# CHAPTER 9: OPERATING PROCEDURES

## 9.0 INTRODUCTION

This chapter contains the operating procedures required for the dry storage of spent nuclear fuel at an on-site HI-STORM FW ISFSI. The decay heat, initial enrichment, burnup and cooling time of the SNF must accord with the restrictions in the Technical Specification. The unloading procedure is also described in this chapter. This sequence of activities is collectively referred to as short-term operations in this safety analysis report (SAR).

The procedures provided in this chapter are prescriptive to the extent that they provide the basis and general guidance for plant personnel in preparing detailed, written, site-specific, loading, handling, storage, and unloading procedures. Users may add, modify the sequence of, perform in parallel, or delete steps as necessary provided that the intent of this guidance are met and the requirements of the Certificate of Compliance (CoC) are complied with *literally*. The information provided in this chapter complies with the provisions of NUREG-1536 [9.0.1].

The information presented in this chapter along with the technical basis of the system design described in this SAR will be used to develop detailed operating procedures. Equipment specific operating details such as valve manipulation, canister drying method, special rigging, etc., will be provided to individual users of the system based on the specific ancillary equipment selected and the configuration of the site. In preparing the site-specific procedures, the user must consult the conditions of the CoC, equipment-specific operating instructions, and the plant's working procedures as well as the information in this chapter to ensure that the short-term operations shall be carried out with utmost safety and ALARA.

The following generic criteria shall be used to determine whether the site-specific operating procedures developed pursuant to the guidance in this chapter are acceptable for use:

- All heavy load handling instructions are in keeping with the guidance in industry standards, and Holtec-provided instructions.
- The procedures are in conformance with this FSAR and the COC.
- The operational steps are ALARA.
- The procedures contain provisions for documenting successful execution of all safety significant steps for archival reference.
- Procedures contain provisions for classroom and hands-on training and for a Holtec-approved personnel qualification process to ensure that all operations personnel are adequately trained.
- The procedures are sufficiently detailed and articulated to enable craft labor to execute them in *literal compliance* with their content.

The operations described in this chapter assume that the fuel will be loaded into or unloaded from the MPC submerged in a spent fuel pool. With some modifications, the information presented herein can be used to develop site-specific procedures for loading or unloading fuel into the system within a hot cell or other remote handling facility.

Users are required to develop or modify existing programs and procedures to account for the implementation of the HI-STORM FW system. Written procedures are required to be developed or modified to account for such items as handling and storage of systems, structures and components identified as *important-to-safety*, 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 all critical set points do not exceed the design limit of lifting equipment and appurtenances.

Control of the operation shall be performed in accordance with the user's Quality Assurance (QA) program to ensure critical steps are not overlooked and that the cask has been confirmed to meet all requirements of the CoC before being released for on-site storage under Part 72.

Fuel assembly selection and verification shall be performed by the user in accordance with written, approved procedures that ensure that only SNF assemblies authorized in the CoC are loaded into the MPC. Fuel handling shall be performed in accordance with written site-specific procedures.

ALARA notes and warnings in this chapter are included to alert users to radiological issues. Actions identified with these notes and warnings are of an advisory nature and shall be implemented based on a site-specific determination by radiation protection personnel.

Section 9.1 provides a technical basis for loading and unloading procedures. Section 9.2 provides the guidance for loading the HI-STORM FW system. Section 9.3 provides the procedures for ISFSI operations and general guidance for performing maintenance and responding to abnormal events. Responses to abnormal events that may occur during normal loading operations are provided with the procedure steps. Section 9.4 provides the procedure for unloading the HI-STORM FW system.

## 9.1 TECHNICAL AND SAFETY BASIS FOR LOADING AND UNLOADING PROCEDURES

The procedures herein are developed for the loading, storing, and unloading of spent fuel in the HI-STORM FW system. The activities involved in loading of spent fuel in a canister system, if not carefully performed, may present physical risk to the operations staff. The design of the HI-STORM FW system, including these procedures, the ancillary equipment and the Technical Specifications, serve to minimize potential risks and mitigate consequences of potential events.

The primary objective of the information presented in this chapter is to identify and describe the sequence of significant operations and actions that are important to safety for cask loading, cask handling, storage operations, and cask unloading to adequately protect health and minimize danger to life or property, protect the fuel from significant damage or degradation, and provide for the safe performance of tasks and operations.

In the event of an extreme abnormal condition the appropriate procedural guidance to respond to the situation must be available and ready for implementation. As a minimum, the procedures shall address establishing emergency action levels, implementation of emergency action program, establishment of personnel exclusions zones, monitoring of radiological conditions, actions to mitigate or prevent the release of radioactive materials, and recovery planning and execution and reporting to the appropriate regulatory agencies, as required.

