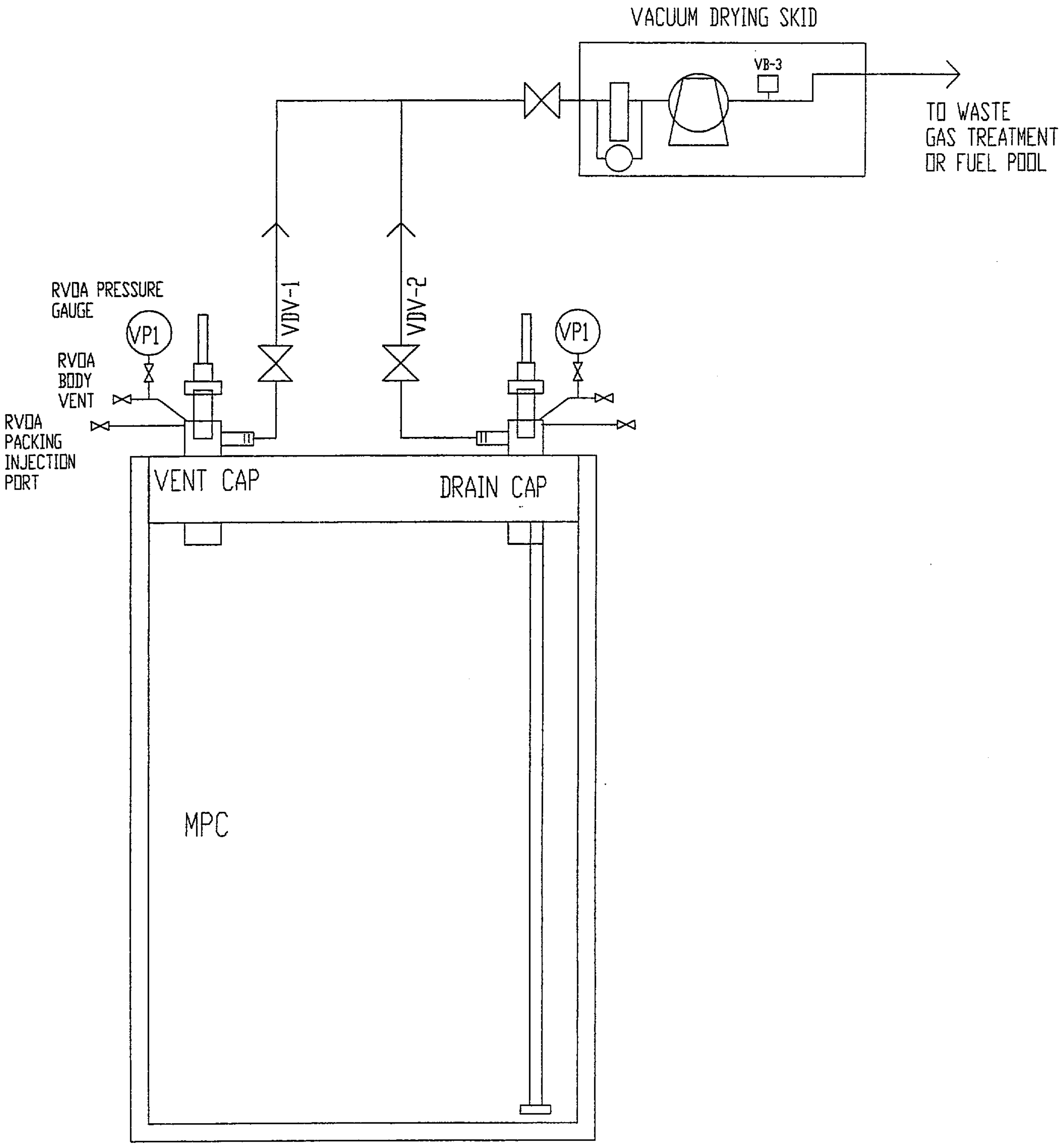


Figure 7.1.25; Vacuum Drying System

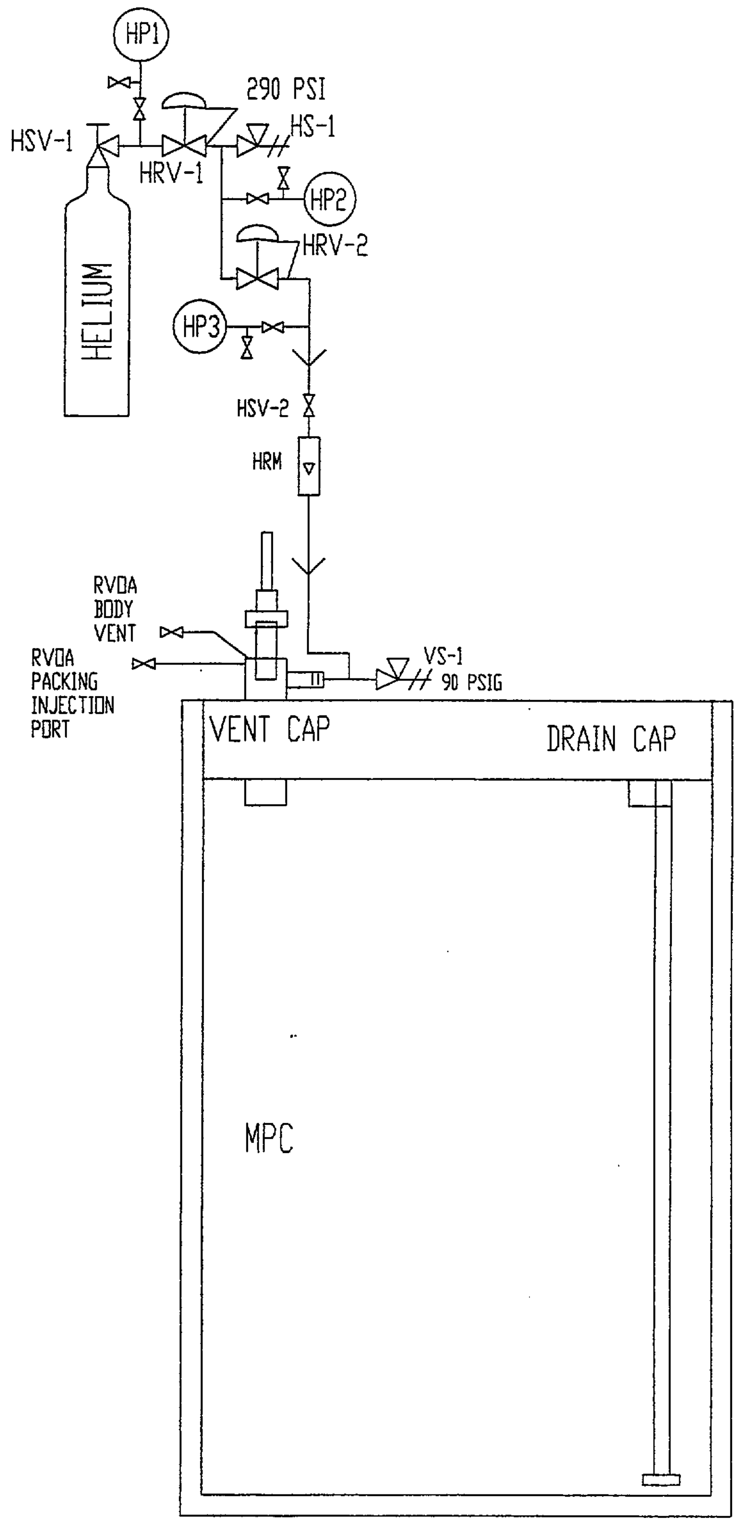


Figure 7.1.26; Helium Backfill System

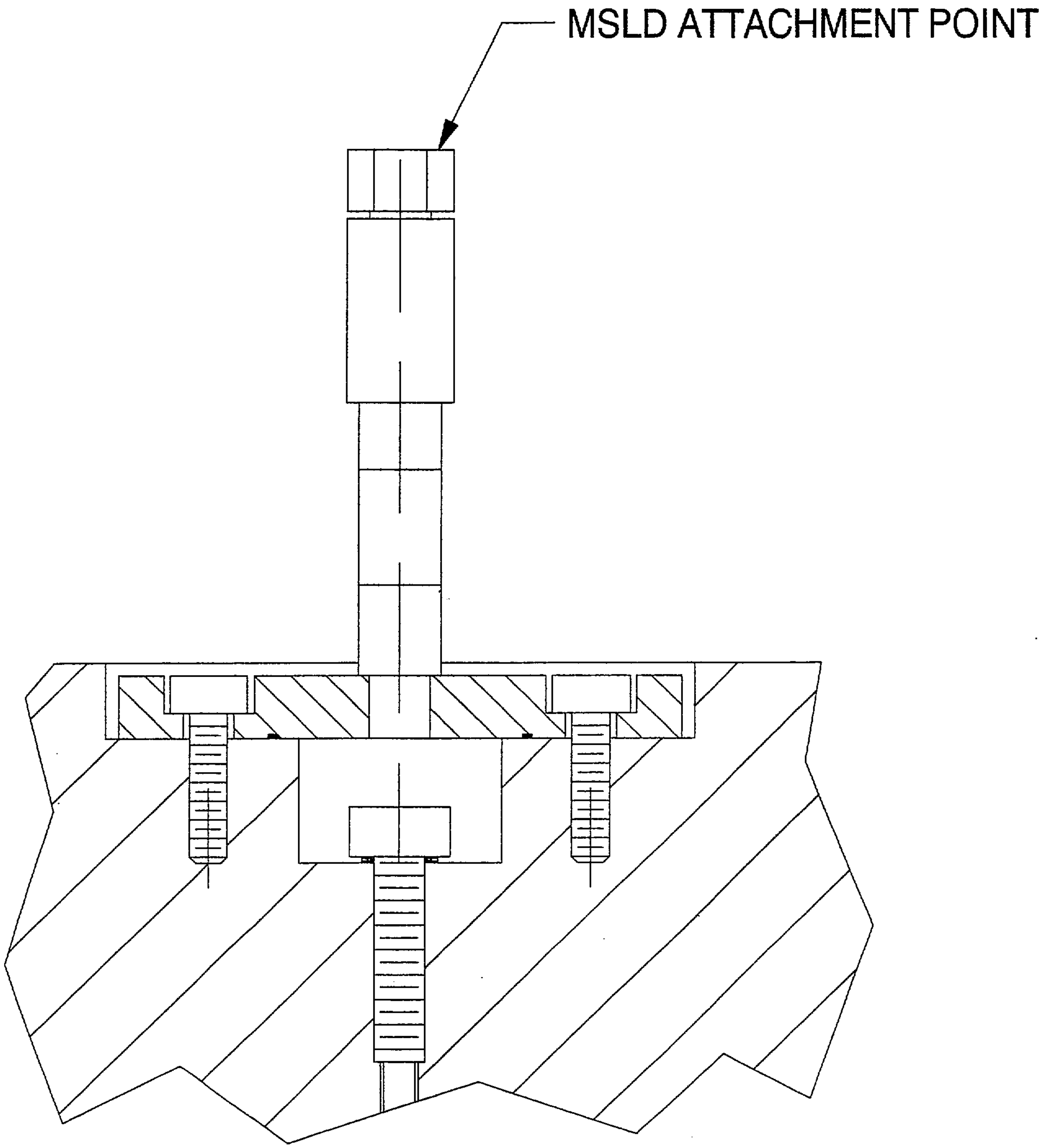


Figure 7.1.27; HI-STAR 100 Overpack Test Cover

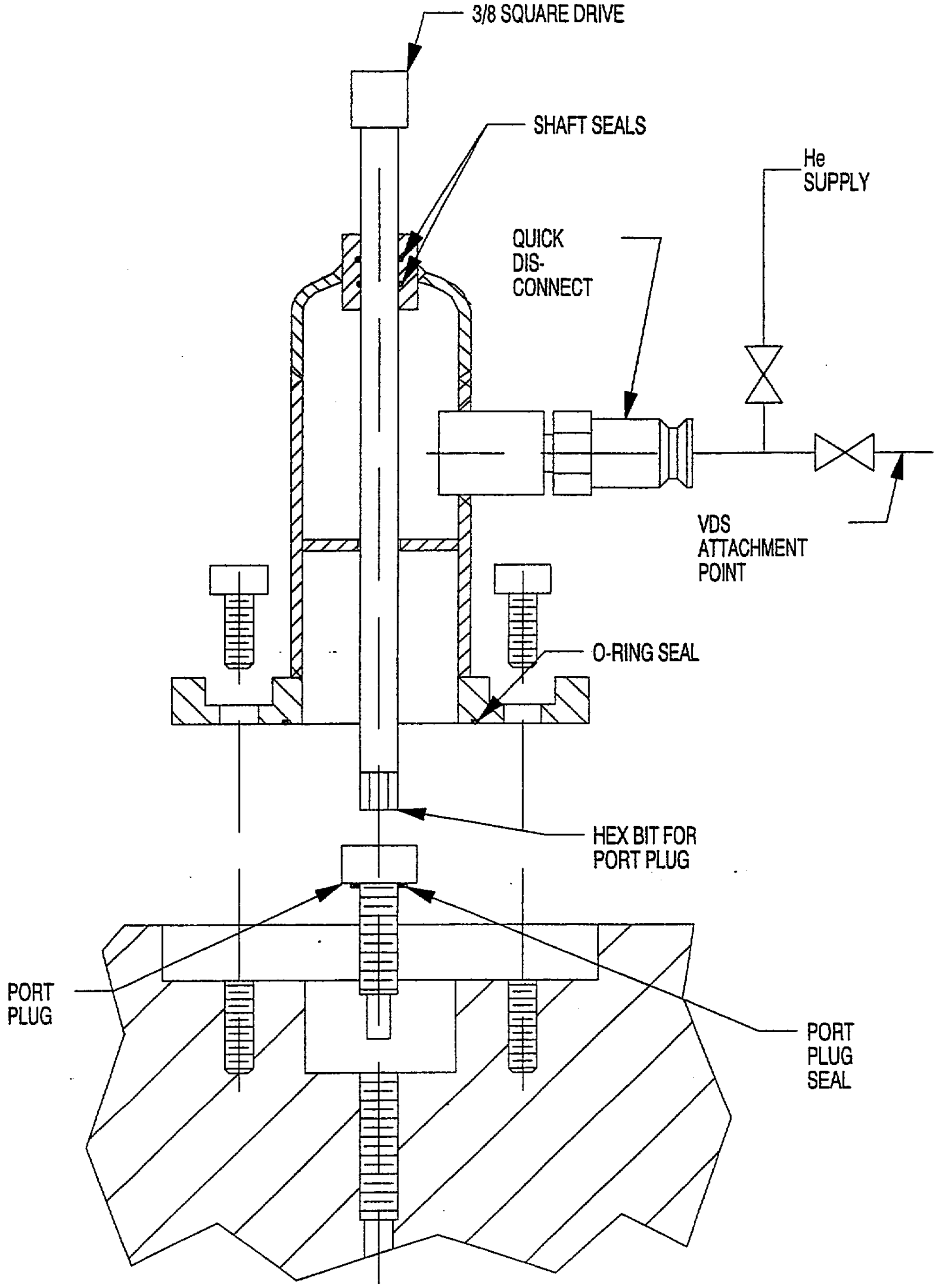


Figure 7.1.28; HI-STAR 100 Backfill Tool

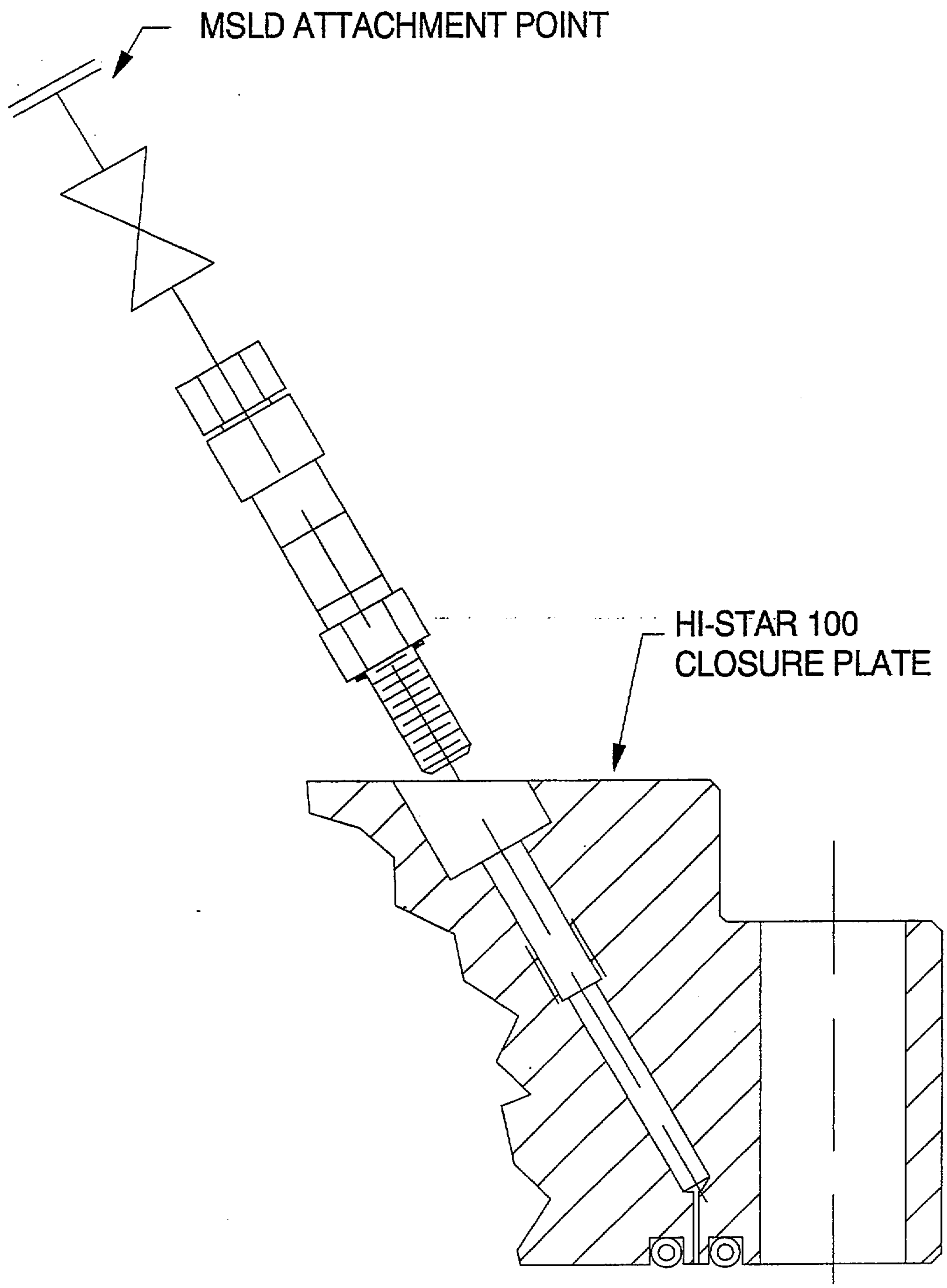


Figure 7.1.29; HI-STAR 100 Closure Plate Test Tool

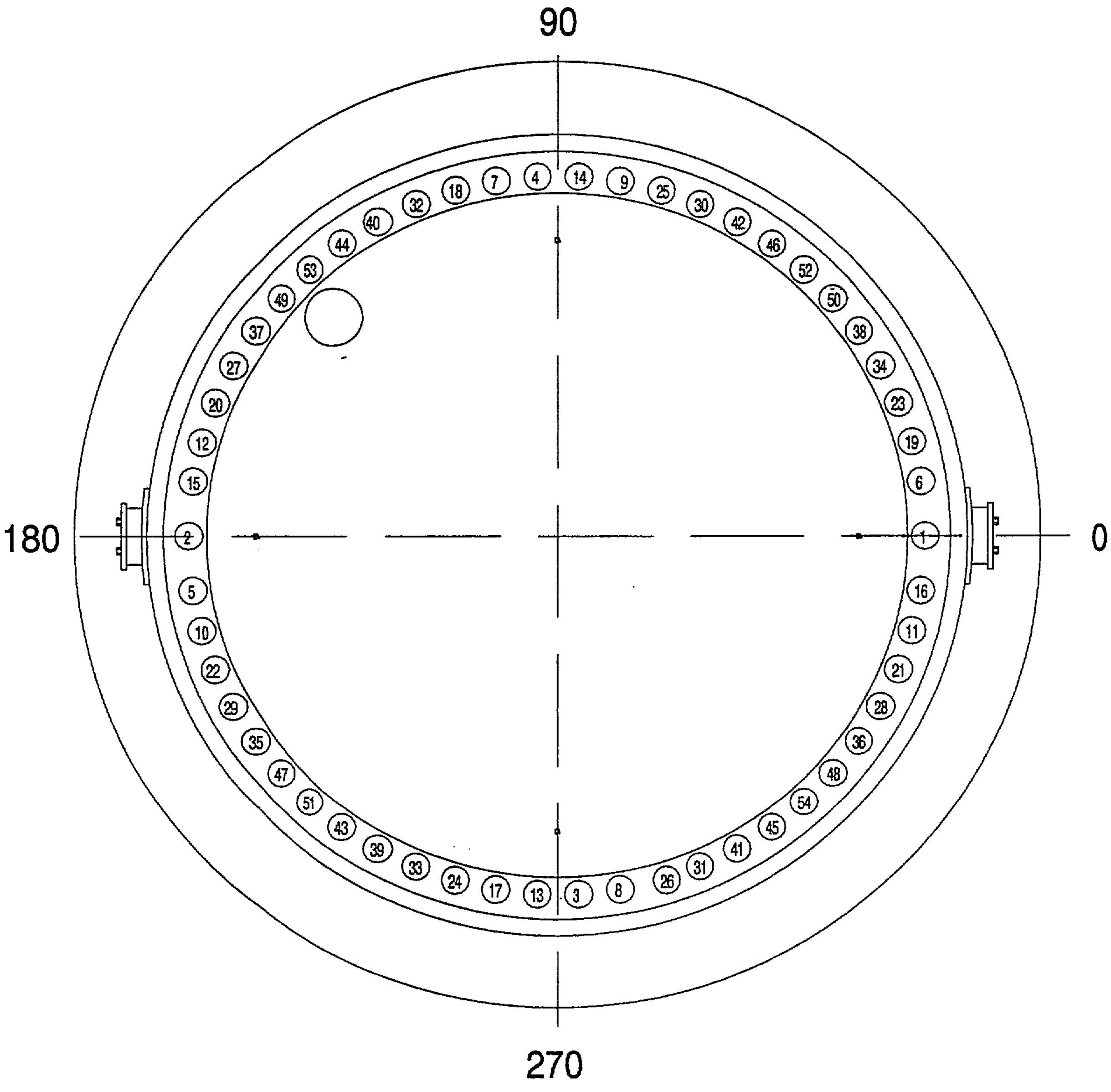


Figure 7.1.30; HI-STAR Closure Plate Bolt Torquing Pattern

7.2 PROCEDURE FOR UNLOADING THE HI-STAR 100 SYSTEM IN THE SPENT FUEL POOL

7.2.1 Overview of HI-STAR 100 System Unloading Operations

ALARA Note:
The procedure described below uses the Weld Removal System, a remotely operated system that mechanically removes the welds. Users may opt to remove some or all of the welds using hand operated equipment. The decision should be based on dose rates, accessibility, degree of weld removal, and available tooling and equipment.