Table 9.1.1

OPERATIONAL CONSIDERATIONS

| POTENTIAL EVENTS | METHODS USED TO ADDRESS AN ADVERSE EVENT |
|---|---|
| Cask Drop During Handling Operations | Cask lifting and handling equipment is designed to ANSI N14.6. Procedural guidance is given for cask handling, inspection of lifting equipment, and proper engagement. |
| Cask Tip-Over Prior to welding of the MPC lid | The design of the Lift Yoke prevents inadvertent disconnection during periods where it is attached. |
| Contamination of the MPC external shell | The annulus seal, bottom lid, and Annulus Overpressure System minimize the potential for the MPC external shell to become contaminated from contact with the spent fuel pool water. |
| Contamination spread from cask process system exhausts | Processing systems are equipped with exhausts that can be directed to the plant's processing systems. |
| Damage to fuel assembly cladding from oxidation | Fuel assemblies are not directly exposed to air or oxygen during loading and unloading operations. Fuel will be blanketed with an inert gas when not immersed in water. Water is introduced at a slow rate to avoid thermal shocking of the system. |
| Damage to Vacuum Drying System vacuum gauges from positive pressure | Vacuum gauges will be isolated from pressurized gas and water systems when not used for vacuum. Isolation valves allow gauges to be easily replaced in service. |
| Ignition of combustible mixtures of gas (e.g., hydrogen) during MPC lid welding or cutting | The area around MPC lid shall be appropriately monitored for combustible gases prior to and during welding or cutting activities. The space below the MPC lid shall be purged prior to and during these activities. |
| Excess dose from failed fuel assemblies during unloading operations | MPC gas sampling allows operators to determine the integrity of the fuel cladding prior to opening the MPC. This allows preparation and planning for failed fuel. 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 operation. |
| Excess dose to operators | The procedures provide ALARA Notes and Warnings when radiological conditions may change. |

Table 9.1.1

OPERATIONAL CONSIDERATIONS

| POTENTIAL EVENTS | METHODS USED TO ADDRESS AN ADVERSE EVENT |
|---|---|
| Excess generation of radioactive waste | The HI-STORM FW system uses process systems that minimize the amount of radioactive waste generated. Such features include smooth surfaces for ease of decontamination efforts, prevention of avoidable contamination, and procedural guidance to reduce decontamination requirements. Where possible, items are installed by hand and require no tools. |
| Fuel assembly misloading event | Procedural guidance is given to perform assembly selection verification and a post-loading visual verification of assembly identification prior to installation of the MPC lid. |
| Incomplete moisture removal from MPC | The vacuum drying process reduces the MPC pressure in a controlled manner to prevent the formation of ice. Vacuum is held below 3 torr for 30 minutes with the vacuum pump isolated to assure dryness. If the forced helium dehydration process is used, the temperature of the gas exiting the demoisturizer is held below 21 $^{o}$F for a minimum of 30 minutes. The TS require the surveillance requirement for moisture removal to be met before entering transport operations. |
| Incorrect MPC lid installation | Procedural guidance is given to visually verify correct MPC lid installation prior to HI-TRAC removal from the spent fuel pool. |
| Load Drop | Rigging diagrams and procedural guidance are provided to users for all applicable lifts. Component weights are provided to users on a site-specific basis. Heavy loads are handled in accordance with the guidance of NUREG-0612. |
| Over-pressurization of MPC during loading and unloading | Pressure relief devices in the water and gas processing systems limit the MPC pressure to acceptable levels. |
| Overstressing MPC lift lugs from side loading | Procedural guidance is provided for all heavy load handling activities on a site-specific basis. |
| Overweight cask lift | Procedural guidance is given to alert operators to potential overweight lifts. Site-specific weight evaluations are provided. |
| Personnel contamination by cutting/grinding activities | Procedural guidance is given to warn operators prior to cutting or grinding activities. |

Table 9.1.1

OPERATIONAL CONSIDERATIONS

| POTENTIAL EVENTS | METHODS USED TO ADDRESS AN ADVERSE EVENT |
|---|---|
| Transfer cask carrying hot particles out of the spent fuel pool | Procedural guidance is given to scan the transfer cask prior to removal from the spent fuel pool. |
| Unplanned or uncontrolled release of radioactive materials | The MPC vent and drain ports are equipped with metal-to-metal seals to minimize the leakage during moisture removal and helium backfill operations. Unlike elastomer seals, the metal seals resist degradation due to temperature and radiation and allow future access to the MPC ports without hot tapping. The RVOAs allow the port to be opened and closed like a valve so gas sampling may be performed. |

## 9.2 PROCEDURE FOR LOADING THE HI-STORM FW SYSTEM IN THE SPENT FUEL POOL

### 9.2.1 Overview of Loading Operations

The HI-STORM FW system is used to load, transfer, and store spent fuel. Specific steps, required to prepare the HI-STORM FW system for fuel loading, to load the fuel, to prepare the system for storage, and to place it in storage at an ISFSI are described in this chapter. The MPC transfer may be performed in the cask receiving area, at the ISFSI, or any other location deemed appropriate by the user. HI-TRAC VW and/or HI-STORM FW may be moved between the ISFSI and the fuel loading facility using any load handling equipment designed for such applications. Users of the HI-STORM FW system are required to develop detailed written procedures to control on-site transport operations. Instructions for general lifting, handling, and placement of the HI-STORM FW overpack, MPC, and HI-TRAC VW vary by site and are provided on a site-specific basis in Holtec-approved procedures and instructions.

The broad operational steps are explained below and illustrative figures are provided at the end of this section. At the start of loading operations, an empty MPC is upended. The empty MPC is raised and inserted into the HI-TRAC VW. The annulus is filled with plant demineralized water[1] and an inflatable seal is installed in the upper end of the annulus between the MPC and HI-TRAC VW to prevent spent fuel pool water from contaminating the exterior surface of the MPC when it is submerged in the pool. The MPC is filled with either spent fuel pool water or plant demineralized water (borated as required)[2]. The HI-TRAC VW top flange is outfitted with the lift blocks and the HI-TRAC VW and MPC are then raised and lowered into the spent fuel pool[3] for fuel loading using the lift yoke. Pre-selected assemblies[4] are loaded into the MPC and a visual verification of the assembly identification is performed.