The HI-STAR 100 System unloading procedures describe the general actions necessary to prepare the MPC for unloading, cool the stored fuel assemblies in the MPC, flood the MPC cavity, remove the lid welds, unload the spent fuel assemblies, and recover the HI-STAR 100 overpack and empty MPC. These procedures are only used to respond to extreme abnormal events. Special precautions are outlined to ensure personnel safety during the unloading operations, and to prevent the risk of MPC over-pressurization and thermal shock to the stored spent fuel assemblies. Figure 7.2.1 shows a flow diagram of the HI-STAR 100 overpack unloading operations. Figure 7.2.2 illustrates the major HI-STAR 100 overpack unloading operations.

Refer to the boxes of Figure 7.2.2 for the following description. The HI-STAR 100 overpack is received from the carrier, inspected and surveyed. The personnel barrier is removed and the impact limiters ~~and tie down~~ are removed. The HI-STAR 100 overpack is upended and returned to the fuel building (Box 1). The HI-STAR 100 overpack vent port cover plate is removed and a gas sample is drawn from the HI-STAR 100 overpack annulus to determine the condition of the MPC confinement boundary. The annulus is depressurized and the HI-STAR 100 overpack closure plate is removed (Box 2). The ~~T~~*t*emporary ~~S~~*s*hield ~~R~~*r*ing is installed on the HI-STAR 100 overpack upper section. The Temporary Shield Ring and annulus are filled with ~~plant demineralized~~*clean* water. The annulus shield is installed to protect the annulus from debris produced from the lid removal process. The MPC closure ring above the vent and drain ports and the vent and drain port cover plates are core-drilled and removed to access the vent and drain ports. (Box 3). The design of the vent and drain ports use metal-to-metal seals that prevent rapid decompression of the MPC and subsequent spread of contamination during unloading. The vent RVOA is attached to the vent port and an evacuated sample bottle is connected. The vent port is slightly opened to allow the sample bottle to obtain a gas sample from inside the MPC. A gas sample is performed to assess the condition of the fuel assembly cladding. *If necessary,* ~~T~~*t*he MPC is cooled using a closed-loop heat exchanger to reduce the MPC internal temperature to allow water flooding (Box 4). The cool-down process gradually reduces the cladding temperature to a point where the MPC may be flooded with water without thermally shocking the fuel assemblies or over-pressurizing the MPC from the formation of steam. Following the fuel cool-down, the MPC is filled with water at a specified rate (Box 5). The Weld Removal System then removes the MPC lid to MPC shell weld. The Weld Removal System is removed with the MPC lid left in place (Box 6).

The top surfaces of the HI-STAR 100 overpack and MPC are cleared of metal shavings. The inflatable annulus seal is installed and pressurized. The MPC lid is rigged to the lift yoke or lid retention system and the lift yoke is engaged to the HI-STAR 100 overpack lifting trunnions. The HI-STAR 100 overpack is placed in the spent fuel pool and the MPC lid is removed (Box 7). All fuel assemblies are returned to the spent fuel storage racks and the MPC fuel cells are vacuumed to remove any assembly debris and crud (Box 8). The HI-STAR 100 overpack and MPC are returned to the designated preparation area (Box 9) where the MPC water is pumped back into the spent fuel pool, liquid radwaste system or other approved location. The annulus water is drained and the MPC and overpack are decontaminated (Box 10 and 11).

7.2.2 HI-STAR 100 Overpack Packaging Receipt

1. Recover the shipping documentation from the carrier along with the keys to the personnel barrier locks.

2. Remove the personnel barrier (See Figure 7.1.9) and perform a partial visual inspection of the HI-STAR 100 overpack to verify that there are no outward visual indications of impaired physical conditions. Identify any significant indications to the cognizant individual for evaluation and resolution.

ALARA Warning:
Dose rates around the unshielded bottom end of the HI-STAR 100 overpack may be higher that other locations around the overpack. Workers should exercise appropriate ALARA controls when working around the bottom end of the HI-STAR 100 overpack.

3. If necessary, remove the overpack from the transport vehicle. See Figure 7.1.5.

~~3.~~*4.* Remove the impact limiters as follows:

a. Record the impact limiter security seal serial numbers and verify that they match the corresponding shipping documentation, as applicable.

b. Clip the security seal wires and remove the security seals and wires.

c. Attach the impact limiter handling frame as shown on Figure 7.1.10.

Caution:
The slings should be preloaded to the impact limiter weight plus the weight of the impact limiter handling frame prior to removal of the impact limiter bolts. (See Table 7.1.1) This will prevent movement of the impact limiter and damage to the bolts from excessive lift pressure during bolt removal.

d. Using the load cell, apply the correct lift load. See Table 7.1.1.

e. Remove the bolts securing the impact limiter to the overpack. See Figure 7.1.11.

f. Remove the impact limiter and store the impact limiter in a site-approved location.

g. Repeat Steps 3.c. through 3.f. for the other impact limiter.

~~4.~~*5.* Complete the HI-STAR 100 overpack visual inspection to verify that there are no outward visual indications of impaired physical conditions. Identify any significant indications to the cognizant individual for evaluation and resolution.

> **Note:**
> On receipt of the loaded or empty HI-STAR 100 packaging, the accessible external surfaces of the HI-STAR 100 packaging (HI-STAR 100 overpack, impact limiters, personnel barrier, tie-down, transport frame and transport vehicle) shall be surveyed for removable radiological contamination and show less than 2200 dpm/100 cm^2 from beta and gamma emitting sources, and 220 dpm/100 cm^2 from alpha emitting sources.

~~5.~~*6.* Perform a radiation survey and removable contamination survey. Record the results on the shipping documentation.

~~6.~~*7.* Verify that the HI-STAR 100 overpack neutron shield rupture discs are installed and intact. Identify any non-conformances to the cognizant individual for evaluation and resolution.

~~7.~~*8.* If necessary, upend the HI-STAR 100 overpack in accordance with Section 7.1.2.

~~8.~~*9.* Transfer the HI-STAR 100 overpack to the fuel building.

~~9.~~*10.* Remove the buttress plate. See Figure 7.1.11 and 7.1.12.

~~10.~~*11.* Place the HI-STAR 100 overpack in the designated preparation area.

7.2.3 <u>Preparation for Unloading</u>

> **ALARA Warning:**
> Gas sampling is performed to assess the condition of the MPC confinement boundary. If a leak is discovered in the MPC boundary, the user's Radiation Control organization may require special actions to vent the HI-STAR 100.

1. Perform annulus gas sampling as follows:

   a. Remove the overpack vent port cover plate and attach the backfill tool with a sample bottle attached. See Figure 7.2.3. Store the cover plate in a site-approved location.

   b. Using a vacuum pump, evacuate the sample bottle and backfill tool.

   c. Slowly open the vent port plug and gather a gas sample from the annulus. Reinstall the HI-STAR 100 overpack vent port plug.

d. Evaluate the gas sample and determine the condition of the MPC confinement boundary.

2. If the confinement boundary is intact (i.e., no radioactive gas is measured) then vent the overpack annulus by removing the overpack vent port seal plug (using the backfill tool). Otherwise vent the annulus gas in accordance with instructions from Radiation Protection.

3. Remove the closure plate bolts. See Table 7.1.3 for de-torquing requirements. Store the closure plate bolts in a site-approved location.

4. Remove the overpack closure plate. See Figure 7.1.12 for rigging. Store the closure plate on cribbing to protect the seal seating surfaces.

5. Install the HI-STAR 100 overpack Seal Surface Protector (See Figure 7.1.13).

Warning:
Annulus fill water may flash to steam due to high MPC shell temperatures. Water addition should be performed in a slow and controlled manner.

6. Remove the HI-STAR 100 overpack drain port cover and port plug and install the drain connector. Store the drain port cover plate and port plug in an approved storage location.

7. Slowly fill the annulus area with ~~plant-demineralized~~*clean* water to approximately 4 inches below the top of the MPC shell and install the annulus shield. The annulus shield reduces the dose around the annulus area and prevents debris from entering the annulus during MPC lid weld removal operations. See Figure 7.1.13.

8. Remove the MPC closure welds as follows:

ALARA Note:
The following procedures describe weld removal using the Weld Removal System. The Weld Removal System removes the welds with a high speed machine tool head. A vacuum head is attached to remove a majority of the metal shavings. Other methods of opening the MPC are acceptable.

ALARA Warning:
Weld removal may create an airborne radiation condition. Weld removal must be performed under the direction of the user's Radiation Protection organization.

a. Install bolt plugs and/or waterproof tape on the closure plate bolt holes.

b. Install the Weld Removal System on the MPC lid and core drill through the closure ring and vent and drain port cover plate welds.

9. Access the vent and drain ports.

~~a.~~

10. Remove ~~the vent port cover plate weld and remove the vent port cover plate.~~*metal shavings from around the vent and drain ports.*

ALARA Note:
The MPC vent and drain ports are equipped with metal-to-metal seals to minimize leakage and withstand the long-term effects of temperature and radiation. The vent and drain port design prevents the need to hot tap into the penetrations during unloading operation and eliminate the risk of a pressurized release of gas from the MPC.

11. Take an MPC gas sample as follows:

    a. Attach the RVOA to the vent port (See Figure 7.1.21).

    b. Attach a sample bottle to the vent port RVOA as shown on Figure 7.2.4.

    c. Using the Vacuum Drying System, evacuate the RVOA and Sample Bottle.

    d. Slowly open the vent port cap using the RVOA and gather a gas sample from the MPC internal atmosphere.

    e. Close the vent port ~~cap~~ and disconnect the sample bottle.

ALARA Note:
The gas sample analysis is performed to determine the condition of the fuel cladding in the MPC. The gas sample may indicate that fuel with damaged cladding is present in the MPC. The results of the gas sample test may affect personnel protection and how the gas is processed during MPC depressurization.

    f. Turn the sample bottle over to the site's Radiation Protection or Chemistry Department for analysis.

    g. Install the RVOA in the drain port.

12. Perform Fuel Assembly Cool-Down, *if necessary, and MPC re-flooding* as follows:

    a. *Ensure that MPC cavity gas temperature is less than 200°F using the appropriate cooldown means a determined by a thermal evaluation. This may require no action, cooling to the exterior of the canister, or use of the helium cooldown system, based on the decay heat of contents of the MPC at the time of unloading.*

~~b. Verify that the helium gas pressure regulator is set to less than 100 psig.~~

~~c. Open the helium gas supply valve to purge the gas lines of air.~~

~~**Note:**~~
~~The coolant flow direction is into the drain port and out of the vent port.~~

~~d. Confirm the heat exchanger coolant flow direction.~~

~~e.If necessary, slowly open the helium supply valve and increase the Cool Down System pressure to MPC pressure. Close the helium supply valve.~~

~~f.Start the gas coolers.~~

~~g.Open the vent and drain port caps using the RVOAs.~~

b. *Deleted.*~~Start the blower and monitor the gas exit temperature. Continue the fuel cool-down operations until the gas exit temperature is ≤ 200° F. These conditions shall be met prior to initiation of MPC re-flooding operations.~~

Note:
If auxiliary cooling of the MPC was used to bring the internal temperature below 200 °F, ~~W~~*w*ater filling should commence immediately after the completion of fuel cool-down operations to minimize prevent fuel assembly heat-up. Prepare the water fill and vent lines in advance of water filling.

~~i.Prepare the MPC fill and vent lines as shown on Figure 7.1.23. Route the vent port line several feet below the spent fuel pool surface or to the radwaste gas facility. Turn off the blower and disconnect the gas lines to the vent and drain port RVOAs. Attach the vent line to the MPC vent port and slowly open the vent line valve to depressurize the MPC.~~

~~j.~~*c.* Attach the water fill line to the MPC ~~drain port~~ and slowly open the water supply valve and establish a pressure less than 90 psi. Fill the MPC until bubbling from the vent line has terminated. Close the water supply valve on completion.

~~k.~~*d.* Disconnect both lines from the drain and vent ports leaving the drain port cap open to allow for thermal expansion of the water during MPC lid weld removal.

~~l.~~*e.* Remove the closure ring-to-MPC shell weld and the MPC lid-to-shell weld using the Weld Removal System and remove the Weld Removal System. See Figure 7.1.12 for rigging.

~~m.~~*f.* ~~Vacuum~~ *Clean* the top surfaces of the MPC and the HI-STAR 100 overpack to remove any metal shavings.

13. Install the inflatable annulus seal as follows:

Caution:
Do not use any sharp tools or instruments to install the inflatable seal.

a. Remove the annulus shield.

b. Manually insert the inflatable seal around the MPC. See Figure 7.1.13.

c. Ensure that the seal is uniformly positioned in the annulus area.

d. Inflate the seal between 30 and 35 psig or as directed by the manufacturer.

e. Visually inspect the seal to ensure that it is properly seated in the annulus. Deflate, adjust and inflate the seal as necessary.

14. Place HI-STAR 100 overpack in the spent fuel pool as follows:

a. Engage the lift yoke to the HI-STAR 100 overpack lifting trunnions, remove the MPC lid lifting threaded inserts and attach the MPC lid slings or Lid Retention System to the MPC lid.

b. If the Lid Retention System is used, inspect the lid bolts for general condition. Replace worn or damaged bolts with new bolts.

c. Install the Lid Retention System bolts if the Lid Retention System is used.

ALARA Note:
The Annulus Overpressure System is used to provide additional protection against MPC external shell contamination during in-pool operations. The Annulus Overpressure System is equipped with double locking quick disconnects to prevent inadvertent draining. The reservoir valve must be closed to ensure that the annulus is not inadvertently drained through the Annulus Overpressure System when the cask is raised above the level of the annulus reservoir.

d. If used, fill the Annulus Overpressure System lines and reservoir with demineralized water and close the reservoir valve. Attach the Annulus Overpressure System to the HI-STAR 100 overpack. ~~via the quick disconnect.~~ See Figure 7.1.17.

Warning:
Cask placement in the spent fuel pool is the heaviest lift that occurs during the HI-STAR 100 unloading operations. The HI-STAR 100 trunnions must not be subjected to lifted loads in excess of 250,000 lbs. Users must ensure that plant-specific lifting equipment is qualified to lift the expected load. Users may elect to pump a measured quantity of water from the MPC prior to placement of the HI-STAR 100 in the spent fuel pool. See Table 7.1.1 and 7.1.2 for weight information.

e. Position the HI-STAR 100 overpack over the cask loading area. ~~with the basket aligned to the orientation of the spent fuel racks.~~

ALARA Note:
Wetting the components that enter the spent fuel pool may reduce the amount of decontamination work to be performed later.

f. Wet the surfaces of the HI-STAR 100 overpack and lift yoke with plant demineralized water while slowly lowering the HI-STAR 100 overpack into the spent fuel pool.

g. When the top of the HI-STAR 100 overpack reaches the approximate elevation of the reservoir, ~~open~~ *start* the Annulus Overpressure System ~~reservoir valve~~ *water flow*. Maintain the reservoir water level at approximately 3/4 full the entire time the cask is in the spent fuel pool.

h. If the Lid Retention System is used, remove the lid retention bolts when the top of the HI-STAR 100 overpack is accessible from the operating floor.

i. Place the HI-STAR 100 overpack on the floor of the cask loading area and disengage the lift yoke. Visually verify that the lift yoke is fully disengaged.

Note:
An underwater camera or other suitable viewing device may be used for monitoring the underwater operations.

j. Apply slight tension to the lift yoke and visually verify proper disengagement of the lift yoke from the trunnions.

k. Remove the lift yoke, MPC lid and drain line from the pool in accordance with directions from the site's Radiation Protection personnel. Spray the equipment with ~~demineralized~~ *clean* water as ~~they are~~ *it is* removed from the pool.

Warning:
The MPC lid and unloaded MPC may contain residual contamination. All work done on the unloaded MPC should be carefully monitored and performed.

l. Disconnect the drain line from the MPC lid.

m. Store the MPC lid components in an approved location. Disengage the lift yoke from MPC lid. Remove any upper fuel spacers using the same process as was used in the installation.

n. Disconnect the Lid Retention System if used.

7.2.4 MPC Unloading

1. Remove the spent fuel assemblies from the MPC using applicable site procedures.

2. ~~Vacuum~~ *Clean* the cells of the MPC to remove any debris or corrosion products.

3. Inspect the open cells for presence of any remaining items. Remove them as appropriate.

7.2.5 Post-Unloading Operations

1. Remove the HI-STAR 100 overpack and the unloaded MPC from the spent fuel pool as follows:

    a. Engage the lift yoke to the top trunnions.

b. Apply slight tension to the lift yoke and visually verify proper engagement of the lift yoke to the trunnions.

c. Raise the HI-STAR 100 overpack until the HI-STAR 100 overpack flange is at the surface of the spent fuel pool.

ALARA Warning:
Activated debris may have settled on the top face of the HI-STAR 100 overpack during fuel unloading.

d. Measure the dose rates at the top of the HI-STAR 100 overpack in accordance with plant radiological procedures and flush or wash the top surfaces to remove any highly-radioactive particles.

e. Raise the top of the HI-STAR 100 overpack and MPC to the level of the spent fuel pool deck.

f. Close the Annulus Overpressure System reservoir valve if the Annulus Overpressure System was used.

g. *As necessary, use*~~Using~~ a water pump~~,~~ *to* lower the water level in the MPC approximately 12 inches to prevent splashing during cask movement.

ALARA Note:
To reduce contamination of the HI-STAR 100 overpack, the surfaces of the HI-STAR 100 overpack and lift yoke should be kept wet until decontamination can begin.

h. Remove the HI-STAR 100 overpack from the spent fuel pool while spraying the surfaces with plant demineralized water.

i. Disconnect the Annulus Overpressure System from the HI-STAR 100 overpack via the quick disconnect. Drain the Annulus Overpressure System lines and reservoir.

j. Place the HI-STAR 100 overpack in the designated preparation area.

k. Disengage the lift yoke.

l. Perform decontamination on the HI-STAR 100 overpack and the lift yoke.

2. Carefully decontaminate the area above the inflatable seal. Deflate, remove, and store the seal in an approved plant storage location.

3. Using a water pump, pump the remaining water in the MPC to the spent fuel pool or liquid radwaste system.

4. Drain the water in the annulus.

5. Remove the MPC from the HI-STAR 100 overpack and decontaminate the MPC as necessary.

6. Decontaminate the HI-STAR 100 overpack.

7. Remove any bolt plugs, seal surface protector and/or waterproof tape from the HI-STAR 100 overpack top bolt holes.

8. Move the HI-STAR 100 overpack and MPC for further inspection, corrective actions, or disposal as necessary.

LOCATION: CASK RECEIVING AREA
REMOVE PERSONNEL BARRIER
PERFORM CASK SURVEY AND RECEIPT INSPECTION
REMOVE IMPACT LIMITERS
REMOVE TIE-DOWN
UPEND HI-STAR OVERPACK
PLACE HI-STAR IN DESIGNATED PREPARATION AREA
LOCATION: CASK PREPARATION AREA
GATEHR ANNULUS GAS SAMPLE
DEPRESSURIZE HI-STAR ANNULUS
REMOVE HI-STAR CLOSURE PLATE
FILL ANNULUS
INSTALL ANNULUS SHIELD
REMOVE MPC CLOSURE RING
REMOVE MPC VENT PORT COVER PLATE AND SAMPLE MPC GAS
REMOVE MPC DRAIN PORT COVER PLATE
PERFORM MPC COOL-DOWN
FILL MPC CAVITY WITH WATER
REMOVE MPC LID TO SHELL WELD
INSTALL INFLATABLE SEAL
PLACE HI-STAR IN SPENT FUEL POOL
LOCATION: SPENT FUEL POOL
REMOVE MPC LID
DISCONNECT DRAIN LINE
REMOVE SPENT FUEL ASSEMBLIES FROM MPC
VACUUM CELLS OF MPC
REMOVE HI-STAR FROM SPENT FUEL POOL
LOCATION: CASK PREPARATION AREA
LOWER WATER LEVEL IN MPC
PUMP REMAINING WATER IN MPC TO SPENT FUEL POOL
REMOVE MPC FROM HI-STAR
DECONTAMINATE MPC AND HI-STAR

Figure 7.2.1; Unloading Operations Flow Diagram

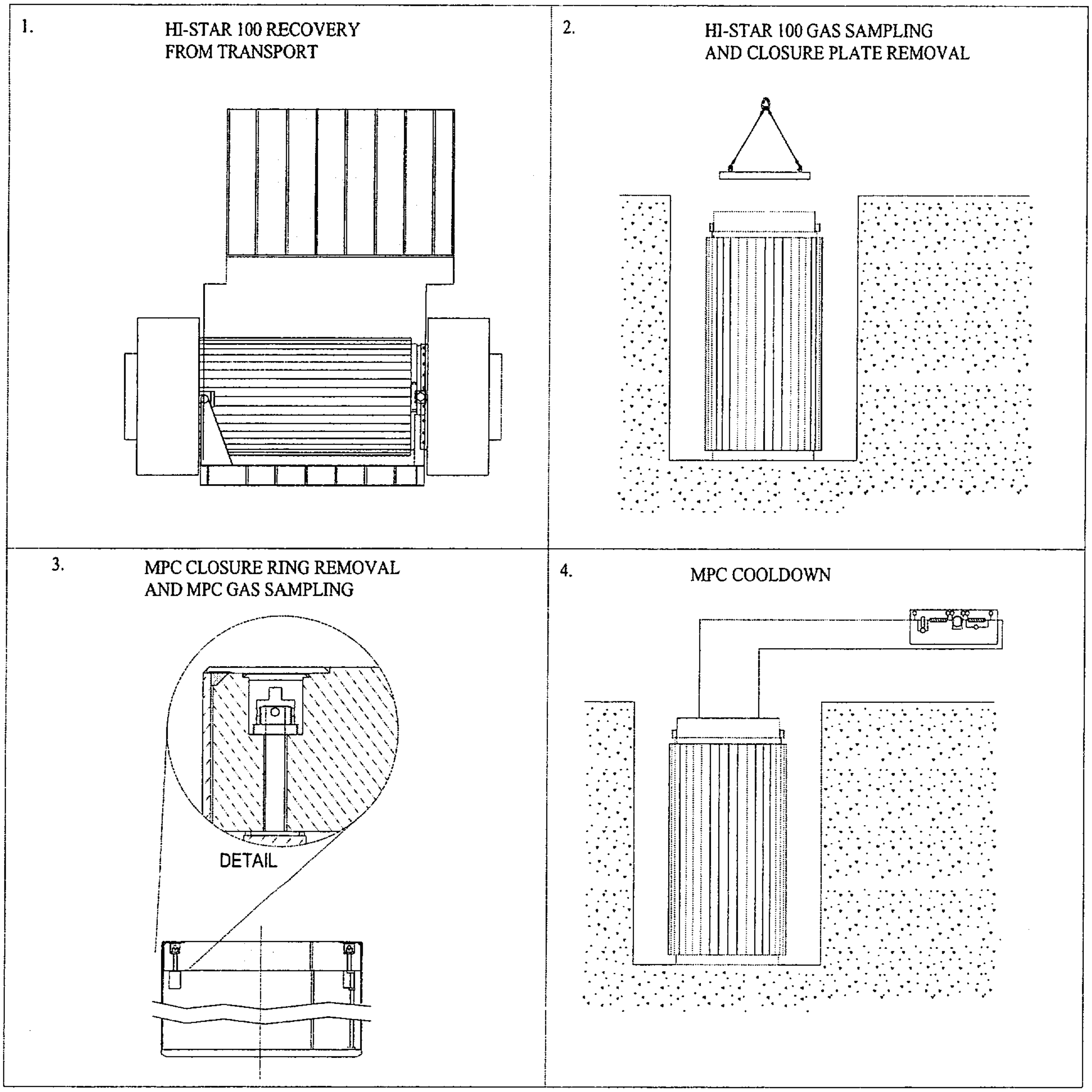


Figure 7.2.2a; Major HI-STAR 100 Unloading Operations (Sheet 1 of 3)

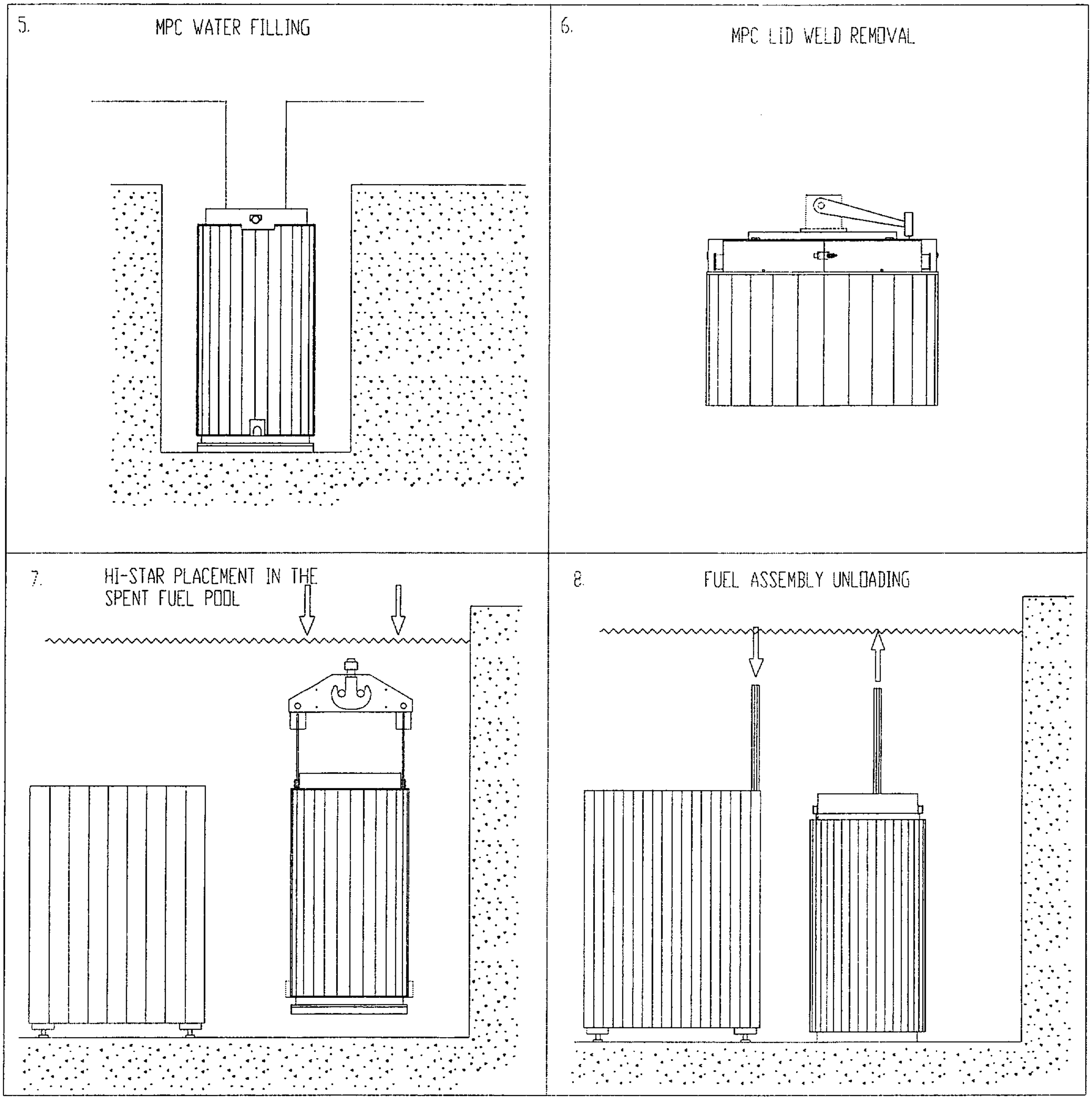


Figure 7.2.2b; Major HI-STAR 100 Unloading Operations (Sheet 2 of 3)

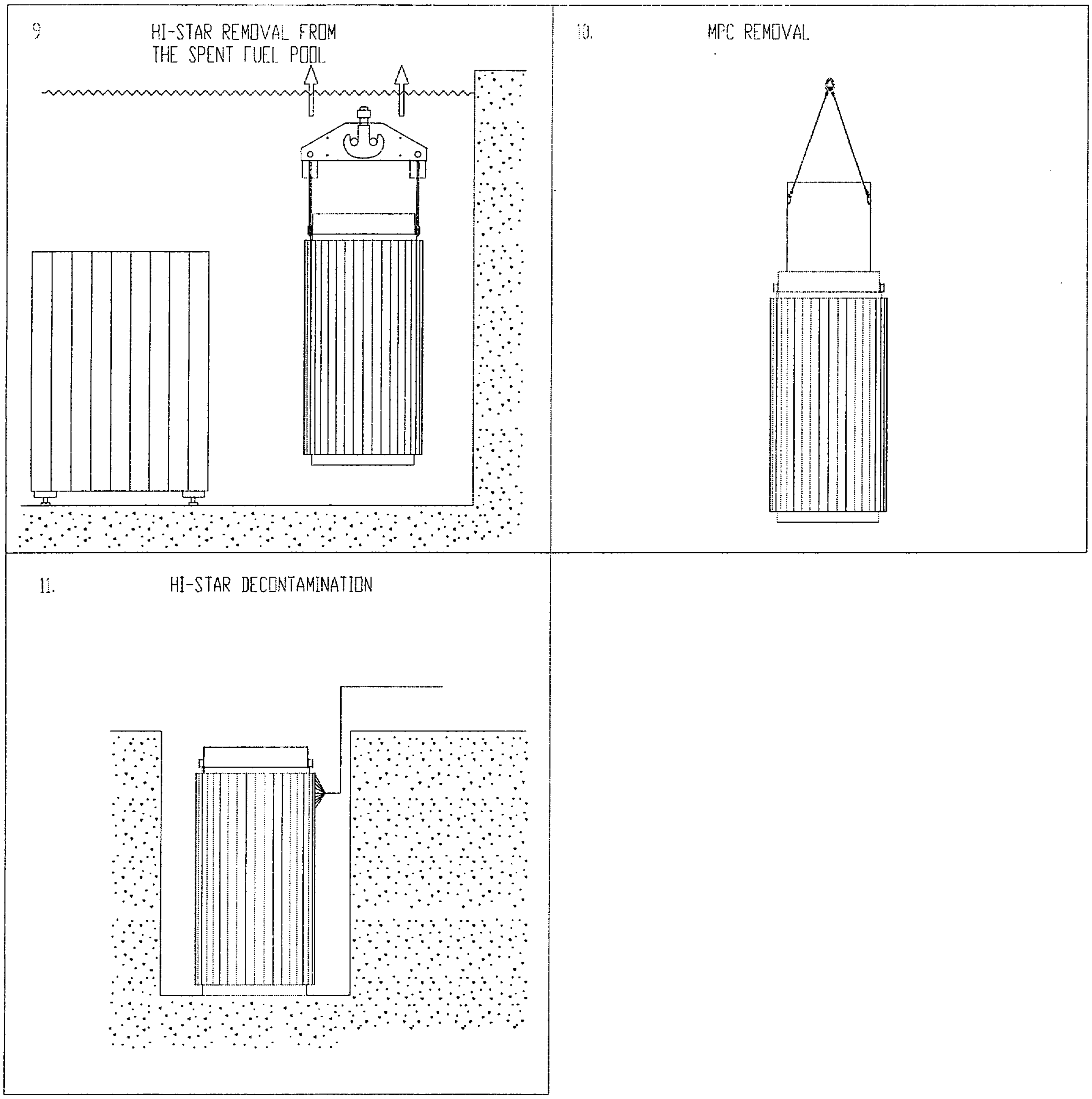


Figure 7.2.2c; Major HI-STAR 100 Unloading Operations (Sheet 3 of 3)