While still underwater, a thick shielded lid (the MPC lid) is installed. The lift yoke remotely engages to the HI-TRAC VW lift blocks to lift the HI-TRAC VW and loaded MPC close to the spent fuel pool surface. When radiation dose rate measurements confirm that it is safe to remove the HI-TRAC VW from the spent fuel pool, the cask is removed from the spent fuel pool. The lift yoke and HI-TRAC VW are decontaminated, in accordance with instructions from the site's radiological protection personnel, as they are removed from the spent fuel pool.

HI-TRAC VW is placed in the designated preparation area and the lift yoke is removed. The next phase of decontamination is then performed. The top surfaces of the MPC lid and the upper flange of HI-TRAC VW are decontaminated. The neutron shield water jacket is filled with water (if drained). The inflatable annulus seal is removed and an annulus shield is installed. Dose rates are measured at the MPC lid to ensure that the dose rates are within expected values.

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1 Users may substitute domestic water or radiologically clean borated water in each step where demineralized water is specified.

2 Users may also fill the MPC with water during HI-TRAC placement in the spent fuel pool.

3 Spent Fuel Pool as used in this chapter generically refers to the users designated cask loading location.

4 Damaged fuel assemblies are loaded and stored in Damaged Fuel Containers in the MPC basket.

The MPC water level and annulus water level are lowered slightly, the MPC is vented, and the MPC lid is welded on using the automated welding system. Visual examinations are performed on the tack welds. Liquid penetrant (PT) examinations are performed on the root and final passes. A progressive PT examination as described in the Code Alternatives listed in the CoC is performed on the MPC Lid-to-Shell weld to ensure that the weld is satisfactory. As an alternative to volumetric examination of the MPC lid-to-shell weld, a multi-layer PT is performed including one intermediate examination after approximately every three-eighth inch of weld depth. The MPC welds are then pressure tested followed by an additional liquid penetrant examination performed on the MPC Lid-to-Shell weld to verify structural integrity. To calculate the helium backfill requirements for the MPC (if the backfill is based upon helium mass or volume measurements), the free volume inside the MPC must first be determined. This free volume may be determined by measurement or determined analytically. The remaining bulk water in the MPC is drained.

Depending on the burn-up or decay heat load of the fuel to be loaded in the MPC, moisture is removed from the MPC using either a vacuum drying system (VDS) or forced helium dehydration (FHD) system. For MPCs without high burn-up fuel or with high burnup fuel and with sufficiently low decay heat, the vacuum drying system may be connected to the MPC and used to remove all liquid water from the MPC. The annular gap between the MPC and HI-TRAC is filled with water during vacuum drying to promote heat transfer from the MPC and maintain lower fuel cladding temperatures. The internal pressure is reduced and held in accordance with Technical Specifications to ensure that all liquid water is removed.

An FHD system is required for high-burn-up fuel at higher decay heat (it can be used as an alternative to vacuum drying) to remove residual moisture from the MPC. Gas is circulated through the MPC to evaporate and remove moisture. The residual moisture is condensed until no additional moisture remains in the MPC. The temperature of the gas exiting the system demoisturizer is maintained in accordance with Technical Specification requirements to ensure that all liquid water is removed.

Following MPC moisture removal, by VDS or FHD, the MPC is backfilled with a predetermined amount of helium gas. The helium backfill ensures adequate heat transfer during storage, and provides an inert atmosphere for long-term fuel integrity. Cover plates are installed and seal welded over the MPC vent and drain ports with liquid penetrant examinations performed on the root and final passes (for multi-pass welds). The cover plate welds are then leak tested.

The MPC closure ring is then placed on the MPC and 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 and final welds are inspected using the liquid penetrant examination technique to ensure weld integrity.

The annulus shield (if utilized) is removed and the remaining water in the annulus is drained. The MPC lid and accessible areas of the top of the MPC shell are smeared for removable contamination. HI-TRAC VW surface dose rates are measured in accordance with the technical specifications. The MPC lift attachments are installed on the MPC lid. The MPC lift attachments

are the primary lifting point on the MPC. MPC slings are installed between the MPC lift attachments and the lift yoke.

MPC transfer may be performed inside or outside the fuel building. The empty HI-STORM FW overpack is inspected and positioned with the lid removed. Next, the mating device is positioned on top of the HI-STORM FW and HI-TRAC VW is placed on top of it. The mating device assists in the removal of the HI-TRAC VW bottom lid and helps guide the HI-TRAC VW during its placement on the HI-STORM FW. The MPC slings are attached to the MPC lift attachments. The MPC is transferred using a suitable load handling device.

Next, the HI-TRAC VW bottom lid is removed and the mating device drawer is opened. The MPC is transferred into HI-STORM FW. Following verification that the MPC is fully lowered, the MPC slings are disconnected from the lifting device and lowered onto the MPC lid. Next, the HI-TRAC VW is removed from the top of HI-STORM FW[5]. The MPC slings and MPC lift attachments are removed. Plugs are installed in the empty MPC lifting holes to fill the voids left by the lift attachment bolts. Next, the mating device is removed. The HI-STORM FW lid, along with the temperature elements (if used), and vent screens may be installed at anytime after the mating device is removed. The HI-STORM FW is secured to the transporter (as applicable) and moved to the ISFSI pad. The HI-STORM FW overpack and HI-TRAC VW transfer cask may be moved using a number of methods as long as the lifting equipment requirements of this FSAR are met. Finally, the temperature elements connections are installed (if used), final dose rate measurements are taken, and any thermal testing (if required) is performed to ensure that the system is functioning within its design parameters.