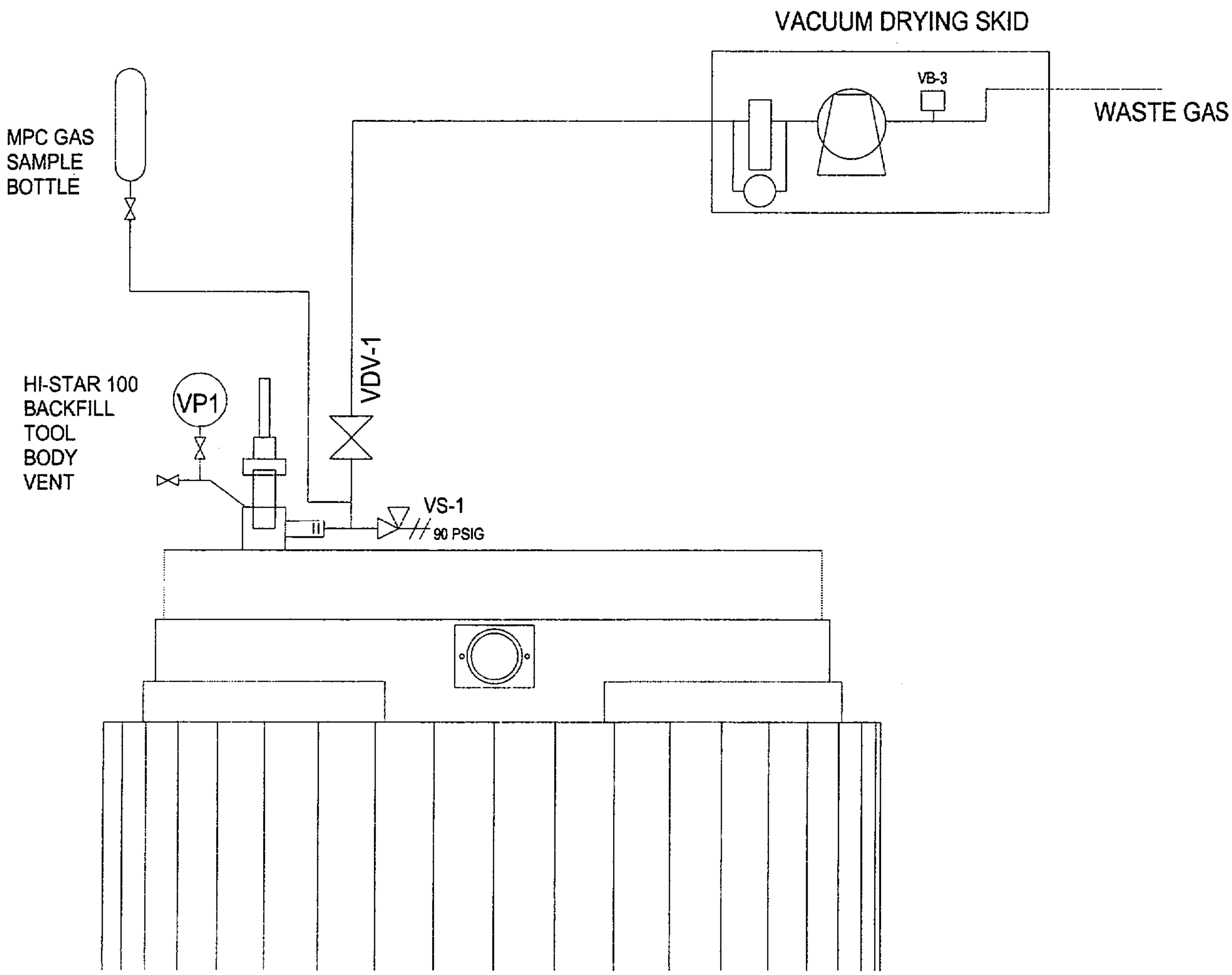


Figure 7.2.3; HI-STAR Annulus Gas Sampling

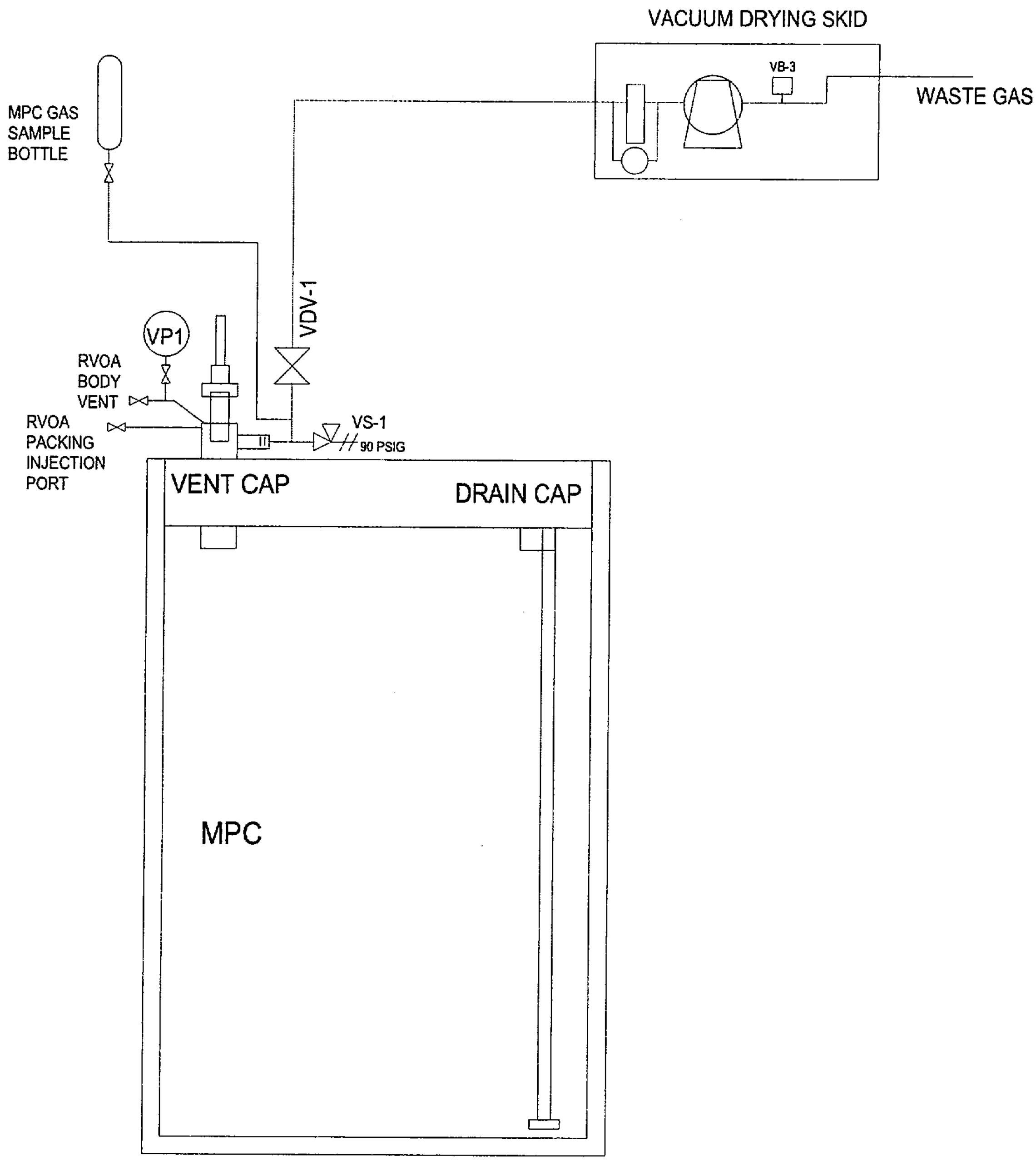


Figure 7.2.4; MPC Gas Sampling in Preparation for Unloading

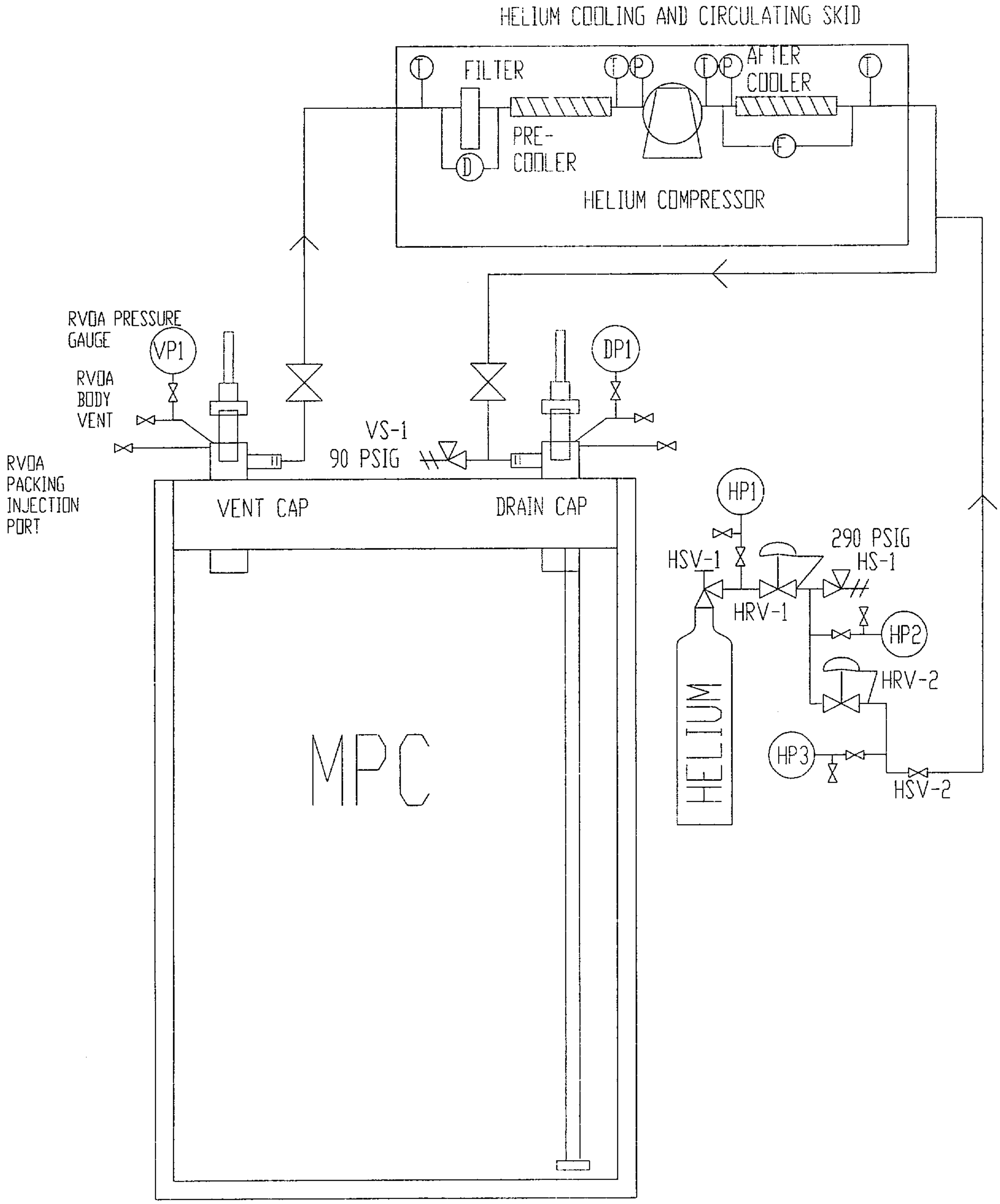


Figure 7.2.5; MPC Cool-Down

7.3 PREPARATION OF AN EMPTY PACKAGE FOR TRANSPORT

7.3.1 Overview of the HI-STAR 100 System Empty Package Transport

The operations for preparing an empty package (previously used) for transport are similar to those required for transporting the loaded package with several exceptions. The closure plate is installed and the bolts are torqued. The HI-STAR 100 overpack is downended ~~on the transport frame and the tie down is installed.~~ A survey for removable contamination is performed to verify that the removable contamination on the internal and external surfaces of the HI-STAR 100 overpack are ALARA and that the limits of 49CFR173.428 [7.1.3] and 10CFR71.87(i) [7.0.1] are met. At the User's discretion, impact limiters are installed and the personnel barrier is installed and locked. The procedures provided herein describe the installation of the impact limiters and personnel barrier. These steps may be omitted as needed.

7.3.2 Preparation for Empty Package Shipment

1. Install the closure plate as follows:

Note:
For empty shipments of the HI-STAR 100 overpack, used metallic seals may be reused.

   a. Remove the Seal Surface Protector from the HI-STAR 100 overpack if necessary.

   b. Perform a contamination survey of the top accessible 12-inches of the HI-STAR 100 Overpack inside surface in accordance with 49CFR173.421(a)(3) [7.1.3]. Verify that the non-fixed contamination levels do not exceed 220,000 dpm/100 cm^2 from beta and gamma radiation and 22,000 pm/100 cm^2 from alpha.

   c. Verify that the HI-STAR 100 Overpack is empty and contains less than 15 gm U-235 in accordance with 49CFR173.421(a)(5) [7.3.1].

   d. Raise and install the closure plate on the HI-STAR 100 overpack. See Figure 7.1.12 for rigging.

   e. Install and torque the closure plate bolts. See Table 7.1.3 for torque requirements.

   f. If necessary, install the vent and drain cover plates.

2. Position the HI-STAR 100 overpack on the transport frame as follows:

   a. Install the HI-STAR 100 overpack buttress plate on the HI-STAR 100 overpack. See Figure 7.1.11 and 7.1.12 for rigging. See Table 7.1.3 for torque requirements.

   b. Downend the HI-STAR 100 overpack ~~in the transport frame~~. See Section 7.1.2.

   c. Install the removable shear ring segments. See Table 7.1.3 for torque requirements.

3. Perform a final inspection of the HI-STAR 100 overpack as follows:

Note:
Prior to shipment of the HI-STAR 100 package, the accessible external surfaces of the HI-STAR 100 packaging (HI-STAR 100 overpack, impact limiters, personnel barrier, tie-down, transport frame and transport vehicle) shall be surveyed for removable radiological contamination in accordance with 49CFR173.443(a) [7.1.3] and show less than 2200 dpm/100 cm^2 from beta and gamma emitting sources, and 220 dpm/100 cm^2 from alpha emitting sources.

a. Perform a final survey for removable contamination. Record the results on the shipping documentation.

b. Perform a radiation survey of the HI-STAR 100 Overpack and confirm that the radiation levels on any external surface of the overpack do not exceed 0.5 mrem/hour in accordance with 49CFR173.421(a)(2) [7.1.3].

c. Perform a visual inspection of the HI-STAR 100 overpack to verify that there are no outward visual indications of impaired physical condition and that the package is securely closed in accordance with 49CFR173.428(b) [7.1.3]. Identify any significant indications to the cognizant individual for evaluation and resolution and record on the shipping documentation.

d. Verify that the HI-STAR 100 overpack neutron shield rupture discs are installed, intact and not covered by tape or other covering.

4. *Deleted.*~~Install the tie-down over the HI-STAR 100 overpack and secure the tie-down bolts. See Table 7.1.3 for torque requirements.~~

5. If necessary, Install the impact limiters as follows:

a. Install the alignment pins in the bottom of the HI-STAR 100 overpack. See Figure 7.1.11. See Table 7.1.3 for torque requirements.

b. Using the impact limiter handling frame, raise and position the impact limiter over the end of HI-STAR 100. See Figure 7.1.10.

c. Install the impact limiter bolts. See Table 7.1.3 for torque requirements.

d. Repeat for the other impact limiter.

Note:
The impact limiters cover all the HI-STAR 100 penetrations. The security seals are used to provide tamper detection.

e. Install a security seal (one each) through the threaded hole in the top and bottom impact limiter bolts. Record the security seal number on the shipping documentation.

f. Perform final radiation surveys of the package surfaces per 10CFR71.47 [7.0.1] and SAR Section 8.1.5.2 and 49CFR173.428(a)(2) [7.1.3].

6. Install the personnel barrier as follows:

   a. Rig the personnel barrier as shown in Figure 7.1.9 and position the personnel barrier over the frame.

   b. Remove the personnel barrier rigging and install the personnel barrier locks.

   c. Transfer the personnel barrier keys to the carrier.

7. Perform a final check to ensure that the package is ready for release as follows:

   a. Verify that the receiver has been notified of the impending shipment.

   b. Verify that any labels previously applied in conformance with Subpart E of 49CFR172 [7.1.3] have been removed, obliterated, or covered and the "Empty" label prescribed in 49CFR172.450 [7.1.3] is affixed to the packaging in accordance with 49CFR173.428(d) [7.1.3].

   c. Verify that the package for shipment is prepared in accordance with 49CFR173.422 [7.1.3]

   d. Verify that all required information is recorded on the shipping documentation.

8. Release the HI-STAR 100 System for transport.

7.4 PROCEDURE FOR PREPARING THE HI-STAR 100 OVERPACK FOR TRANSPORT FOLLOWING A PERIOD OF STORAGE

7.4.1 Overview of the HI-STAR 100 System Preparation for Transport Following a Period of Storage

The operations for preparing the loaded HI-STAR 100 Overpack for transport following a period of storage (in excess of one year from the date of completion of HI-STAR 100 ~~O~~*o*verpack mechanical seal leakage testing) are identical to the later portion of operations required for normal transport of the package as summarized herein. The cask is positioned and the closure plate test port plug, HI-STAR 100 ~~O~~*o*verpack vent port cover and drain port cover plates are removed. The MSLD is attached and the mechanical seal leakage test is repeated as described in Section 7.1.6. Following successful completion of the leakage tests the closure plate plug and vent and drain port cover plates are reinstalled with new seals. The package is prepared for transport as described in Section 7.1.6.

For the MPC-68F*/24EF*, The HI-STAR 100 overpack vent port cover plate is removed and a gas sample is drawn from the HI-STAR 100 overpack annulus to determine the condition of the MPC confinement boundary. The annulus is vented (as described in Section 7.2.3), evacuated and backfilled with nitrogen gas several times to clear residual helium from the annulus space. The MPC-68F*/24EF* is then leakage tested as described in Section 7.1.6. Following the leakage test of the MPC-68F*/24EF*, the HI-STAR 100 Overpack is prepared for transport as described in Section 7.1.6.

7.4.2 Preparation for Transport Following a Period of Storage

1. Position the HI-STAR 100 Overpack ~~from~~ *for* leakage testing.

> **Note:**
> Leakage testing *requirements* for transport ~~is~~ *are specified in the CoC.* ~~only required for packages whose metallic seals have not been leakage tested within the last 12 months (in excess of one year from the date of completion of HI-STAR 100 Overpack mechanical seal leakage testing).~~ Step 2 is only required for the MPC-68F *or MPC-24EF*. Skip this step if not applicable.

2. If necessary, perform a leakage test of the MPC-68F*/24EF* as follows:

   a. Sample the annulus gas as follows:

      1. Remove the overpack vent port cover plate and attach the backfill tool with a sample bottle attached. See Figure 7.2.3. Store the cover plate in a site-approved location.

      2. Using a vacuum pump, evacuate the sample bottle and backfill tool.

      3. Slowly open the vent port plug and gather a gas sample from the annulus. Reinstall the HI-STAR 100 overpack vent port plug.

b. Evaluate the gas sample and determine the condition of the MPC confinement boundary.

c. If the confinement boundary is intact (i.e., no radioactive gas is measured) then vent the overpack annulus by removing the overpack vent port seal plug (using the backfill tool). Otherwise vent the annulus gas in accordance with instructions from Radiation Protection.

d. Flush the annulus and perform leakage testing of the MPC-68F/*24EF* as follows:

   1. Install the overpack test cover to the overpack vent port as shown on Figure 7.1.27. See Table 7.1.3 for torque requirements.

   2. Evacuate the annulus to below 5 torr and break the vacuum allowing air to fill the annulus space. Repeat this process several times to remove residual helium from the annulus space.

   3. Evacuate the annulus per the MSLD manufacturer's instructions and isolate the vacuum pump from the overpack test cover.

   4. Perform a leakage rate test of MPC-68F/*24EF* per the MSLD manufacturer's instructions. The overpack Helium Leak Rate shall be ≤ 5.0E-6 ~~std~~-*atm* cc/sec (He) with a minimum test sensitivity less than 2.5E-6 ~~std~~-*atm* cc/sec (He).

   5. Disconnect the overpack test cover.

   6. Remove the closure plate test port plug. Discard any used metallic seals.

e. Dry and backfill the overpack annulus as follows:

   1. Load the backfill tool with the HI-STAR 100 overpack vent port plug and the vent port with a new plug seal. Attach the backfill tool to the HI-STAR 100 overpack vent port with the plug removed. See Figure 7.1.28. See Table 7.1.3 for torque requirements.

   2. Attach the Vacuum Drying System to the backfill tool and reduce the HI-STAR 100 overpack pressure to below 3 torr.

Note:

The annulus pressure may rise due to the presence of water in the HI-STAR 100 overpack. The dryness test may need to be repeated several times until all the water has been removed. Leaks in the Vacuum Drying System, damage to the vacuum pump, and improper vacuum gauge calibration may cause repeated failure of the dryness verification test. These conditions should be checked as part of the corrective actions if repeated failure of the dryness verification test is occurring.

3. Perform a HI-STAR 100 overpack Annulus Dryness Verification. The overpack annulus shall hold stable vacuum drying pressure of $\leq$ 3 torr for $\geq$ 30 minutes.

4. Attach the helium supply to the backfill tool.

5. Verify the correct pressure on the helium supply (pressure set to10+4/-0 psig) and open the helium supply valve.

6. Backfill the HI-STAR 100 overpack annulus to $\geq$ 10 psig and $\leq$ 14 psig.

7. Install the overpack vent port plug and torque. See Table 7.1.3 for torque requirements.

8. Disconnect the overpack backfill tool from the vent port.

9. Flush the overpack vent port recess with compressed air to remove any standing helium gas.

3. Leak test the HI-STAR 100 ~~O~~overpack vent and drain port plug mechanical seals as follows:

   a. Install the overpack test cover to the overpack vent port as shown on Figure 7.1.27. See Table 7.1.3 for torque requirements.

   b. Evacuate the test cavity per the MSLD manufacturer's instructions and isolate the vacuum pump from the overpack test cover.

   c. Perform a leakage rate test of overpack vent port plug per the MSLD manufacturer's instructions. The overpack Helium Leak Rate shall be $\leq$ 4.3E-6 std cc/sec (He) with a minimum test sensitivity less than 2.15E-6 std cc/sec (He).

   d. Remove the overpack test cover and install a new metallic seal on the overpack vent port cover plate. Discard any used metallic seals.

   e. Install the vent port cover plate and torque the bolts. See Table 7.1.3 for torque requirements.

   f. Repeat Steps a through e for the overpack drain port.

4. Leak test the overpack closure plate inner mechanical seal as follows:

   a. Attach the closure plate test tool to the closure plate test port with the and MSLD attached. See Figure 7.1.29. See Table 7.1.3 for torque requirements.

   b. Evacuate the closure plate test port tool and closure plate inter-seal area per the MSLD manufacturer's instructions.

c. Perform a leakage rate test of overpack closure plate inner mechanical seal in accordance with the MSLD manufacturer's instructions. The overpack Helium Leak Rate shall be ≤ 4.3E-6 ~~std~~ *atm* cc/sec (He) with a minimum test sensitivity less than 2.15E-6 ~~std~~ *atm* cc/sec (He).

d. Remove the closure plate test tool from the test port and install the test port plug with a new mechanical seal. See Table 7.1.3 for torque requirements. Discard any used metallic seals.

5. Verify that the HI-STAR 100 overpack dose rates are within the acceptance requirements listed above.

6. Continue cask loading and preparation for transport as described in Section 7.1.7.

7.5 REGULATORY COMPLIANCE

7.5.1 The special controls and precautions for transport, loading and handling, and special controls in case of accident or delay have been provided and they satisfy 10CFR71.35(c) [7.0.1].

7.5.2 The radiation survey requirements of the package exterior are provided in Section 7.1.3, 7.1.7 and 7.3.2 and the requirements of 10CFR71.47 [7.0.1] will be met.

7.5.3 The temperature measurement requirements are provided in Section 7.1.7 and the limits specified in 10CFR71.43 (g) [7.0.1] will be met.

7.5.4 The routine determinations for package use prior to transport is provided in Section 7.1.7 and Section 7.3 and the requirements of 10CFR71.87 [7.0.1] will be met.

7.5.5 The procedures needed to safely open the package are provided in Section 7.2. Verification that the consignee has the appropriate procedures is given in Section 7.1.7. The requirements of 10CFR71.89 [7.0.1] are met.

7.6 REFERENCES

[7.0.1] *U.S. Code of Federal Regulations" Packaging and Transport of Radioactive Materials*," Part 71, "Energy."

[7.1.1] U.S. Nuclear Regulatory Commission, "Control of Heavy Loads at Nuclear Power Plants," NUREG-0612.

[7.1.2] Holtec International Report HI-941184, HI-STAR 100 System ~~Topical~~*Final* Safety Analysis Report.

[7.1.3] *U.S. Code of Federal Regulations,* "Shippers – General Requirements for Shipments and Packages," Part 49, *"Transportation."*

[7.1.4] *U.S. Code of Federal Regulations,* "Standards for Protection Against Radiation", Part 20, *"Energy."*

[7.1.5] American National Standards Institute, Institute for Nuclear Materials Management, "American National Standard for Radioactive Materials – Leakage Tests on Packages for Shipment," ANSI N14.5-1987, January 1987.

[7.1.6] American Society of Mechanical Engineers "Boiler and Pressure Vessel Code".

CHAPTER 8: ACCEPTANCE CRITERIA AND MAINTENANCE PROGRAM

8.0 INTRODUCTION

This chapter identifies the fabrication, inspection, test, and maintenance programs to be conducted on the HI-STAR 100 Package to verify that the structures, systems and components (SSCs) classified as important to safety have been fabricated, assembled, inspected, tested, accepted, and maintained in accordance with the requirements set forth in this Safety Analysis Report (SAR), the applicable regulatory requirements, and the Certificate of Compliance (CoC).

The controls, inspections, and tests set forth in this chapter, in conjunction with the design requirements described in previous chapters, ensure that the HI-STAR 100 Package will maintain containment of radioactive material; will maintain subcriticality control; will properly transfer the decay heat of the contained radioactive materials; and that radiation doses will meet regulatory requirements under all normal and hypothetical accident conditions of transport in accordance with 10CFR71 [8.0.1].

Both pre-operational and operational tests and inspections are performed throughout HI-STAR 100 loading operations to assure that the HI-STAR 100 Package is functioning within its design parameters. These include receipt inspections, nondestructive weld inspections, hydrostatic tests, radiation shielding tests, thermal performance tests, dryness tests, and others. Chapter 7 identifies the sequence ~~and conduct~~ of the tests and inspections. "Pre-operation", as referred to in this chapter, defines that period of time from receipt inspection of a HI-STAR 100 Package until the empty MPC is loaded into a HI-STAR overpack for fuel assembly loading.

The HI-STAR 100 Package is classified as important to safety. Therefore, the individual structures, systems, and components (SSCs) that make up the HI-STAR 100 Package shall be designed, fabricated, assembled, inspected, tested, accepted, and maintained in accordance with a quality program commensurate with the particular SSC's graded quality category. Table 1.3.3 provides the *safety classification and* quality category, *as applicable,* for each major item or component of the HI-STAR 100 Package and required ancillary equipment and systems.

The acceptance criteria and maintenance program described in this chapter fully comply with the requirements of 10CFR Part 71.

8.1 ACCEPTANCE CRITERIA

This section provides the workmanship inspections and acceptance tests to be performed on the HI-STAR 100 Package prior to or during use. These inspections and tests provide assurance that the HI-STAR 100 Package has been fabricated, assembled, inspected, tested, and accepted for use and loading under the conditions specified in this SAR and the Certificate of Compliance issued by the NRC in accordance with the requirements of 10CFR Part 71.

Noncompliances encountered during the required inspections and tests shall be corrected or dispositioned to bring the item into compliance with this SAR prior to use. Identification and resolution of noncompliances shall be performed in accordance with the Holtec International

Quality Assurance Program [8.1.1] or the licensee's NRC-approved Quality Assurance Program. The testing and inspection acceptance criteria applicable to the MPCs and the HI-STAR overpack are listed in Tables 8.1.1 and 8.1.2, respectively, and discussed in more detail in the sections that follow. These inspections and tests are intended to demonstrate that the HI-STAR 100 Package has been fabricated, assembled, and examined in accordance with the design evaluated in this SAR.

This section summarizes the test program established for the HI-STAR 100 Package.

8.1.1 Fabrication and Nondestructive Examination (NDE)

The design, material procurement, fabrication, and inspection of the HI-STAR 100 Package is performed in accordance with applicable codes and standards, *including approved alternatives to the ASME Code, as* specified in Table*s* 1.3.1 *and 1.3.2, respectively*. Additional details on specific codes used are provided below.

The following fabrication controls and required inspections shall be performed on the HI-STAR 100 Package, including the MPCs, in order to assure compliance with this SAR and the Certificate of Compliance.

1. Materials of construction specified for the HI-STAR 100 Package are identified in the drawing*s and text* ~~Bills of Material~~ in Chapter 1 and shall be procured with certification and supporting documentation as required by ASME Code [8.1.2] Section II (when applicable); the applicable subsection of ASME Code Section III (when applicable); Holtec procurement specifications; and 10CFR71, Subpart H. Materials and components shall be receipt inspected for visual and dimensional acceptability, material conformance to specification requirements, and traceability markings, as applicable. Controls shall be in place to assure material traceability is maintained throughout fabrication *for ITS items*. Materials for the primary containment boundary of the HI-STAR overpack (bottom plate, inner shell, top flange, closure plate, port plugs, and closure plate bolts) and for the secondary containment boundary provided by the MPC (for the *MPC-24EF and* MPC-68F), shall also be inspected per the requirements of ASME Section III, Article NB-2500 Subsection NB.

2. The HI-STAR 100 Package primary containment boundary and the MPC (secondary containment boundary for *MPC-24EF and* MPC-68F) shall be fabricated and inspected in accordance with ASME Code Section III, Subsection NB to the maximum extent practicable (see ~~exceptions~~*alternatives* in Table 1.3.2). Other portions of the HI-STAR 100 Package shall be fabricated and inspected in accordance with ASME Code Section III, Subsection NF (see ~~exceptions~~*alternatives* in Chapter 1). The MPC basket *and*~~,~~ *certain* basket supports~~, and fuel spacers~~ shall be fabricated and inspected in accordance with ASME Code Section III, Subsection NG (see *Tables 1.3.2 and 1.3.3 for Code applicability and* ~~exceptions~~ *approved Code alternatives).*~~ in Chapter 1).~~

3. Welding shall be performed using welders and weld procedures that have been qualified in accordance with ASME Code Section IX and the applicable ASME Section III Subsections (e.g., NB, NG, or NF, as applicable to the SSC).

4. Welds shall be visually examined in accordance with ASME Code Section V, Article 9 with acceptance criteria per ASME Code Section III, Subsection NF, Article NF-5360, except the MPC fuel basket cell plate-to-cell plate welds~~,~~ *and* fuel basket support-to-canister welds, ~~and fuel spacer welds~~ which shall have acceptance criteria to ASME Code Section III, Subsection NG, Article NG-5360, except as *clarified by the Code alternatives*~~modified by the Design Drawings~~. Table 8.1.3 identifies additional nondestructive examination (NDE) requirements to be performed on specific welds, and the applicable codes and acceptance criteria to be used in order to meet the requirements of the applicable portions of Section III of the ASME Code. Acceptance criteria for NDE shall be in accordance with the applicable Code for which the item was fabricated, except as modified by the *Code alternatives*~~Design Drawings~~. These additional NDE criteria are also specified in the ~~Design~~ ~~D~~*d*rawings provided in Chapter 1 for the specific welds. Weld inspections shall be detailed in a weld inspection plan ~~which~~*that* identifies the weld and the examination requirements, the sequence of examination, and the acceptance criteria. The inspection plan shall be reviewed and approved by Holtec International in accordance with its QA program. NDE inspections shall be performed in accordance with written and approved procedures by personnel qualified in accordance with SNT-TC-1A [8.1.3] or other site-specific, NRC-approved program for personnel qualification.

5. The HI-STAR 100 ~~Package~~ *containment boundary* shall be visually examined in accordance with ASME Code Section V, Article 9, to verify that each packaging is free of cracks, pin holes, uncontrolled voids, or other defects that could significantly reduce its effectiveness.

6. Any welds requiring weld repair shall be repaired in accordance with the requirements of the ASME Code Section III, Article NB-4450, NG-4450, or NF-4450, as applicable to the SSC, and examined after repair in the same manner as the original weld.

7. Any base metal repairs shall be performed and examined in accordance with the applicable fabrication Code.

8. Grinding and machining operations of the HI-STAR 100 overpack primary containment boundary and the MPC shall be controlled through written and approved procedures and quality assurance oversight to ensure grinding and machining operations do not reduce base metal wall thicknesses of the boundaries beyond that allowed *by the design.*~~per the Design Drawings in Chapter 1.~~ The thicknesses of base metals shall be ultrasonically tested, as necessary, in accordance with written and approved procedures to verify base metal thickness meets ~~D~~*d*esign ~~Drawing~~ requirements. A nonconformance shall be written for

areas found to be below allowable base metal thickness and shall be evaluated and repaired as necessary per the ASME Code Section III, Subsection NB requirements.

9. Dimensional inspections of the HI-STAR 100 Package shall be performed in accordance with written and approved procedures in order to verify compliance to ~~D~~*d*esign ~~D~~*d*rawings and fit-up of individual components. All dimensional inspections and functional fit-up tests shall be documented.

10. All required inspections, examinations, and tests shall be documented. The inspection, examination, and test documentation shall become part of the final quality documentation package.

11. The HI-STAR 100 Package shall be inspected for cleanliness and proper preparation for shipping in accordance with written and approved procedures.

12. Each HI-STAR overpack shall be durably marked with the CoC identification number assigned by the NRC, trefoil radiation symbol, gross weight, model number, and unique identification serial number in accordance with 10CFR71.85(c) at the completion of the acceptance test program.

13. Consistent with its multi-purpose design and certification, each HI-STAR 100 Package shall be durably marked with the appropriate model number, a unique identification number, and its empty weight per 10CFR72.236(k) at the completion of the acceptance test program performed in accordance with Chapter 9 of the HI-STAR 100 10CFR72 storage *certification*~~application~~ ~~T~~*F*SAR~~ (HI-941184)~~ [8.1.4].

14. A completed quality documentation record package shall be prepared and maintained during fabrication of each HI-STAR 100 Package to include detailed records and evidence that the required inspections and tests have been performed. ~~Prior to shipment of a HI-STAR 100 Package or component for first use, t~~*T*he quality document record package shall be reviewed to verify that the HI-STAR 100 Package or component has been properly fabricated and inspected in accordance with the design and Code construction requirements. The quality documentation record package shall include, but not be limited to:

- Completed ~~Shop Travelers~~*Weld Records*
- Inspection Records
- Nonconformance Reports
- Material Test Reports
- NDE Reports
- ~~As-Built~~*Dimensional Inspection* Reports

8.1.1.1 MPC Lid-to-Shell Weld Volumetric Inspection

1. The MPC lid-to-shell (LTS) weld (the confinement boundary closure per 10CFR72, and secondary containment (inner container) boundary per 10CFR71 for the MPC-68F *and MPC-24EF*) shall be volumetrically or multi-layer liquid penetrant examined following completion of field welding. If volumetric examination is used, the ultrasonic test (UT) method shall be employed. Ultrasonic techniques (including, as appropriate, Time-of-Flight Diffraction, Focussed Phased Array, and conventional pulse-echo) shall be supplemented, as necessary, to ensure substantially complete coverage of the examination volume.

2. If volumetric examination is used, then a liquid penetrant (PT) examination of the root and final pass of the LTS weld shall be performed and unacceptable indications shall be documented, repaired and re-examined.

3. If a volumetric examination is not used, a multi-layer PT examination shall be employed. The multi-layer PT must, at a minimum, include the root and final weld layers and one intermediate PT after each approximately 3/8 inch weld depth has been completed. The 3/8-inch weld depth corresponds to the maximum allowable flaw size.

4. It is recognized that welding of the LTS weld may result in indications in the root pass that are not detected by the root pass PT. The overall minimum thickness of the LTS weld has been increased by 0.125 inch such that it is not necessary to take structural credit for the root pass on the ~~D~~*d*esign ~~D~~*d*rawings in Chapter 1 (actual weld to be 0.75 inch *for the standard MPC model and 1.25 inches for the "F" model*). A 0.625 inch J-groove weld was assumed in the structural analyses in Chapter 2.

5. For either UT or PT, the maximum undetectable flaw size must be demonstrated to be less than the critical flaw size. The critical flaw size must be determined in accordance with ASME Section XI methods. The critical flaw size shall not cause the primary stress limits of NB-3000 to be exceeded. The inspection process, including findings (indications) shall be made a permanent part of the user's records by video, photographic, or other means which provide an equivalent retrievable record of weld integrity. The video or photographic records should be taken during the final interpretation period described in ASME Section V, Article 6, T-676. The inspection of the weld shall be performed by qualified personnel and shall meet the acceptance requirements of ASME Section III, NB-5350 for PT and NB-5332 for UT.

6. Evaluation of any indications shall include consideration of any active flaw mechanisms. However, cyclic loading on the LTS weld is not significant, so fatigue will not be a factor. The LTS weld is protected from the external environment by the closure ring and the root of the LTS weld is dry and inert (He atmosphere), so stress corrosion cracking is not a concern for the LTS weld.

7. The volumetric or multi-layer PT examination of the LTS weld, in conjunction with other examinations which will be performed on this weld (PT of root and final pass, hydrostatic test, and helium leakage test); the use of the ASME Code Section III acceptance criteria; and the additional weld material added to account for potential defects in the root pass of the weld, in total, provide reasonable assurance that the LTS weld is sound and will perform its secondary containment boundary function under all loading conditions. The volumetric (or multi-layer PT) examination and evaluation of indications provides reasonable assurance that leakage of the weld or structural failure under normal or hypothetical accident conditions of transport will not occur.

8.1.2 Structural and Pressure Tests

8.1.2.1 Lifting Trunnions

Two trunnions (located near the top of the HI-STAR overpack) are provided for vertical lifting and handling of the HI-STAR 100 Package without the impact limiters installed. The trunnions are designed and shall be inspected and tested in accordance with ANSI N14.6 [8.1.5]. The trunnions are fabricated using a high-strength and high-ductility material (see ~~Chapter 1~~*overpack drawing in Section 1.4*). The trunnions contain no welded components. The maximum design lifting load of 250,000 pounds for the HI-STAR 100 Package will occur during the removal of the HI-STAR overpack from the spent fuel pool after the MPC has been loaded, flooded with water, and the MPC lid is installed. The high material ductility, absence of materials vulnerable to brittle fracture, excellent stress margins, and a carefully engineered design to eliminate local stress risers in the highly-stressed regions (during lift operations) ensure that the lifting trunnions will work reliably. However, pursuant to the defense-in-depth approach of NUREG-0612 [8.1.6], acceptance criteria for the lifting trunnions have been established in conjunction with other considerations applicable to heavy load handling.

Section 5 of NUREG-0612 calls for measures to "provide an adequate defense-in-depth for handling of heavy loads...". The NUREG-0612 guidelines cite four major causes of load handling accidents, of which rigging failure (including trunnion failure) is one:

i. operator errors
ii. rigging failure
iii. lack of adequate inspection
iv. inadequate procedures

The cask loading and handling operations program shall ensure maximum emphasis to minimize the potential of load drop accidents by implementing measures to eliminate shortcomings in all aspects of the operation including the four aforementioned areas.

In order to ensure that the lifting trunnions do not have any hidden material flaws, the trunnions shall be tested at 300% of the maximum design (service) lifting load. The load (750,000 lbs) shall be applied for a minimum of 10 minutes to the pair of lifting trunnions. The accessible parts of the trunnions (areas outside the HI-STAR overpack), and the local HI-STAR 100 cask areas shall then be visually examined to verify no deformation, distortion, or cracking has occurred. Any evidence of deformation, distortion or cracking of the trunnion or adjacent HI-STAR 100 cask areas shall require replacement of the trunnion and/or repair of the HI-STAR 100 cask. Following any replacements and/or repair, the load testing shall be re-performed and the components re-examined in accordance with the original procedure and acceptance criteria. Testing shall be performed in accordance with written and approved procedures. Certified material test reports verifying trunnion material mechanical properties meet ASME Code Section II requirements provide further verification of the trunnion load capabilities. Test results shall be documented and shall become part of the final quality documentation package.

The acceptance testing of the trunnions in the manner described above provide reasonable assurance that a handling accidents will not occur due to trunnion failure.

8.1.2.2 Pressure Testing

8.1.2.2.1 HI-STAR 100 Containment Boundary

The containment boundary of the HI-STAR Package shall be hydrostatically or pneumatically pressure tested to 150 psig +10,-0 psig, in accordance with the requirements of the ASME Code Section III, Subsection NB, Article NB-6000. The test pressure of 150 psig is 150% of the Maximum Normal Operating Pressure (established per 10CFR71.85(b) requirements). This bounds the ASME Code Section III requirement (NB-6221) for hydrostatic testing to 125% of the design pressure (100 psig). The test shall be performed in accordance with written and approved procedures. The written and approved test procedure shall clearly define the test equipment arrangement.

The overpack pressure test may be performed at any time during fabrication after the containment boundary is complete. Preferably, the pressure test should be performed after overpack fabrication is complete, including attachment of the intermediate shells. The HI-STAR overpack shall be assembled for this test with the closure plate mechanical seal (only one required) or temporary test seal installed. Closure bolts shall be installed and torqued to a value less than or equal to the value specified in *the CoC*~~Chapter 7~~.

The calibrated test pressure gage installed on the overpack shall have an upper limit of approximately twice that of the test pressure. The test pressure shall be maintained for ten minutes. During this time period, the pressure gauge reading shall not fall below 150 psig. At the end of ten minutes, and while the pressure is being maintained at a minimum of 150 psig, the overpack shall be observed for leakage. In particular, the closure plate-to-top forging joint (the only credible leakage point) shall be examined. If a leak is discovered, the overpack shall be emptied and an evaluation shall be performed to determine the cause of the leakage. Repairs and retest shall be performed until the pressure test acceptance criterion is met.

Note: If failure of the pressure retest occurs after initial repairs are completed, a nonconformance report shall be issued and root cause and corrective action shall be addressed before further repairs and retest are performed.

After completion of the pressure testing, the overpack closure plate shall be removed and the internal surfaces shall be visually examined for cracking or deformation. Any evidence of cracking or deformation shall be cause for rejection or repair and retest, as applicable. The overpack shall be required to be pressure tested until the examinations are found to be acceptable.

Test results shall be documented and shall become part of the final quality documentation package.

8.1.2.2.2 MPC Secondary Containment Boundary

Hydrostatic testing of the MPC secondary containment boundary shall be performed in accordance with the requirements of the ASME Code Section III, Subsection NB, Article NB-6000, when field welding of the MPC lid-to-shell weld is completed. The hydrostatic pressure for the test shall be 125 +5,-0 psig, which is 125% of the design pressure of 100 psig. The MPC vent and drain ports are used for pressurizing the MPC cavity. The loading procedures in Chapter 7 define the test equipment arrangement. The calibrated test pressure gage installed on the MPC pressure boundary shall have an upper limit of approximately twice that of the test pressure. Following completion of the 10-minute hold period at the hydrostatic test pressure, and while maintaining a minimum test pressure of 125 psig, the surface of the MPC lid-to-shell weld shall be visually examined for leakage and then re-examined by liquid penetrant examination performed in accordance with ASME Code Section V, Article 6, with acceptance criteria per ASME Code Section III, Subsection NB, Article NB-5350. Any unacceptable areas shall require repair in accordance with the ASME Code Section III, Subsection NB, Article NB-4450. Any evidence of cracking or deformation shall be cause for rejection, or repair and retest, as applicable. The performance and sequence of the test is described in Section 7.1 (loading procedures).

If a leak is discovered, the test pressure shall be reduced, the MPC cavity water level lowered, the MPC cavity vented~~ (to the pool or the licensee's off gas system)~~, and the weld shall be examined to determine the cause of the leakage and/or cracking. Repairs to the weld shall be performed in accordance with approved written procedures prepared in accordance with the ASME Code Section III, Subsection NB, NB-4450.

The MPC pressure boundary hydrostatic test shall be repeated until all visual and ~~dye~~ *liquid* penetrant examinations are found to be acceptable. Test results shall be documented and shall be maintained as part of the loaded MPC quality documentation package.

8.1.2.3 Materials Testing

The majority of materials used in the HI-STAR overpack are ferritic steels. ASME Code Section III and Regulatory Guides 7.11 [8.1.7] and 7.12 [8.1.8] require that certain materials be tested in order to assure that these materials are not subject to brittle fracture failures.

Each plate or forging for the HI-STAR 100 Package containment boundary (overpack inner shell, bottom plate, top flange, and closure plate) shall be required to be drop weight tested in accordance with the requirements of Regulatory Guides 7.11 and 7.12, as applicable. Additionally, per the ASME Code Section III, Subsection NB, Article NB-2300, Charpy V-notch testing shall be performed on these materials. Weld material used in welding the containment boundary shall be Charpy V-notch tested in accordance with ASME Section III, Subsection NB, Articles NB-2300 and NB-2430.

Non-containment portions of the overpack, as required, shall be Charpy V-notch tested in accordance with ASME Section III, Subsection NF, Articles NF-2300, and NF-2430. The non-containment materials to be tested include the intermediate shells, overpack port cover plates, and applicable weld materials.

Tables 2.1.22 and 2.1.23 provide the test temperatures or T_{NDT}, and test requirements to be used when performing the testing specified above.

Test results shall be documented and shall become part of the final quality documentation record package.

8.1.2.4 Pneumatic Testing of the Neutron Shield Enclosure Vessel

A pneumatic pressure test of the neutron shield enclosure vessel shall be performed following final closure welding of the enclosure shell returns and enclosure panels. The pneumatic test pressure shall be 37.5+2.5,-0 psig, which is 125 percent of the ~~rupture disc~~ relief *device* set pressure. The test shall be performed in accordance with approved written procedures.

During the test, the ~~two rupture discs~~ *relief devices* on the neutron shield enclosure vessel shall be removed. One of the ~~rupture disc~~*relief device* threaded connections is used for connection of the air pressure line and the other ~~rupture disc~~ connection will be used for connection of the pressure gauge.

Following the introduction of pressurized air into the neutron shield enclosure vessel, a 15 minute pressure hold time is required. If the neutron shield enclosure vessel fails to hold pressure, an approved soap bubble solution shall be applied to determine the location of the leak. The leak shall be repaired using weld repair procedures prepared in accordance with the ASME Code Section III, Subsection NF, Article NF-4450. The pneumatic pressure test shall be re-performed until no pressure loss is observed.

Test results shall be documented and shall become part of the final quality documentation package.

8.1.3 Leakage Testing

Leakage testing shall be performed in accordance with the requirements of ANSI N14.5 [8.1.9]. Testing shall be performed in accordance with written and approved procedures.

8.1.3.1 HI-STAR Overpack

A Containment System Fabrication Verification Leakage test of the welded structure shall be performed at any time after the containment boundary fabrication is complete. Preferably, this test should be performed at the completion of overpack fabrication, after all intermediate shells have been attached. The leakage test instrumentation shall have a minimum test sensitivity of $2.15x10^{-6}$ atm cm^3/s (helium). Containment boundary welds shall have indicated leakage rates not exceeding $4.3x10^{-6}$ atm cm^3/s (helium). If a leakage rate exceeding the acceptance criterion is detected, the area of leakage shall be determined using the sniffer probe method or other means, and the area shall be repaired per ASME Code Section III, Subsection NB, NB-4450 requirements. Following repair and appropriate NDE, the leakage testing shall be re-performed until the test acceptance criterion is satisfied.

> Note: If failure of the leakage rate retest occurs after initial repairs are completed, a nonconformance report shall be issued and root cause and corrective action shall be addressed before further repairs and retest are performed.

At the completion of overpack fabrication, helium leakage through the helium retention penetrations (consisting of the inner mechanical seal between the closure plate and the top flange and the vent and drain port plug seals) shall be demonstrated to not exceed the leakage rate of $4.3x10^{-6}$ atm cm^3/sec (helium) at a minimum test sensitivity of $2.15x10^{-6}$ atm cm^3/sec (helium). This may be performed simultaneously with the Containment System Fabrication Verification Leakage test or may be performed separately using the methods described in the paragraph below.