### 9.2.2 Preparation of HI-TRAC VW and MPC

| **Note:** |
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| Handling of loaded equipment shall only be performed if the ambient temperature is above 0°F |

1. Place HI-TRAC VW in the cask receiving area.

2. Perform a HI-TRAC VW receipt inspection and cleanliness inspection (See Table 9.2.5 for example).

3. Clear the HI-TRAC VW top for installation of the MPC.

4. Remove any road dirt. Remove any foreign objects from cavity locations.

5. If necessary, perform a radiological survey of the inside of HI-TRAC VW to verify there is no residual contamination from previous uses of the cask.

6. If necessary, configure HI-TRAC VW with the bottom lid.

[5] The empty HI-TRAC VW may be removed from the mating device with its bottom lid installed or removed.

7. Perform an MPC receipt inspection and cleanliness inspection (See Table 9.2.4 for example).

8. Install the MPC inside HI-TRAC VW in accordance with site-approved rigging procedures.

9. If necessary, perform an MPC, lid, closure ring, drain line, vent, and drain port cover plate fit test and verify that the weld prep is in accordance with the approved fabrication drawings.

**Note:**
Annulus filling and draining operations vary by site. Instructions for filling and draining the annulus along with the use of the annulus overpressure system are provided on a site-specific basis.

10. Fill the annulus with non-contaminated water to just below the inflatable seal seating surface.

11. Install the inflatable annulus seal around the MPC.

12. To the extent practicable, apply waterproof tape over any empty bolt holes or locations where water may create a decontamination issue.

**Note:**
Canister filling and draining operations vary by site. Instructions are provided on a site-specific basis.

13. Fill the MPC with water to approximately 12 inches below the top of the MPC shell. Refer to LCO 3.3.1 for boron concentration requirements.

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

14. Place HI-TRAC VW in the designated cask loading area.

15. Verify spent fuel pool for boron concentration requirements in accordance with LCO 3.3.1. Testing must be completed within four hours prior to loading and every 48 hours after in accordance with the LCO. Two independent measurements shall be taken to ensure that the requirement of 10 CFR 72.124(a) is met.

### 9.2.3 MPC Fuel Loading

**Note:**
When loading an MPC requiring soluble boron, the boron concentration of the water shall be checked in accordance with LCO 3.3.1 before and during operations with fuel and water in the MPC.

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 Approved Contents Section of Appendix B to the CoC, have been selected for loading into the MPC. Perform a verification of the types, amounts, and location of non-fuel hardware using plant fuel records to ensure that only non-fuel hardware that meet the conditions for loading, as specified in the Approved Contents Section of Appendix B to the CoC, 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[6].

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

4. If required, install fuel shims where necessary in the fuel cells.

### 9.2.4 MPC Closure

1. Install MPC lid and remove the HI-TRAC VW from the spent fuel pool as follows:

   a. Rig the MPC lid for installation in the MPC in accordance with site-approved rigging procedures.

   b. Install the drain line to the underside of the MPC lid.

   c. Align the MPC lid and lift yoke so the drain line will be positioned in the MPC for installation.

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

   e. Record the time to begin the time-to-boil monitoring, if necessary.

   f. Engage the lift yoke to HI-TRAC VW.

[6] Damaged fuel must be loaded into Damage Fuel Containers in the MPC basket.

**ALARA Note:**
Activated debris may have settled on the top face of HI-TRAC VW 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. Soluble boron concentration, when applicable, shall be monitored to prevent non-compliance with the Technical Specification LCO 3.3.1.

g. Raise the HI-TRAC VW 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. Remove any activated or highly radioactive particles from the HI-TRAC VW or MPC.

h. Continue to raise the HI-TRAC VW under the direction of the plant's radiological control personnel. Continue general decontamination activities.

i. Remove HI-TRAC VW from the spent fuel pool while performing outer decontamination activities in accordance with directions from the radiological control personnel.

j. Place HI-TRAC VW in the designated cask preparation area.

**Note:**
If the transfer cask is expected to be operated in an environment below 32 $^{o}$F, the water jacket shall be filled with an ethylene glycol solution (25% ethylene glycol). Otherwise, the jacket shall be filled with clean potable or demineralized water. Depending on weight limitations, the neutron shield jacket may remain filled (with pure water or 25% ethylene glycol solution, as required). Cask weights shall be evaluated to ensure that the equipment load limitations are not violated.

k. If previously drained, fill the neutron shield jacket with plant demineralized water or an ethylene glycol solution (25% ethylene glycol) as necessary.

l. Disconnect any special rigging from the MPC lid and disengage the lift yoke in accordance with site-approved rigging procedures.

**Warning:**
MPC lid dose rates are measured to ensure that dose rates are within expected values. Dose rates exceeding the expected values could be an indication that fuel assemblies not meeting the CoC have been loaded.

m. Measure the dose rates at the MPC lid and verify that the combined gamma and neutron dose is below expected values.

n. Perform decontamination and a dose rate/contamination survey of HI-TRAC.

o. Prepare the MPC annulus for MPC lid welding by removing the annulus seal and draining the annulus approximately 6 inches.

2. Prepare for MPC lid welding as follows:

   a. Clean the vent and drain ports to remove any dirt or standing water. Install the RVOAs to the MPC lid vent and drain ports, leaving caps open.

   b. Lower the MPC internal water level in preparation for MPC lid-to-shell welding.

**ALARA Note:**
The MPC exterior shell survey is performed. Indications of contamination could require the MPC to be unloaded. In the event that the MPC shell is contaminated, users must decontaminate the annulus. If the contamination cannot be reduced to acceptable levels, the MPC must be returned to the spent fuel pool and unloaded. The MPC may then be removed and the external shell decontaminated.

   c. Survey the MPC lid top surfaces and the accessible areas (approximately the top three inches) of the MPC external shell. Decontaminate the MPC lid and accessible surfaces of the MPC shell in accordance with LCO 3.2.1.