At the completion of fabrication, a Containment System Fabrication Verification Leakage test shall be performed on the HI-STAR overpack closures. Helium leakage through the containment penetrations (consisting of the inner mechanical seal between the closure plate and top flange, and the vent and drain port plug seals) shall be demonstrated to not exceed a leakage rate of $4.3x10^{-6}$ atm cm^3/s (helium) at a minimum test sensitivity of $2.15x10^{-6}$ atm cm^3/s (helium).

The leakage testing is performed by evacuating and backfilling the overpack with helium gas to an appropriate pressure. A helium Mass Spectrometer Leak Detector (MSLD) with a minimum calibrated sensitivity of $2.15x10^{-6}$ atm cm^3/s (helium) shall be used in parallel with a vacuum pump and a test cover (see Chapter 7 for details) designed for testing the penetration seals. Starting with the vent or drain port plug, the test cover is connected. The cavity on the external side of the port plug is evacuated and the vacuum pump is valved out. The MSLD detector measures the leakage rate of helium into the test cavity. If the leakage rate exceeds a leakage rate of 4.3×10^{-6} atm cm^3/s (helium), the test chamber is vented and removed. The corresponding plug seal is removed, seal seating surfaces are inspected and cleaned, and the plug with a new seal is reinstalled and torqued to the required value. The test process is then repeated until the seal leakage rate is successfully achieved. The same process is repeated for the remaining overpack vent or drain port. The process is used for the closure plate seals except the closure plate test tool (see Chapter 7 for details) is used in lieu of the test cover.

If the total measured leakage rate for all tested penetrations does not exceed 4.6×10^{-6} atm cm^3/sec, the leakage tests are successful. If the total leakage rate exceeds 4.6×10^{-6} atm cm^3/sec, an evaluation should be performed to determine the cause of the leakage, repairs made as necessary, and the overpack must be re-tested until the total leakage rate is within the required acceptance criterion. Leak testing results for the HI-STAR overpack shall become part of the quality record documentation record package.

8.1.3.2 MPC Secondary Containment Boundary

Upon the completion of welding the MPC shell to the baseplate, a confinement boundary weld leakage test shall be performed using a helium MSLD as described in Chapter 9 of the HI-STAR ~~T~~*F*SAR [8.1.4]. The pressure boundary welds of the MPC canisters shall have indicated leakage rates not exceeding 5×10^{-6} atm cm^3/s (helium). If leakage rates exceeding the test criteria are detected, then the area of leakage shall be determined and the area repaired per ASME Code Section III, Subsection NB, NB-4450, requirements. Re-testing of the MPC shall be performed until the leakage rate acceptance criterion is met.

> Note: If failure of the leakage rate retest occurs after initial repairs are completed, a nonconformance report shall be issued and root cause and corrective action shall be addressed before further repairs and retest are performed.

Leakage testing of the field welded MPC lid-to-shell weld shall be performed following completion of the MPC hydrostatic test performed per Subsection 8.1.2.2.2. Leakage testing of the vent and drain port cover plate welds shall be performed after welding of the cover plates and subsequent NDE. The description and procedures for these field tests are provided in Section 7.1.

All leak testing results for the MPC shall be documented and shall become part of the quality record documentation package.

Prior to the transport of an MPC-68F *or MPC-24EF* containing fuel debris in the HI-STAR 100 Package, a Containment Fabrication Verification Leakage Test shall be performed on the secondary containment boundary of the MPC~~-68F~~. The test is performed with the MPC~~-68F~~ loaded into the HI-STAR overpack. The HI-STAR overpack annulus is sampled to inspect for radioactive material and then evacuated to an appropriate vacuum condition. The HI-STAR overpack annulus is then isolated from the vacuum pump. Following an appropriate isolation period, the HI-STAR overpack annulus atmosphere is sampled for helium leakage from the

MPC-~~68F~~. The test is considered acceptable if the detected leakage from the MPC does not exceed 5×10^{-6} atm cm^3/s (helium). If the acceptance criterion is not met, transport of the MPC-68F *or MPC-24EF* is not authorized. Corrective actions from re-testing, up to and including off-loading of the MPC, shall be taken until the leakage rate acceptance criterion is met.

8.1.4 Component Tests

8.1.4.1 Valves, ~~Rupture Discs~~*Relief Devices*, and Fluid Transport Devices

There are no fluid transport devices associated with the HI-STAR 100 Package. The only valve-like components in the HI-STAR 100 Package are the specially designed caps installed in the MPC lid for the drain and vent ports. These caps are recessed inside the MPC lid and covered by the fully-welded vent and drain port cover plates. No credit is taken for the caps' ability to confine helium or radioactivity. After completion of drying and backfill operations, the drain and vent port cover plates are welded in place on the MPC lid and are leak tested to verify the MPC secondary containment (MPC-68F) boundary.

The vent and drain ports in the HI-STAR overpack are accessed through port plugs specially designed for removal and installation using connector tools. The tools are described and presented in figures in Chapter 7.

There are two *relief devices (e.g.,* rupture discs*)* installed in the upper ledge surface of the neutron shield enclosure vessel of the HI-STAR overpack. These ~~rupture discs~~*relief devices* are provided for venting purposes under hypothetical fire accident conditions in which vapor formation from neutron shielding material degradation may occur. The ~~rupture discs~~*relief devices* are designed to relieve at 30 psig (± 5 psig). ~~Each manufactured lot of rupture discs shall be sample tested to verify their point of rupture. The sample test program shall be documented and the test results shall become part of the quality record documentation package.~~

8.1.4.2 Seals and Gaskets

Two concentric mechanical seals are provided on the HI-STAR overpack closure plate to provide containment boundary sealing. Mechanical seals are also used on the overpack vent and drain port plugs of the HI-STAR overpack containment boundary. Each primary seal is individually leak tested in accordance with Subsection 8.1.3.1. prior to the HI-STAR 100 Package's first use and during each loading operation. An independent and redundant seal is provided for each penetration (e.g., closure plate, port cover plates, and closure plate test plug). No containment credit is taken for these redundant seals and they are not leakage tested. Details on these seals are provided in Chapter 4.

8.1.4.3 Transport Impact Limiter

The removable HI-STAR transport impact limiters consist of aluminum honeycomb crush material arranged around a carbon steel structure and enclosed by a stainless steel shell. The ~~Design D~~*d*rawings ~~and Bills of Material~~ in Chapter 1 specify the crush strength of the aluminum honeycomb materials *(nominal +/- 7%)* for each zone of the impact limiter. For manufacturing purposes, verification of the impact limiter material is accomplished by performance of a crush test of sample blocks of aluminum honeycomb material for each large block manufactured. The verification tests are performed by the aluminum honeycomb supplier in accordance with approved procedures. The certified test results shall be submitted to Holtec International with each shipment. ~~The honeycomb material crush strength for each block (nominal ± 7%) shall be as specified on the Design Drawings in Section 1.4.~~

All welds on the HI-STAR impact limiter shall be visually examined in accordance with the ASME Code, Section V, Article 9, with acceptance criteria per ASME Section III, Subsection NF, Article NF-5360.

8.1.5 Shielding Integrity

The HI-STAR 100 System has three specifically designed shields for neutron and gamma ray attenuation. For gamma shielding, there are successive carbon steel intermediate shells attached onto the outer surface of the overpack inner shell. The details of the manufacturing process are discussed in Chapter 1. Holtite-A neutron shielding is provided in the outer enclosure of the overpack. Additional neutron attenuation is provided by the encased Boral neutron absorber attached to the fuel basket cell surfaces inside the MPCs. Test requirements for each of the three shielding items are described below.

8.1.5.1 Fabrication Testing and Controls

Holtite-A:

Neutron shield properties of Holtite-A are provided in Chapter 1. Each manufactured lot of neutron shield material shall be tested to verify that the material composition (aluminum and hydrogen), boron concentration, and neutron shield density (or specific gravity) meet the requirements specified in Chapter 1. A manufactured lot is defined as the total amount of material used to make any number of mixed batches comprised of constituent ingredients from the same lot/batch identification numbers supplied by the constituent manufacturer. Testing shall be performed in accordance with written and approved procedures and/or standards. Material composition, boron concentration, and density (or specific gravity) data for each manufactured lot of neutron shield material shall become part of the quality record documentation package.

The installation of the neutron shielding material shall be performed in accordance with written, approved, and qualified procedures. The procedures shall ensure that mix ratios and mixing methods are controlled in order to achieve proper material composition, boron concentration and distribution, and that pours are controlled in order to prevent gaps or voids from occurring in the material. Samples of each *manufactured* lot of neutron shield material shall be maintained by Holtec International ~~as part of the quality record documentation package.~~

Steel:

The steel plates utilized in the construction of the HI-STAR 100 Package shall be dimensionally inspected to assure compliance with the ~~Design D~~*d*rawings in Section 1.4.

The total measured thickness of the inner shell plus intermediate shells shall be nominally 8.5 inches over the total surface area of the overpack shell. The top flange, closure plate, and bottom plate of the overpack shall be measured to confirm their thicknesses meet ~~Design D~~*d*rawing requirements of Section 1.4. Measurements shall be performed in accordance with written and approved procedures. ~~The measurement locations and measurement results shall be documented.~~ Measurements shall be made through a combination of receipt inspection thickness measurements on individual plates and actual measurements taken prior to welding the forgings and shells. Any area found to be under the specified minimum thickness shall be repaired in accordance with applicable ASME Code requirements.

No additional gamma shield testing of the HI-STAR 100 Package is required. A shielding effectiveness test as described in Subsection 8.1.5.2 shall be performed on each fabricated HI-STAR 100 Package after the first fuel loading.

General for Shield Materials:

1. Test results shall be documented and become part of the quality documentation package.

2. Dimensional inspections of the cavities containing poured neutron shielding materials shall assure that the amount of shielding material specified in the design documents is incorporated into the fabricated item.

8.1.5.2 Shielding Effectiveness Tests

Users shall implement procedures ~~which~~ *that* verify the integrity of the Holtite-A neutron shield once for each overpack. Neutron shield integrity shall be verified via measurements either at first use or with a check source using, at a maximum, a 6x6 inch test grid over the entire surface of the neutron shield, including the impact limiters. *If a significant breakdown in the Holtite shielding is discovered during the test, appropriate corrective actions shall be taken to restore adequate neutron shielding.*

~~Following the first fuel loading of~~*Prior to* each *shipment of a loaded* HI-STAR 100 Package, a shielding effectiveness test shall be performed ~~at the loading facility site~~ to verify ~~the~~ *compliance with the dose rate limits of 10 CFR 71.* ~~effectiveness of the gamma and neutron shields.~~ This test shall be performed after the HI-STAR 100 Package has been loaded with fuel, drained, sealed, and backfilled with helium.

The neutron and gamma shielding effectiveness tests shall be performed using written and approved procedures. Calibrated neutron and gamma dose meters shall be used to measure the actual neutron and gamma dose rates at the surface of the HI-STAR overpack. ~~Measurements shall be taken at three cross sectional planes and at four points along each plane's circumference. Additionally, four measurements shall be taken at the top of the overpack closure plate. Dose rate measurements shall be documented and become part of the quality documentation package. The average results from each sectional plane shall be compared to the design basis limits for surface dose rates established in Chapter 5. The test is considered acceptable if the actual dose readings are less than the predicted dose rates for the location measured.~~ If dose rates are higher than the ~~predicted design basis dose rates~~*regulatory limits*, the HI-STAR 100 Package shall not be placed into transport service until the discrepancy is adequately resolved. ~~See Chapter 7 for details on test performance and dose rate measurement locations.~~

8.1.5.3 Neutron Absorber Tests

Each plate of Boral shall be visually inspected by the manufacturer for damage (e.g., scratches, cracks, burrs, and peeled cladding) and foreign material embedded in the surfaces. In addition, the MPC fabricator shall visually inspect the Boral plates on a lot sampling basis. The sample size shall be determined in accordance with MIL-STD-105D or equivalent. The selected Boral plates shall be inspected for damage such as inclusions, cracks, voids, delamination, and surface finish.

After manufacturing, a statistical sample of each lot of Boral shall be tested using wet chemistry and/or neutron attenuation techniques to verify a minimum ^{10}B content at the ends of the panel. *The minimum ^{10}B loading of the Boral panels for each MPC model is provided in Table 1.2.3* Any panel in which ^{10}B loading is less than the minimum allowed per the ~~Design D~~drawings *in Section 1.4*~~and Bills of Material~~ shall be rejected.

Tests shall be performed using written and approved procedures. Results shall be documented and become part of the ~~HI-STAR 100 Package~~ quality records documentation package.

Installation of Boral panels into the fuel basket shall be performed in accordance with written and approved procedures (or shop travelers). Travelers and/or quality control procedures shall be in place to assure each required cell wall of the MPC basket contains a Boral panel in accordance with the ~~Design D~~drawings *in Section 1.4.* ~~in Chapter 1.~~ These quality control processes, in conjunction with Boral manufacturing testing, provide the necessary assurances that the Boral will perform its intended function. The criticality design for the HI-STAR 100 System is based on favorable geometry and fixed neutron poisons. The inert helium environment inside the MPC cavity where the Boral is located ensures that the poisons will remain effective for the life of the canister. Given the design and service conditions, there are no credible means to lose the fixed neutron poisons. Therefore, no additional testing is required to ensure the Boral is present and in proper condition per 10 CFR 71.87(g).

8.1.6 Thermal Acceptance Test

The first fabricated HI-STAR overpack shall be tested to confirm its heat transfer capability. The test shall be conducted after the radial channels, enclosure shell panels, and neutron shield material have been installed and all inside and outside surfaces are painted per the ~~Design D~~drawings in Section 1.4. A test cover plate shall be used to seal the overpack cavity. Testing shall be performed in accordance with written and approved procedures.

Steam heating of the overpack cavity surfaces is the preferred method for this test instead of electric heating. There are several advantages with steam heated testing as listed below:

(i) Uniform cavity surface temperatures are readily achieved as a result of high steam condensation heat transfer coefficient (about 2,000 Btu/ft^2 hr-^{o}F compared to about 1 Btu/ft^2 hr-^{o}F for air) coupled with the steam's uniform distribution throughout the cavity.

(ii) A reliable constant temperature source (steam at atmospheric pressure condenses at 212^o F compared to variable heater surface temperatures in excess of 1,000^o F) eliminates concerns of overpack cavity surface overheating.

(iii) Interpretation of isothermal test data is not susceptible to errors associated with electric heating systems due to heat input measurement uncertainties, leakage of heat from electrical cables, thermocouple wires, overpack lid, bottom baseplate, etc.

(iv) The test setup is simple requiring only a steam inlet source and drain compared to numerous power measurement and control instruments, switchgear and safety interlocks required to operate an electric heater assembly.

Twelve (12) calibrated thermocouples shall be installed on the external walls of the overpack as shown in Figure 8.1.2. Three calibrated thermocouples shall be installed on the internal walls of the overpack in locations to be determined by procedure. Additional temperature sensors shall be used to monitor ambient temperature, steam supply temperature, and condensate drain temperature. The thermocouples shall be attached to strip chart recorders or other similar mechanism to allow for continuous monitoring and recording of temperatures during the test. Instrumentation shall be installed to monitor overpack cavity internal pressure.

After the thermocouples have been installed, dry steam will be introduced through an opening in the test cover plate previously installed on the overpack and the test initiated. Temperatures of the thermocouples, plus ambient, steam supply, and condensate drain temperature shall be recorded at hourly intervals until thermal equilibrium is reached. Appropriate criteria defining when thermal equilibrium is achieved shall be determined based on a variety of potential ambient test conditions and incorporated into the test procedure. In general, thermal equilibrium is expected approximately 12 hours after the start of steam heating. Air will be purged from the overpack cavity via venting during the heatup cycle. During the test, the steam condensate flowing out of the overpack drain shall be collected and the mass of the condensate measured with a precision weighing instrument.

Once thermal equilibrium is established, the final ambient, steam supply, and condensate drain temperatures and temperatures at each of the thermocouples shall be recorded. The strip charts, hand-written logs, or other similar readout shall be marked to show the point when thermal equilibrium was established and final test measurements were recorded. The final test readings along with the hourly data inputs and strip charts (or other similar mechanism) shall become part of the quality records documentation package for the HI-STAR 100 Package.

The heat rejection capability of the overpack at test conditions shall be computed using the following formula:

$$Q_{hm} = (h_l - h_2)\, m_c \qquad (8\text{-}1)$$

Where: Q_{hm} = Heat rejection rate of the overpack (Btu/hr)

h_l = Enthalpy of steam entering the overpack cavity (Btu/lbm)

h_2 = Enthalpy of condensate leaving the overpack cavity (Btu/lbm)

m_c = Average rate of condensate flow measured during thermal equilibrium conditions (lbm/hr)

Based on the HI-STAR 100 overpack thermal model, a design basis minimum heat rejection capacity (Q_{hd}) shall be computed at the measured test conditions (i.e., steam temperature in the overpack cavity and ambient air temperature). The thermal test shall be considered acceptable if the measured heat rejection capability is greater than the design basis minimum heat rejection capacity ($Q_{hm} > Q_{hd}$).

The summary of reference ambient inputs that define the thermal test environment are provided in Table 8.1.4. In Figure 8.1.3, a steady-state temperature contour plot of a steam heated overpack is provided based on the thermal analysis methodology described in SAR Chapter 3. Transient heating of the overpack is also determined to establish the time required to approach (within 2° F) the equilibrium temperatures. The surface temperature plot shown in Figure 8.1.4 demonstrates that a 12-hour steam heating time is adequate to closely approach the equilibrium condition.

If the acceptance criteria above are not met, then the HI-STAR 100 Package shall not be accepted until the root cause is determined, appropriate corrective actions are completed, and the overpack is re-tested with acceptable results.

Test results shall be documented and shall become part of the quality record documentation package.

8.1.7 Cask Identification

Each HI-STAR 100 Package shall be provided with unique identification plates with appropriate markings per 10CFR71.85(c) and 10CFR72.236(k). ~~as shown in the Design Drawings in Section 1.4.~~ The identification plates shall not be installed until each HI-STAR 100 Package component has completed the fabrication acceptance test program and been accepted by authorized Holtec International personnel. A unique identifying serial number shall also be stamped on the MPC to provide traceability back to the MPC specific quality records documentation package.

Table 8.1.1

MPC INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operations
Visual Inspection and Nondestructive Examination (NDE)	a) Examination of MPC components per ASME Code Section III, Subsections NB, NF, and NG, ~~as defined on design drawings~~, per NB-5300, NF-5300, and NG-5300, as applicable. b) A dimensional inspection of the ~~internal~~ *fuel* basket assembly and canister shall be performed to verify compliance with design requirements. c) A dimensional inspection of the MPC lid and MPC closure ring shall be performed prior to inserting into the canister shell to verify compliance with design requirements. d) NDE of weldments are defined on the ~~design~~ drawings using standard American Welding Society NDE symbols and/or notations. e) Cleanliness of the MPC shall be verified upon completion of fabrication. f) The packaging of the MPC at the completion of fabrication shall be verified prior to shipment.	a) The MPC shall be visually inspected prior to placement in service at the licensee's facility. b) MPC protection at the licensee's facility shall be verified. c) MPC cleanliness and exclusion of foreign material shall be verified prior to placing in the spent fuel pool.	a) None.

Table 8.1.1 (continued)

MPC INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operations
Structural	a) Assembly and welding of MPC components shall be performed per ASME Code Section IX and III, Subsections NB, NF, and NG, as applicable. b) Materials analysis (steel, Boral, etc.), shall be performed and records shall be kept in a manner commensurate with "important to safety" classifications.	a) None.	a) An ultrasonic (UT) examination or multi-layer liquid penetrant (PT) examination of the MPC lid-to-shell weld shall be performed per ASME Section V, Article 5 (or ASME Section V, Article 2). Acceptance criteria for the examination are defined in Subsection 8.1.1.1. ~~and in the Design Drawings.~~ b) ASME Code NB-6000 hydrostatic test shall be performed after MPC closure welding. Acceptance criteria are defined in Subsection 8.1.2.2.2.
Leak Tests	a) Helium leak rate testing shall be performed on all MPC pressure boundary shop welds.	a) None.	a) Helium leak rate testing shall be performed on MPC lid-to-shell, and vent and drain ports-to-MPC lid field welds after closure welding. Acceptance criteria are defined in Subsection 8.1.3.2. b) A Containment System Fabrication Verification Leakage Test shall be performed on the MPC-68F prior to the transport of the HI-STAR 100 Package containing fuel debris. Acceptance criteria are defined in Subsection 8.1.3.2.

Table 8.1.1 (continued)

MPC INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operations
Criticality Safety	a) The boron content shall be verified at the time of neutron absorber material manufacture. b) The installation of Boral panels into MPC basket plates shall be verified by inspection.	a) None.	a) None.
Shielding Integrity	a) Material compliance shall be verified through CMTRs. b) Dimensional verification of MPC lid thickness shall be performed.	a) None.	a) None.
Thermal Acceptance	a) None.	a) None.	a) None.
Fit-Up Tests	a) Fit-up of the following components is to be tested during fabrication. - MPC lid - vent/drain port cover plates - MPC closure ring b) A gauge test of all basket fuel compartments.	a) Fit-up of the following components is to be verified during pre-operation. - MPC lid - MPC closure ring vent/drain cover plates	a) None.
Canister Identification Inspections	a) Verification of identification marking applied at completion of fabrication.	a) Identification marking shall be checked for legibility during pre-operation.	a) None.

Table 8.1.2

HI-STAR OVERPACK INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operations
Visual Inspection and Nondestructive Examination (NDE)	a) Examination of the HI-STAR overpack shall be performed per ASME Code, Subsection NB, NB-5300 for containment boundary components, and Subsection NF, NF-5300 for non-containment boundary components. b) A dimensional inspection of the overpack internal cavity, external dimensions, and closure plate shall be performed to verify compliance with design requirements. c) The HI-STAR overpack shall be visually examined in accordance with the ASME Code Section V, Article 9, to verify that the overpack is free of cracks, pinholes, uncontrolled voids, or other defects that could significantly reduce its effectiveness. d) NDE of weldments shall be defined on ~~design~~ drawings using standard American Welding Society NDE symbols and/or notations. e) Cleanliness of the HI-STAR overpack shall be verified upon completion of fabrication. f) Packaging of the HI-STAR overpack at the completion of fabrication shall be verified prior to shipment. g) Examination of the AL-STAR impact limiters shall be performed per ASME Code, Subsection NF, NF-5300.	a) The HI-STAR overpack shall be visually inspected prior to placement in service at the licensee's facility. b) HI-STAR overpack protection at the licensee's facility shall be verified. c) HI-STAR overpack cleanliness and exclusion of foreign material shall be verified prior to use.	a) Inspect overpack cavity and accessible external surfaces prior to each fuel loading. b) Visually inspect impact limiters for damage and compliance to drawing requirements prior to each transport.

Table 8.1.2 (continued)

HI-STAR OVERPACK INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operations
Structural	a) Assembly and welding of HI-STAR overpack components shall be performed per ASME Code, Subsection NB and NF, as applicable. b) Verification of structural materials shall be performed through receipt inspection and review of certified material test reports (CMTRs) obtained in accordance with the item's quality classification category. c) A load test of the lifting trunnions shall be performed during fabrication. d) A pressure test of the containment boundary in accordance with ASME Code Section III, Subsection NB-6000 and 10CFR71.85(b) shall be performed. e) A pneumatic pressure test of the neutron shield enclosure shall be performed during fabrication.	a) None.	a) The ~~rupture discs~~relief devices on the neutron shield vessel shall be replaced every 5 years.

Table 8.1.2 (continued)

HI-STAR OVERPACK INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operations
Leak Tests	a) Containment Fabrication Verification Leakage rate testing of the HI-STAR containment boundary welds shall be performed in accordance with ANSI N14.5. b) A Containment System Fabrication Verification Leakage rate test shall be performed on all HI-STAR overpack containment boundary mechanical seal boundaries in accordance with ANSI N14.5 at the completion of fabrication.	a) None.	a) Containment System Periodic Verification Leakage Test of the HI-STAR 100 Package shall be performed prior to each loaded transport (if not previously tested within 12 months). b) Containment System Fabrication Verification Leakage Test of the HI-STAR 100 Package shall be performed after the third use.
Criticality Safety	a) None.	a) None.	a) None.
Shielding Integrity	a) Material verifications (Holtite-A, shell plates, etc.), shall be performed in accordance with the item's ~~quality category~~*safety classification*. The required material certifications shall be obtained. b) The placement of Holtite-A shall be controlled through written special process procedures.	a) None.	a) A shielding effectiveness test shall be performed after the first fuel loading and reperformed every five years while in service. b) Verify the integrity of the Holtite-A neutron shield once at first use or with a check source.

Table 8.1.2 (continued)

HI-STAR OVERPACK INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operation
Thermal Acceptance	a) A thermal acceptance test is performed at completion of fabrication of the first HI-STAR overpack to confirm the heat transfer capabilities.	a) None.	a) An in-service thermal test shall be performed every five years during transport operations, or prior to transport if period exceeds five years from previous test. Acceptance criteria are defined in Subsection 8.2.6.
Cask Identification Inspection	a) Identification plates shall be installed on the HI-STAR overpack at completion of the acceptance test program.	a) The identification plates shall be checked prior to loading.	a) The identification plates shall be periodically inspected per licensee procedures and shall be repaired or replaced if damaged.
Fit-Up Tests	a) Fit-up tests of HI-STAR 100 Package components (closure plates, port plugs, cover plates impact limiters (if available)), shall be performed during fabrication.	a) Fit-up test of the HI-STAR overpack lifting trunnions with the lifting yoke shall be performed. b) Fit-up test of the HI-STAR overpack rotation trunnions with the transport frame shall be performed. c) Fit-up test of the MPC into the HI-STAR overpack shall be performed prior to loading.	a) Fit-up of all removable components shall be verified during each loading operation.

Table 8.1.3

HI-STAR 100 NDE REQUIREMENTS

MPC			
Weld Location	**NDE Requirement**	**Applicable Code**	**AcceptanceCriteria (Applicable Code)**
Shell longitudinal seam	RT PT (surface)	ASME Section V, Article 2 (RT) ASME Section V, Article 6 (PT)	RT: ASME Section III, Subsection NB, Article NB-5320 PT: ASME Section III, Subsection NB, Article NB-5350
Shell circumferential seam	RT PT (surface)	ASME Section V, Article 2 (RT) ASME Section V, Article 6 (PT)	RT: ASME Section III, Subsection NB, Article NB-5320 PT: ASME Section III, Subsection NB, Article NB-5350
Baseplate-to-shell	RT or UT PT (surface)	ASME Section V, Article 2 (RT) ASME Section V, Article 5 (UT) ASME Section V, Article 6 (PT)	RT: ASME Section III, Subsection NB, Article NB-5320 UT: ASME Section III, Subsection NB, Article NB-5330 PT: ASME Section III, Subsection NB, Article NB-5350

Table 8.1.3 (continued) HI-STAR 100 NDE REQUIREMENTS			
		MPC	
Weld Location	**NDE Requirement**	**Applicable Code**	**Acceptance Criteria (Applicable Code)**
Lid-to-shell	PT (root and final pass) and multi-layer PT (if UT is not performed). PT (surface following hydrostatic test) UT (if multi-layer PT is not performed)	ASME Section V, Article 6 (PT) ASME Section V, Article 5 (UT)	PT: ASME Section III, Subsection NB, Article NB-5350 UT: ASME Section III, Subsection NB, Article NB-5332
Closure ring-to-shell	PT (final pass)	ASME Section V, Article 6 (PT)	PT: ASME Section III, Subsection NB, Article NB-5350
Closure ring-to-lid	PT (final pass)	ASME Section V, Article 6 (PT)	PT: ASME Section III, Subsection NB, Article NB-5350
Closure ring radial welds	PT (final pass)	ASME Section V, Article 6 (PT)	PT: ASME Section III, Subsection NB, Article NB-5350
Port cover plates-to-lid	PT (root and final pass)	ASME Section V, Article 6 (PT)	PT: ASME Section III, Subsection NB, Article NB-5350
~~Lift lug and lift lug baseplate~~	~~PT (surface)~~	~~ASME Section V, Article 6 (PT)~~	~~PT: ASME Section III, Subsection NG, Article NG-5350~~
Vent and drain port cover plate plug welds	*PT (surface)*	*ASME Section V, Article 6 (PT)*	*PT: ASME Section III, Subsection NG, Article NG-5350*

Table 8.1.3 (continued) HI-STAR 100 NDE REQUIREMENTS			
HI-STAR OVERPACK			
Weld Location	**NDE Requirement**	**Applicable Code**	**Acceptance Criteria (Applicable Code)**
Inner shell-to-top flange	RT MT or PT (surface)	ASME Section V, Article 2 (RT) ASME Section V, Article 7 (MT) ASME Section V, Article 6 (PT)	RT: ASME Section III, Subsection NB, Article NB-5320 MT: ASME Section III, Subsection NB, Article NB-5340 PT: ASME Section III, Subsection NB, Article NB-5350
Inner shell-to-bottom plate	RT MT or PT (surface)	ASME Section V, Article 2 (RT) ASME Section V, Article 7 (MT) ASME Section V, Article 6 (PT)	RT: ASME Section III, Subsection NB, Article NB-5320 MT: ASME Section III, Subsection NB, Article NB-5340 PT: ASME Section III, Subsection NB, Article NB-5350
Inner shell longitudinal seam	RT MT or PT (surface)	ASME Section V, Article 2 (RT) ASME Section V, Article 7 (MT) ASME Section V, Article 6 (PT)	RT: ASME Section III, Subsection NB, Article NB-5320 MT: ASME Section III, Subsection NB, Article NB-5340 PT: ASME Section III, Subsection NB, Article NB-5350

Table 8.1.3 (continued) HI-STAR 100 NDE REQUIREMENTS			
HI-STAR OVERPACK			
Weld Location	**NDE Requirement**	**Applicable Code**	**AcceptanceCriteria (Applicable Code)**
Inner shell circumferential seam	RT MT or PT (surface)	ASME Section V, Article 2 (RT) ASME Section V, Article 7 (MT) ASME Section V, Article 6 (PT)	RT: ASME Section III, Subsection NB, Article NB-5320 MT: ASME Section III, Subsection NB, Article NB-5340 PT: ASME Section III, Subsection NB, Article NB-5350
Intermediate shell welds (as noted on ~~Design D~~drawings)	MT or PT (surface)	ASME Section V, Article 6 (PT) ASME Section V, Article 7 (MT)	PT: ASME Section III, Subsection NF, Article NF-5350 MT ASME Section III, Subsection NF, Article NF-5340

Table 8.1.4

SUMMARY OF OVERPACK THERMAL ANALYSIS
REFERENCE AMBIENT INPUTS

PARAMETER	VALUE
Steam Temperature	212° F
Ambient Temperature	70° F
Radiative Blocking	None[1]
Exposed Surfaces Insolation	None

1 The test shall be performed on an isolated overpack. Thus, cask radiation blocking at an ISFSI array is not applicable to test conditions.

Figure 8.1.1 Deleted

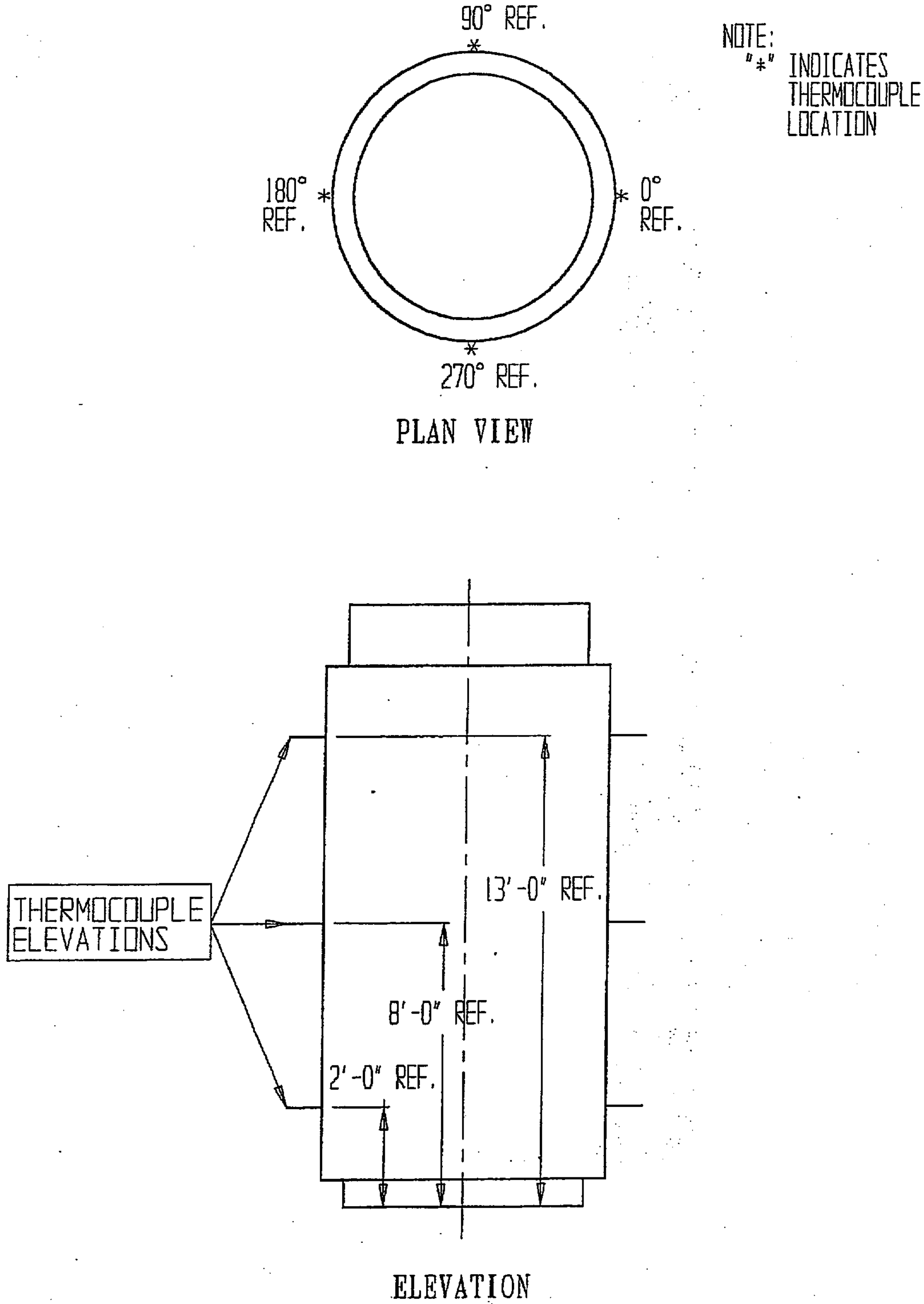


FIGURE 8.1.2; THERMOCOUPLE LOCATIONS

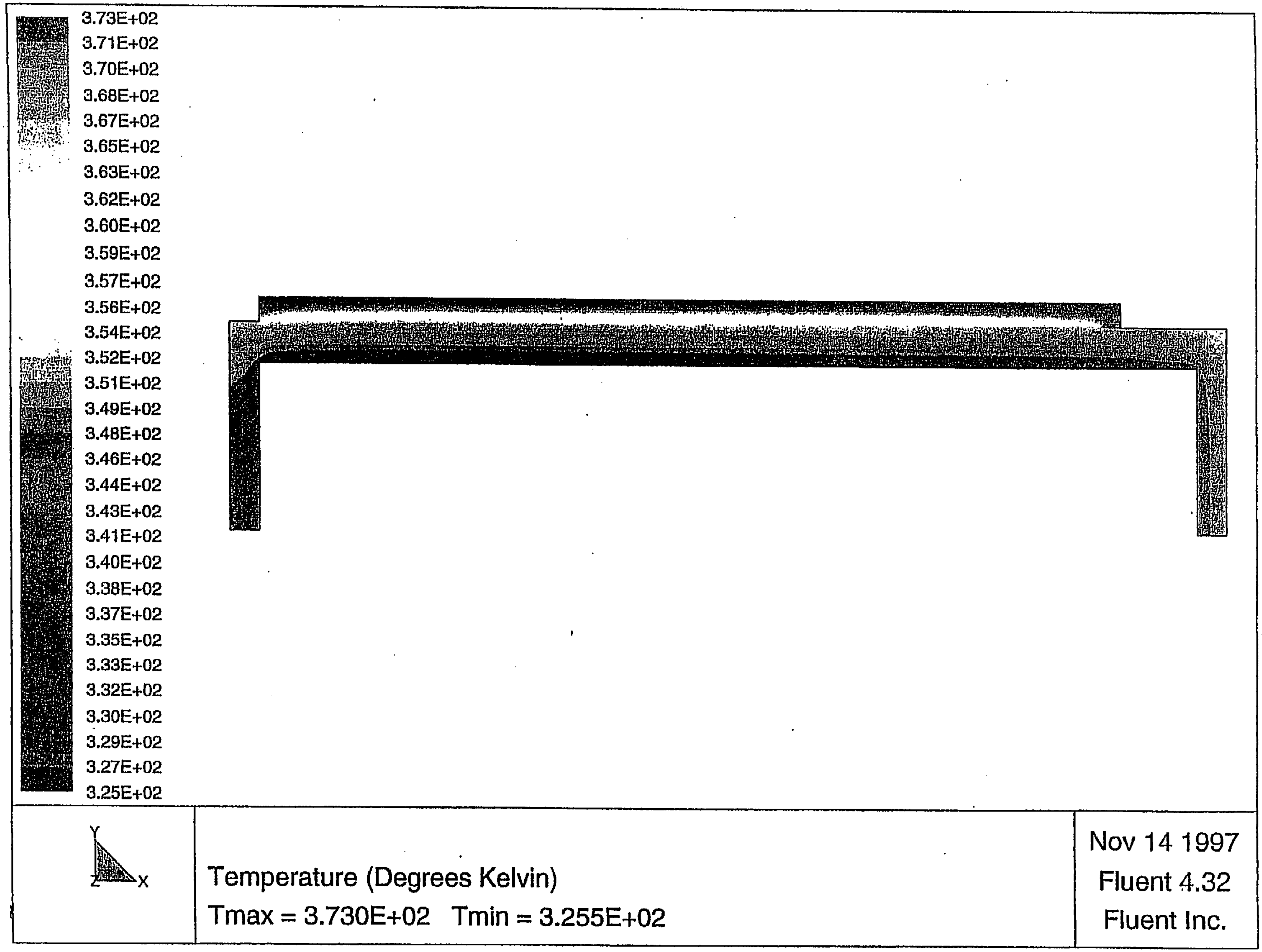


FIGURE 8.1.3 : OVERPACK STEAM HEATED TEST TEMPERATURE CONTOURS PLOT

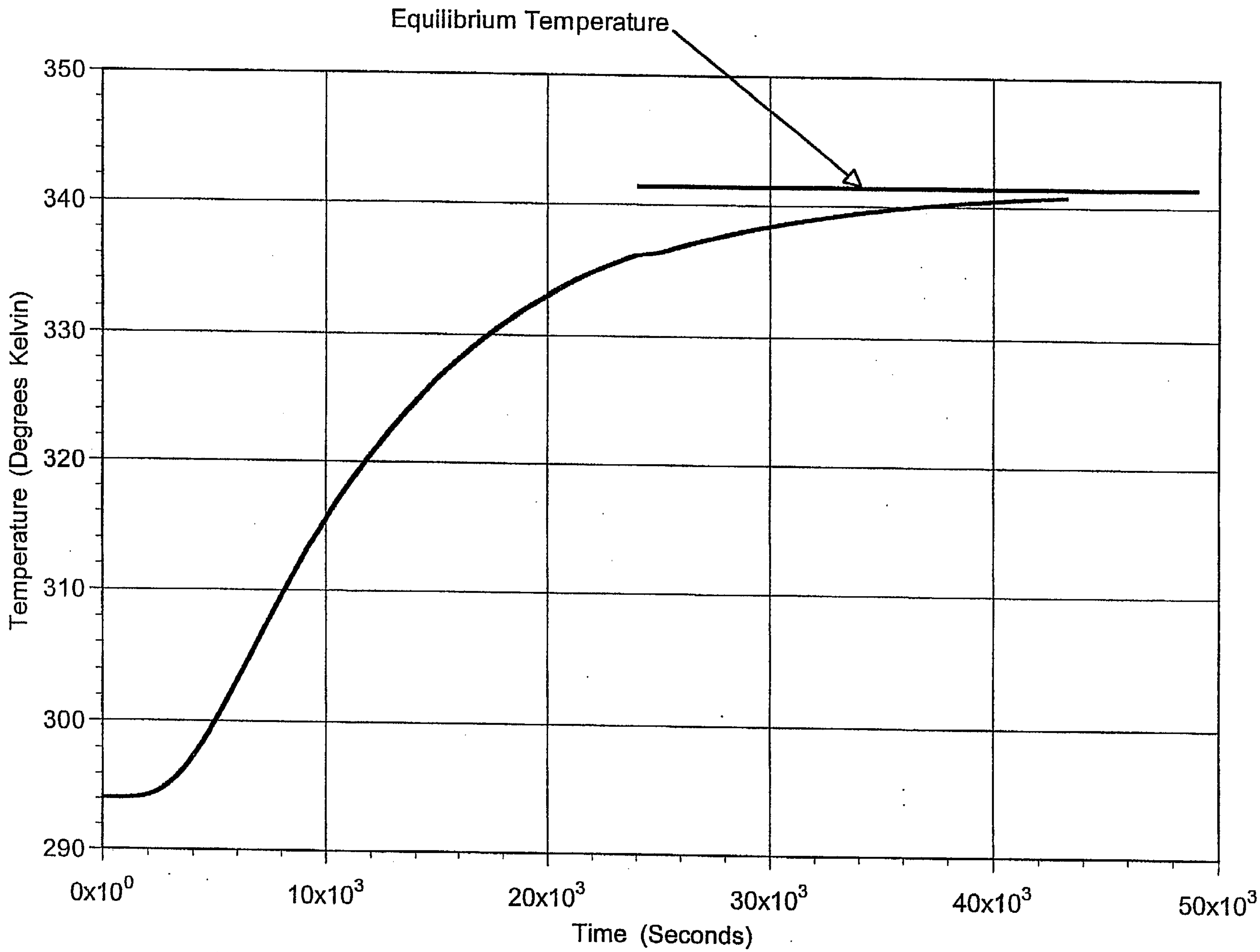


FIGURE 8.1.4: OVERPACK SURFACE TEMPERATURE HISTORY DURING A STEAM HEATED TEST

8.2 MAINTENANCE PROGRAM

An ongoing maintenance program is defined and incorporated in the HI-STAR 100 System Operations Manual which will be prepared and issued prior to the delivery and first use of the HI-STAR 100 Package. This document shall delineate the detailed inspections, testing, and parts replacement necessary to ensure continued radiological safety, proper handling, and containment performance of the HI-STAR 100 Package in accordance with 10CFR71 regulations, conditions in the Certificate of Compliance, and the design requirements and criteria contained in this Safety Analysis Report (SAR).