3. Weld the MPC lid as follows:

   a. As necessary, install the MPC lid shims around the MPC lid to make the weld gap uniform and to close the gap to the requirements of the licensing drawings.

   b. Install the Automated Welding System (AWS).

**Note:**
It may be necessary to remove the RVOAs to allow access for the automated welding system. In this event, the vent and drain port caps should be opened to allow for thermal expansion of the MPC water.

**Caution:**
A radiolysis of water may occur in high flux conditions inside the MPC creating combustible gases. Appropriate monitoring for combustible gas concentrations shall be performed prior to, and during MPC lid welding operations. The space below the MPC lid shall be purged with inert gas prior to, and during MPC lid welding operations, including welding, grinding, and other hot work, to provide additional assurance that flammable gas concentrations will not develop in this space.

   c. Perform combustible gas monitoring and purge the space under the MPC lid with an inert gas to ensure that there is no combustible mixture present in the welding area.

**Note:**
MPC closure welding procedures dictate the performance requirements and acceptance requirements of the weld examinations.

d. Perform the MPC lid-to-shell weld and NDE in accordance with the licensing drawings using approved procedures. Repair any weld defects in accordance with the applicable code and re-perform the NDE until the weld meets the required acceptance criteria.

4. Perform MPC lid-to-shell weld pressure testing in accordance with site-approved procedures.

5. Repeat the liquid penetrant examination on the final pass of the MPC lid-to-shell weld.

   a. Repair any weld defects in accordance with the applicable code requirements and re-perform the NDE in accordance with approved procedures.

6. Drain the MPC and terminate time-to-boil monitoring and boron sampling program, where required.

**Note:**
Detailed procedures for MPC drying are provided on a site-specific basis. The following summarize those procedures.

7. Dry and backfill the MPC (Vacuum Drying Method).

**Note:**
During drying activities, the annulus between the MPC and the HI-TRAC VW must be maintained full of water. Water lost due to evaporation or boiling must be replaced to maintain the water level.

   a. Fill the annulus between the MPC and HI-TRAC VW with clean water. The water level must be within 6” of the top of the MPC.

   b. Attach the vacuum drying system (VDS) to the vent and drain port RVOAs. Other equipment configurations that achieve the same results may also be used.

**Caution:**
Rapidly reducing the pressure in the VDS piping and MPC while the system contains significant amounts of water can lead to freezing of the water and to improper conclusions that the system is dry. To prevent freezing of water, the MPC internal pressure should be lowered in a controlled fashion. The vacuum drying system pressure will remain at about 30 torr until most of the liquid water has been removed from the MPC.

   c. Start the VDS system and slowly reduce the MPC pressure to below 3 torr.

**Note:**
Helium backfill shall be in accordance with the Technical Specification using 99.995% (minimum) purity. If at any time during final closure operations the helium backfill gas is lost or oxidizing gases are introduced into the MPC, then the dryness test shall be repeated and the MPC refilled with helium in accordance with the Technical Specifications.

d. Perform the MPC drying pressure test in accordance with the Technical Specifications.

e. When the MPC is dry, in accordance with the acceptance criteria in the LCO 3.1.1, close the vent and drain port valves.

f. Backfill the MPC in accordance with LCO 3.1.1 using site-specific procedures.

g. Disconnect the VDS from the MPC.

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

i. If used, stop the water flow through the annulus between the MPC and HI-TRAC. Drain.

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

8. Dry and Backfill the MPC (FHD Method):

| **Note:** |
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| Helium backfill shall be in accordance with the Technical Specification using 99.995% (minimum) purity. When using the FHD system to perform the MPC helium backfill, the FHD system shall be evacuated or purged and the system operated with high purity helium. |
| **Note:** |
| MPC internal pressure during FHD operation must comply with Technical Specification. |
| **Caution:** |
| MPC internal pressure during FHD operation may be less than the Technical Specification minimum backfill requirement. In the event of an FHD System failure where the MPC internal pressure is below the Technical Specification limit, the MPC internal pressure must be raised to at least 20 psig to place the MPC in an acceptable condition. |

a. Attach the moisture removal system to the vent and drain port RVOAs. Other equipment configurations that achieve the same results may also be used.

b. Drain the water from the annulus.

c. Circulate the drying gas through the MPC while monitoring the circulating gas for moisture. Collect and remove the moisture from the system as necessary.

d. Continue the monitoring and moisture removal until LCO 3.1.1 is met for MPC dryness.

| **Note:** |
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| The demoisturizer module must maintain the temperature of the helium exiting the FHD below the Technical Specification limits continuously from the end of the drying operations until the MPC has been backfilled and isolated. If the temperature of the gas exiting the FHD exceeds the temperature limit, the dryness test must be repeated and the backfill re-performed. |

e. Continue operation of the FHD system with the demoisturizer on.

f. While monitoring the temperatures into and out of the MPC, adjust the helium pressure in the MPC to provide a fill pressure as required by LCO 3.1.1.

g. Open the FHD bypass line and Close the vent and drain port RVOAs.

h. Shutdown the FHD system and disconnect it from the RVOAs.

i. Remove the vent and drain port RVOAs.

9. Weld the vent and drain port cover plates and perform NDE in accordance with the licensing drawings using approved procedures. Repair any weld defects in accordance with the applicable code and re-perform the NDE until the weld meets the required acceptance criteria.

10. Perform a leakage test of the MPC vent port cover plate and drain port cover plate in accordance with the following and site-approved procedures:

    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 approximately ¼ inch below the top of the cover plate.

    c. Plug weld the recess above each set screw to complete the penetration closure welding in accordance with the licensing drawings using approved procedures. Repair any weld defects in accordance with the applicable code and re-perform the NDE until the weld meets the required acceptance criteria.

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

    e. 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 leakage test methods and procedures of ANSI N14.5 [9.1.2]. The MPC Helium Leak Rate acceptance criterion is provided in LCO 3.1.1.

11. Weld the MPC closure ring as follows:

    a. Install and align the closure ring.

    b. Weld the closure ring to the MPC shell and the MPC lid, and perform NDE in accordance with the licensing drawings using approved procedures. Repair any weld defects in accordance with the applicable code and re-perform the NDE until the weld meets the required acceptance criteria.

    c. If necessary, remove the AWS.

## 9.2.5 Preparation for Storage

| **ALARA Warning:** |
|---|
| Dose rates will rise around the top of the annulus as water is drained from the annulus. Apply appropriate ALARA practices. |
| **Caution:** |
| Limitations for the handling an MPC containing high burn-up fuel in a HI-TRAC VW are evaluated and established on a canister basis to ensure that acceptable cladding temperatures are not exceeded. Refer to SAR Chapter 4. |

1. Drain the remaining water from the annulus.

2. Perform the HI-TRAC VW surface dose rate measurements in accordance with the Technical Specifications. Measured dose rates must be compared with calculated dose rates that are consistent with the calculated doses that demonstrate compliance with the dose limits of 10CFR 72.104(a). Remove any surface contamination from the HI-TRAC surfaces as required by LCO 3.2.1.

| **Note:** |
|---|
| HI-STORM FW receipt inspection and preparation may be performed independent of procedural sequence, but prior to transfer of the loaded MPC. See Table 9.2.3 for example of HI-STORM FW Receipt Inspection Checklist. |

3. Perform a HI-STORM FW receipt inspection and cleanliness inspection in accordance with a site-approved inspection site-approved inspection checklist, if required.

| **Note:** |
|---|
| MPC transfer may be performed at any location deemed appropriate by the licensee. The following steps describe the general transfer operations. The HI-STORM FW may be positioned on an air pad, roller skid or any other suitable equipment in the cask receiving area or at the ISFSI. The HI-STORM FW or HI-TRAC VW may be transferred to the ISFSI using any equipment specifically designed for such a function. The licensee is responsible for assessing and controlling floor loading conditions during the MPC transfer operations. Installation of the lid, vent screen, and other components may vary according to the cask movement methods and location of MPC transfer. |

## 9.2.6 Placement of HI-STORM FW into Storage

1. Position an empty HI-STORM FW module at the designated MPC transfer location.

2. Remove any road dirt with water. Remove any foreign objects from cavity locations.

3. Transfer the HI-TRAC VW to the MPC transfer location.

4. Install the mating device on top of the HI-STORM FW.

5. Position HI-TRAC VW above HI-STORM FW.

6. Align HI-TRAC VW over HI-STORM FW and mate the components.

7. Attach the MPC to the lifting device in accordance with the site-approved rigging procedures.

8. Raise the MPC slightly to remove the weight of the MPC from the mating device.

9. Remove the bottom lid from HI-TRAC VW using the mating device.

**ALARA Warning:**
Personnel should remain clear (to the maximum extent practicable) of the HI-STORM FW annulus when HI-TRAC VW is removed due to radiation streaming. The mating device may be used to supplement shielding during removal of the MPC lift rigging.

10. Lower the MPC into HI-STORM FW.

11. Disconnect the MPC lifting slings from the lifting device.

**Note:**
It may be necessary, due to site-specific circumstances, to move HI-STORM FW from under the empty HI-TRAC VW to install the HI-STORM FW lid, while inside the Part 50 facility. In these cases, users shall evaluate the specifics of their movements within the requirements of their Part 50 license.

12. Remove HI-TRAC VW from on top of HI-STORM FW with or without the HI-TRAC bottom lid.

13. Remove the MPC lift rigging and install plugs in the empty MPC bolt holes.

14. Place HI-STORM FW in storage as follows:

**Note:**

Closing the mating device drawer while the MPC is in the HI-STORM will block air flow. The mating device drawer shall remain open, to the extent possible, such that the open air path is at least as large as the HI-STORM Lid vent openings until the mating device is to be removed from the HI-STORM. When the mating device drawer is closed for mating device removal, the process shall be completed in an expeditious manner.

a. Remove the mating device.

b. Inspect the HI-STORM FW lid studs and nuts or lid closure bolts for general condition. Replace worn or damaged components with new ones.

**Note:**
Unless the lift has redundant drop protection features (or equivalent safety factor) for the HI-STORM FW lid, the lid shall be kept less than 2 feet above the top surface of the overpack. This is performed to protect the MPC lid from a potential HI-STORM FW lid drop.

c. Install the HI-STORM FW lid and the lid studs and nuts or lid closure bolts.

d. Remove the HI-STORM FW lid lifting device and install the hole plugs in the empty holes. Store the lifting device in an approved plant storage location.

**Warning:**
HI-STORM FW dose rates are measured to ensure they are within expected values. Dose rates exceeding the expected values could indicate that fuel assemblies not meeting the CoC may have been loaded.

e. Perform the HI-STORM FW surface dose rate measurements in accordance with the Technical Specifications. Measured dose rates must be compared with calculated dose rates that are consistent with the calculated doses that demonstrate compliance with the dose limits of 10CFR72.104(a).

f. Secure HI-STORM FW to the transporter device as necessary.