The HI-STAR 100 Package is totally passive by design. There are no active components or systems required to assure the continued performance of its safety functions. As a result, only minimal maintenance will be required over its lifetime, and this maintenance would primarily result from weathering effects, and pre- and post-usage requirements for transportation. Typical of such maintenance would be the reapplication of corrosion inhibiting materials on accessible external surfaces, and seal replacement and leak testing following replacement. Such maintenance requires methods and procedures *are* no more demanding than those currently in use at power plants.

A maintenance program schedule for the HI-STAR 100 Package is provided in Table 8.2.1.

8.2.1 Structural and Pressure Parts

Prior to each fuel loading, a visual examination in accordance with a written and approved procedure shall be required of the following HI-STAR 100 Package components: lifting trunnions (area outside of the overpack); pocket trunnion recesses; overpack internals and externals; and impact limiters. The examination shall inspect for indications of overstress such as cracking, deformation or wear marks, gross damage to components, or areas of chipped or missing surface coatings. Repairs or replacement in accordance with written and approved procedures shall be required if unacceptable conditions are identified.

No periodic structural or pressure tests on the overpack or MPCs following the initial acceptance tests are required to verify continuing performance.

8.2.2 Leakage Tests

There are no seals in the MPC secondary containment boundary (of the ~~MPC-68F~~ *"F" model MPCs*) because the MPC lid, port cover plates, and closure ring are welded closures. Mechanical seals are used on the HI-STAR 100 overpack containment boundary to ensure the retention of the radioactive material contents in the HI-STAR 100 Package. These seals are not temperature sensitive within the design temperature range, are resistant to corrosion and radiation environments, and are helium leak tested after fuel loading. The containment system has been designed to withstand normal and accident conditions of transport without loss of containment integrity. The overpack containment penetration seals shall be leakage tested in accordance with Chapter 7 and the acceptance criteria of Subsection 8.1.3.1 prior to transport if not previously tested within 12 months of the commencement of transport.

The mechanical seals on the overpack containment boundary shall be replaced as defined in Table 8.2.1. After each replacement, the helium leak test of the overpack containment seals described in Chapter 7 shall be performed to verify the leakage rate does not exceed 4.3×10^{-6} ~~std~~ *atm* cm^3/s (helium). Prior to replacement of each seal, the mating surfaces shall be cleaned and visually inspected for scratches, pitting or roughness, and affected surface areas shall be polished smooth or repaired as necessary in accordance with written and approved procedures. The bolting for the closure plate and the vent and drain port cover plates, and port plugs shall also be inspected for indications of wear, galling, or indentations on the threaded surfaces prior to reinstallation and closure torquing. Any bolt or port plug showing any of these indications shall be replaced.

8.2.3 Subsystem Maintenance

The HI-STAR 100 Package does not include any subsystems which provide auxiliary cooling or shielding. Normal maintenance and calibration testing is performed on the vacuum drying, helium backfill, and leakage testing systems based on manufacturer's recommendations. Rigging, remote welders, cranes, and lifting beams shall also be inspected in accordance with the operations manual to ensure proper maintenance and continued performance is achieved.

8.2.4 ~~Rupture Discs~~*Relief Devices*

The ~~two rupture discs~~*relief devices* on the overpack neutron shield enclosure shell shall be visually inspected prior to each use of the HI-STAR 100 Package for damage or indications of excessive corrosion. If the inspection determines an unacceptable condition, the ~~rupture discs~~*relief devices* shall be replaced. The ~~rupture discs~~*relief devices* shall be replaced with approved spares every five years while the cask is in transport service.

8.2.5 Shielding

The gamma and neutron shielding materials in the HI-STAR 100 degrade negligibly over time or as a result of usage. *Compliance with the dose rate limits of 10 CFR 71 must be demonstrated prior to each shipment. Therefore, periodic shielding effectiveness testing is not required.* ~~To ensure continuing compliance of the HI-STAR 100 Package to the design basis shielding values, the Shielding Effectiveness Test in accordance with Subsection 8.1.5.2 shall be performed every five years while the cask is in transport service.~~

~~The post loading and receipt radiation surveys performed in accordance with 10CFR71 and 10CFR20, prior to and at the completion of transport, as described in the Operating Procedures in Chapter 7, provide ongoing evidence and confirmation of shield integrity.~~

8.2.6 In-Service Thermal Test

A thermal performance test shall be performed on each HI-STAR 100 Package prior to commencing transportation operations. This test shall be performed immediately after a HI-STAR Package is loaded with spent nuclear fuel prior to transport or when a previously loaded

HI-STAR 100 System is prepared for transport if the test has not been successfully performed in the preceding five years. The in-service test is performed to verify an adequate rate of heat dissipation from the cask to the environs. Acceptable performance under test conditions ensures that design basis fuel cladding temperature limits to which the HI-STAR 100 Package is qualified under design basis heat loads will not be exceeded during transport.

Prior to performing the test, thermal equilibrium of the HI-STAR 100 Package shall be verified by measuring the temperature using a calibrated thermocouple or surface pyrometer at a defined point near the mid-plane of the HI-STAR 100 Package at one hour intervals for two hours. Appropriate criteria defining when thermal equilibrium is achieved shall be determined based on a variety of ambient test conditions and incorporated into the test procedure.

After thermal equilibrium is established, temperatures shall be measured and recorded using a calibrated thermocouple or surface pyrometer at the locations shown on Figure 8.2.1. The decay heat load and fuel cycle history of the fuel assemblies loaded in the HI-STAR 100 Package shall also be recorded. These records shall become part of the maintenance program quality records for the HI-STAR 100 Package.

The HI-STAR 100 Package is considered acceptable if the average measured surface to ambient temperature differential shown in Table 8.2.2, when adjusted for environmental conditions, is not exceeded.

8.2.7 Miscellaneous

The impact limiters shall be visually inspected in accordance with a written procedure prior to each use to inspect for surface denting, surface penetrations, and weld cracking. Any areas found to not meet the defined acceptance criteria shall be repaired and/or replaced in accordance with written and approved procedures.

Table 8.2.1

MAINTENANCE AND INSPECTION PROGRAM SCHEDULE

Task	Frequency
Overpack cavity and external surface (accessible) visual inspection	Prior to each fuel loading
Overpack bolting and port plug visual inspection	Prior to installation and prior to each transport
Lifting trunnion and pocket trunnion recess visual inspection	Prior to each fuel loading and prior to each transport
Containment System Periodic Leakage Test of closure plate, and vent and drain port plugs	Following each fuel loading, and prior to off-site transport if period from last test exceeds 1 year
Containment System Fabrication Verification Leakage Test of containment boundary closures	After third use
Containment System Fabrication Verification Leakage Test of ~~MPC-68F~~ *"F" model MPC* secondary containment boundary	Prior to each transport
Transport impact limiter visual inspection	Prior to each transport
Shielding effectiveness test	*Neutron shield: Once per overpack* *10 CFR 71 Compliance: Prior to each shipment*
Closure plate mechanical seal replacement	Following removal of closure plate bolting
Closure plate bolt replacement	Every 240 bolting cycles (assumes 20 years at 12 cycles per year)
Port plug seal replacement	Following removal of applicable port plug
Port cover plate seal replacement	Following removal of applicable cover plate
~~Rupture disc~~*Relief Device* visual inspection	Prior to each transport
~~Rupture disc~~*Relief Device* replacement	Every five years
In-service thermal test	Every five years during transportation operations, or prior to transport if period exceeds five years from previous test.

Table 8.2.2

HI-STAR 100 PACKAGE TEST CONDITION OVERPACK
SURFACE TO AMBIENT TEMPERATURE DIFFERENTIAL[1]
UNDER DESIGN BASIS DECAY HEAT LOADS AND INSOLATION

	~~MPC-24~~*PWR MPCs* ΔT (°F)	~~MPC-68~~*BWR MPCs* ΔT (°F)
Overpack Enclosure Active Fuel Mid-Height Location	122	117

1 This information is obtained from Tables 3.4.9 through 3.4.11 in SAR Chapter 3.

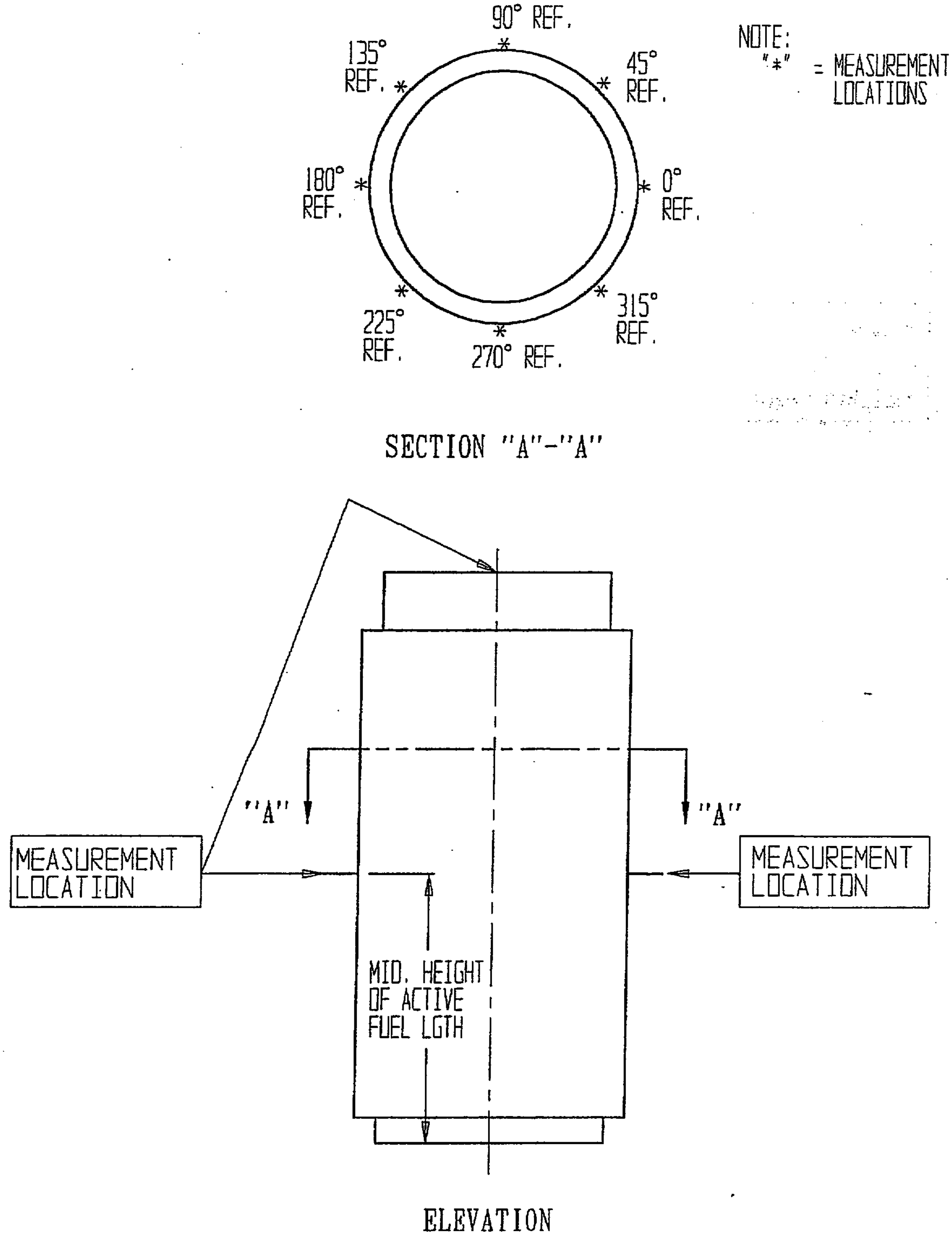


FIGURE 8.2.1; TEMPERATURE MEASUREMENT LOCATIONS FOR PERIODIC THERMAL TEST

8.3 REGULATORY COMPLIANCE

This chapter summarizes the commitments of Holtec International to design, construct, inspect, and test the HI-STAR 100 Package in accordance with the Codes and Standards identified in Chapter 1. Completion of the defined acceptance test program for each HI-STAR 100 Package will provide assurance that the SSCs important to safety will perform their design function. The performance of the maintenance program by Holtec International or the licensee for each HI-STAR 100 Package will provide assurance for the continued effectiveness of the Package.

The described acceptance criteria and maintenance programs can be summarized in the following evaluation statements:

1. Section 8.1 of this SAR describes Holtec International's proposed program for preoperational testing and initial operations of the HI-STAR 100 Package. Section 8.2 describes the proposed HI-STAR 100 maintenance program. The preliminary determinations for the HI-STAR 100 Package prior to first use meets the requirements of 10CFR71.85 and 10CFR71.87(g).

2. Structures, systems, and components (SSCs) of the HI-STAR 100 Package designated as important to safety shall be designed, fabricated, erected, assembled, inspected, tested, and maintained to quality standards commensurate with the importance to safety of the function they are intended to perform. Table 1.3.3 of this SAR identifies the safety ~~importance~~ and quality classifications of SSCs of the HI-STAR 100 Package, and Table 1.3.1 presents the applicable standards for their design, fabrication, and inspection, *as clarified by the alternatives in Table 1.3.3.*

3. Holtec International shall examine and test the HI-STAR 100 Package to ensure that it does not exhibit any defects that could significantly reduce its containment effectiveness.

4. Holtec International shall durably mark each HI-STAR 100 Package with a data plate indicating the COC identification number assigned by the NRC, trefoil radiation symbol, gross weight, model number, and unique identification serial number in accordance with 10CFR71.85(c) at the completion of the acceptance test program. ~~Holtec International Design Drawing No. 1397, Sheet 4 of 7, in Section 1.4 of this SAR illustrates and details this data plate.~~

5. The description of the routine determinations defined in the maintenance program in Section 8.2 for the HI-STAR 100 Package prior to transport use meets the requirements of 10CFR71.87(b) and 10CFR71.87(g).

6. It can be concluded that the acceptance tests and maintenance program for the HI-STAR 100 Package are in compliance with 10CFR71 [8.0.1], and that the applicable acceptance criteria have been satisfied. The acceptance tests and

maintenance program provide reasonable assurance that the HI-STAR 100 Package will allow safe transport of spent fuel throughout its certified life. This conclusion is based on a review that considers the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted industry practices.

8.4 REFERENCES

[8.0.1] U.S. Code of Federal Regulations, Title 10, "Energy", Part 71, "Packaging and Transportation of Radioactive Materials."

[8.1.1] Holtec International Quality Assurance Manual, current revision.

[8.1.2] American Society of Mechanical Engineers, " Boiler and Pressure Vessel Code," Sections II, III, V, IX, and XI, 1995 Edition with 1996 and 1997 Addenda.

[8.1.3] American Society for Nondestructive Testing, "Personnel Qualification and Certification in Nondestructive Testing," Recommended Practice No. SNT-TC-1A, December 1992.

[8.1.4] HI-STAR 100 ~~Topical~~ *Final* Safety Analysis Report, Holtec Report No. HI-~~941184~~*2012610*, current revision.

[8.1.5] American National Standards Institute, Institute for Nuclear Materials Management, "American National Standard for Radioactive Materials - Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kilograms) or More", ANSI N14.6, September 1993.

[8.1.6] NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants", U.S. Nuclear Regulatory Commission, Washington, D.C., July 1980.

[8.1.7] U.S. Nuclear Regulatory Commission, "Fracture Toughness Criteria of Base Material for Ferritic Steel Shipping Cask Containment Vessels with a Maximum Wall Thickness of 4 Inches (0.1m)," Regulatory Guide 7.11, June 1991.

[8.1.8] U.S. Nuclear Regulatory Commission, "Fracture Toughness Criteria of Base Material for Ferritic Steel Shipping Cask Containment Vessels with a Wall Thickness Greater than 4 Inches (0.1m) But Not Exceeding 12 Inches (0.3m)," Regulatory Guide 7.12, June 1991.

[8.1.9] American National Standards Institute, Institute for Nuclear Materials Management, "American National Standard for Radioactive Materials Leakage Tests on Packages for Shipment", ANSI N14.5, 1997.

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Document ID 5014462
Attachment 6

AFFIDAVIT PURSUANT TO 10CFR2.790

I, Brian Gutherman, being duly sworn, depose and state as follows:

(1) I am Licensing Manager of Holtec International and have reviewed the information described in paragraph (2) which is sought to be withheld, and am authorized to apply for its withholding.

(2) The information sought to be withheld is included in HI-STAR SAR Chapter 6, contained in enclosed with Holtec Letter No. 5014462, appropriately identified as confidential information in shaded text. Specifically:

- Portions of Section 6.4.11
- Tables 6.4.12, 6.4.13, 6.4.15, 6.4.16,
- Figures 6.4.14, 6.4.15, and 6.4.16
- Portions of Appendices 6.E, 6.F, 6.H, 6.I, 6.J, 6.K, 6.L, and 6.M

This information is considered proprietary to Holtec International.

(3) In making this application for withholding of proprietary information of which it is the owner, Holtec International relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4) and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10CFR Part 9.17(a)(4), 2.790(a)(4), and 2.790(b)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, <u>Critical Mass Energy Project v. Nuclear Regulatory Commission</u>, 975F2d871 (DC Cir. 1992), and <u>Public Citizen Health Research Group v. FDA</u>, 704F2d1280 (DC Cir. 1983).

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(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by Holtec's competitors without license from Holtec International constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.

c. Information which reveals cost or price information, production, capacities, budget levels, or commercial strategies of Holtec International, its customers, or its suppliers;

d. Information which reveals aspects of past, present, or future Holtec International customer-funded development plans and programs of potential commercial value to Holtec International;

e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs 4.a, 4.b, 4.d, and 4.e, above.

(5) The information sought to be withheld is being submitted to the NRC in confidence. The information (including that compiled from many sources) is of a sort customarily held in confidence by Holtec International, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by Holtec International. No public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have

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been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within Holtec International is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his designee), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside Holtec International are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information classified as proprietary was developed and compiled by Holtec International at a significant cost to Holtec International. This information is classified as proprietary because it contains detailed descriptions of analytical approaches and methodologies not available elsewhere. This information would provide other parties, including competitors, with information from Holtec International's technical database and the results of evaluations performed by Holtec International. A substantial effort has been expended by Holtec International to develop this information. Release of this information at this time would improve a competitor's position because it would enable Holtec's competitor to copy our technology and offer it for sale in competition with our company, causing us financial injury.

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(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to Holtec International's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of Holtec International's comprehensive spent fuel storage technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology, and includes development of the expertise to determine and apply the appropriate evaluation process.

The research, development, engineering, and analytical costs comprise a substantial investment of time and money by Holtec International.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

Holtec International's competitive advantage will be lost if its competitors are able to use the results of the Holtec International experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to Holtec International would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive Holtec International of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

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STATE OF NEW JERSEY)
) ss:
COUNTY OF BURLINGTON)

Mr. Brian Gutherman, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at Marlton, New Jersey, this 30th day of May, 2002.

Brian Gutherman
Holtec International

Subscribed and sworn before me this 30th day of May, 2002.

MARIA C. PEPE
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires April 25, 2005