**Note:**
The site-specific transport route conditions must satisfy the requirements of the Technical Specification.

g. Perform a transport route walkdown to ensure that the transport conditions are met.

h. Transfer the HI-STORM FW to its designated storage location at the appropriate pitch.

i. Attach the HI-STORM FW temperature elements (if used) and screens.

15. If required per CoC Condition #8 the user must perform the following annular air flow thermal test or cite a test report that was performed and prepared by another user.

a. The annular air flow thermal test shall be conducted at least 7 days after the HI-STORM is loaded in order for the overpack to establish thermal equilibrium.

b. The user or other qualified engineer shall calculate and record the actual heat load of the fuel stored in the HI-STORM.

c. To minimize the effects on the annular air flow, the test shall be performed when the weather is relatively dry and calm.

d. The ambient air temperature at the cask shall be recorded.

e. The test data shall be collected for the annular flow in the approximate center of the outlet vent as follows:

   1. The outlet vent screen and gamma shield shall be removed from one outlet vent, if necessary.

   2. A hot wire anemometer or similar flow measuring instrument shall be inserted into the annular space between the MPC and HI-STORM inner shell.

   3. The flow measuring instrument shall be at positioned at least 6" below the top of the MPC and shall not significantly block the air flow.

   4. The instrument shall not be placed too close to the MPC or HI-STORM shells to avoid edge effects on the flow.

   5. The outlet gamma shield and vent screen shall be re-installed if removed.

   6. Measurements of the air flow shall be taken and recorded for a minimum of three places radially across the annular gap.

   7. The outlet vent screen and gamma shield shall be removed from the outlet vent, if necessary, and the flow measuring instrument removed.

   8. The outlet gamma shield and vent screen shall be re-installed if removed.

f. Air flow in each of the three remaining outlet vents shall be measured and recorded in accordance with step 23.e above.

g. All test data shall be transmitted to the general license holder for evaluation and validation of the thermal model.

h. Users shall forward test and analysis results to the NRC in accordance with 10 CFR 72.4.

Table 9.2.1

HI-STORM FW SYSTEM ANCILLARY EQUIPMENT OPERATIONAL DESCRIPTION

| Equipment | Important To Safety Classification | Description |
|---|---|---|
| Air Pads/Rollers | Not Important To Safety | Used for HI-STORM FW or HI-TRAC VW cask positioning. May be used in conjunction with the cask transporter or other HI-STORM FW or HI-TRAC VW lifting device. |
| Annulus Overpressure System | Not Important To Safety | The Annulus Overpressure System is used for protection against spent fuel pool water contamination of the external MPC shell and baseplate surfaces by providing a slight annulus overpressure during in-pool operations. |
| Automated Welding System | Not Important To Safety | Used for remote field welding of the MPC. |
| Cask Transporter | Not Important to Safety unless used for MPC transfers | Used for handling of the HI-STORM FW overpack and/or the HI-TRAC VW Transfer Cask around the site. The cask transporter may take the form of heavy haul transfer trailer, special transporter or other equipment specifically designed for such a function. May also be used for MPC transfers if appropriately configured. |
| Lid and empty component lifting rigging | Not Important To Safety, Rigging shall be provided in accordance with NUREG 0612 | Used for rigging components such as the HI-TRAC VW top lid, bottom lid, MPC lid, AWS, and HI-STORM FW Lid and the empty MPC. |
| Helium Backfill System | Not Important To Safety | Used for controlled insertion of helium into the MPC for pressure testing, blowdown and placement into storage. |
| HI-STORM FW Lifting Devices | Determined site-specifically based on type, location, and height of lift being performed. Lifting devices shall be provided in accordance with ANSI N14.6. | A special lifting device used for connecting the crane (or other primary lifting device) to the HI-STORM FW for cask handling. |
| HI-TRAC VW Lift Yoke/Lifting Links | Determined site-specifically based on type and location, and height of lift being performed. Lift yoke and lifting devices for loaded HI-TRAC VW handling shall be provided in accordance with ANSI N14.6. | Used for connecting the crane (or other primary lifting device) to the HI-TRAC VW for cask handling. Does not include the crane hook (or other primary lifting device). May include one or more extensions to prevent immersion of the crane hook into the spent fuel pool water. |
| HI-TRAC VW transfer frame | Not Important To Safety | A steel frame used to support HI-TRAC VW during delivery, on-site movement and upending/downending operations. |
| Inflatable Annulus Seal | Not Important To Safety | Used to prevent spent fuel pool water from contaminating the external MPC shell and baseplate surfaces during in-pool operations. |

Table 9.2.1

HI-STORM FW SYSTEM ANCILLARY EQUIPMENT OPERATIONAL DESCRIPTION

| Equipment | Important To Safety Classification | Description |
|---|---|---|
| MPC Lift Attachments | Important To Safety – Category A. MPC Lift Attachments shall be provided in accordance with ANSI N14.6. | MPC lift attachments consist of the strongback and attachment hardware. The MPC lift attachments are used to support the MPC during MPC transfer from HI-TRAC VW into HI-STORM FW and vice versa. The ITS classification of the lifting device attached to the attachments may be lower than the attachment itself, as determined site-specifically. Lift Attachments may take different forms based on site specific needs and may include remote disconnect features. |
| Pressure Test System | Not Important to Safety | Used to pressure test the MPC lid-to-shell weld. |
| HI-TRAC Lift Block | Important-To-Safety Category A. Lift Blocks shall be provided in accordance with ANSI N14.6. | Used to attach the HI-TRAC to the lifting yoke. |
| Mating Device | Important-To-Safety – Category B | Used to mate HI-TRAC VW to HI-STORM FW during transfer operations. Used to shield operators during MPC transfer operations. Includes sliding drawer for use in removing HI-TRAC VW bottom lid. |
| MPC Lifting Slings | Important To Safety – Category A – Rigging shall be provided in accordance with NUREG 0612. | Used to secure the MPC to the overhead lifting device during HI-TRAC VW bottom lid removal and MPC transfer operations. Attaches between the MPC lift attachments and the lift yoke or overhead lifting device. |
| MPC Upending Device | Not Important to Safety | Used to evenly support the MPC during handling and upending operations and help control the upending process. |
| MSLD (Helium Leakage Detector) | Not Important to Safety | Used for helium leakage testing of the MPC closure welds. |
| Vacuum Drying System | Not Important To Safety | Used for removal of residual moisture from the MPC following water draining. |
| Forced Helium Dehydration System | Not Important To Safety | Used for removal of residual moisture from the MPC following water draining. |
| Vent and Drain RVOAs | Not Important To Safety | Used to access the vent and drain ports. The vent and drain RVOAs allow the vent and drain ports to be operated like valves. |
| Weld Removal System | Not Important To Safety | Semi-automated weld removal system used for removal of the MPC field weld to support unloading operations. |

Table 9.2.2

HI-STORM FW SYSTEM INSTRUMENTATION SUMMARY FOR LOADING AND UNLOADING OPERATIONS†

| Instrument | Function |
|---|---|
| Contamination Survey Instruments | Monitors fixed and non-fixed contamination levels. |
| 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 fluid flow rate during various loading and unloading operations. |
| Helium Mass Spectrometer Leakage Detector (MSLD) | Ensures leakage rates of welds are within acceptable limits. |
| Volumetric Examination Testing Rig | Used to assess the integrity of the MPC lid-to-shell weld. |
| Pressure Gauges | Ensures correct pressure during loading and unloading operations. |
| Temperature Gauges | Monitors the state of gas and water temperatures during closure and unloading operations. |
| Vacuum Gages (Optional) | Used for vacuum drying operations and to prepare an MPC evacuated sample bottle for MPC gas sampling for unloading operations. |
| Moisture Monitoring Instruments | Used to monitor the MPC moisture levels as part of the moisture removal system. |

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

Table 9.2.3

HI-STORM FW SYSTEM OVERPACK INSPECTION CHECKLIST

**Note:**

This checklist provides the basis for establishing a site-specific inspection checklist for the HI-STORM FW 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-STORM FW Overpack Lid:

1. Lid studs and nuts or lid closure bolts shall be inspected for general condition.
2. The painted surfaces shall be inspected for corrosion and chipped, cracked or blistered paint.
3. All lid surfaces shall be relatively free of dents, scratches, gouges or other damage.
4. The lid shall be inspected for the presence or availability of studs and nuts and hole plugs.
5. Lid lifting device/ holes shall be inspected for dirt and debris and thread condition.
6. Lid bolt holes shall be inspected for general condition.
7. Vent screens shall be inspected for proper fit and for tears and holes that would allow debris entry into the vent openings.
8. Vent openings shall be inspected for foreign material that may cause vent blockage.

HI-STORM FW Main Body:

1. Lid bolt holes shall be inspected for dirt, debris, and thread condition.
2. Vents shall be free from obstructions.
3. Vent screens shall be inspected for proper fit and for tears and holes that would allow debris entry into the vent openings.
4. The interior cavity shall be free of debris, litter, tools, and equipment.
5. Painted surfaces shall be inspected for corrosion, and chipped, cracked or blistered paint.
6. The nameplate shall be inspected for presence, legibility, and general condition and conformance to Quality Assurance records package.

Table 9.2.4

MPC 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.

MPC Lid and Closure Ring:

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. Vent and Drain attachments shall be inspected for availability, thread condition operability, and general condition.
4. 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.
7. The MPC lid lift holes shall be inspected for thread condition.
8. The MPC lid, cover plates, and closure ring shall be checked for proper fit-up.

MPC Main Body:

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. Basket panels shall be inspected for gross deformation that may inhibit fuel assembly insertion.
4. Lift lugs shall be inspected for general condition.
5. Lift lug threads shall be in inspected for thread condition
6. Verify proper MPC basket type for contents.
7. Serial numbers shall be inspected for readability.

Table 9.2.5

HI-TRAC VW TRANSFER CASK INSPECTION CHECKLIST

**Note:**

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

HI-TRAC VW Main Body:

1. The painted surfaces shall be inspected for corrosion, chipped, cracked, or blistered paint.
2. 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.
3. The nameplate shall be inspected for presence and general condition.
4. The neutron shield jacket shall be inspected for leaks.
5. Neutron shield jacket pressure relief device shall be inspected for presence and general condition.
6. The neutron shield jacket fill and neutron shield jacket drain plugs shall be inspected for presence, leaks, and general condition.
7. Bottom lid flange surface shall be clean and free of large scratches and gouges that may inhibit sealing of the lid to body.
8. The threaded anchor locations shall be inspected for thread damage, excessive wear, and general condition.

HI-TRAC VW Bottom lid:

1. Seal shall be inspected for cracks, breaks, cuts, excessive wear, flattening, and general condition.
2. Drain line shall be inspected for blockage and thread condition.
3. The lifting holes shall be inspected for thread damage.
4. The bolts shall be inspected for indications of overstressing (i.e., cracks and deformation, thread damage, and excessive wear).
5. The painted surfaces shall be inspected for corrosion, chipped, cracked, or blistered paint.
6. Threads shall be inspected for indications of damage.

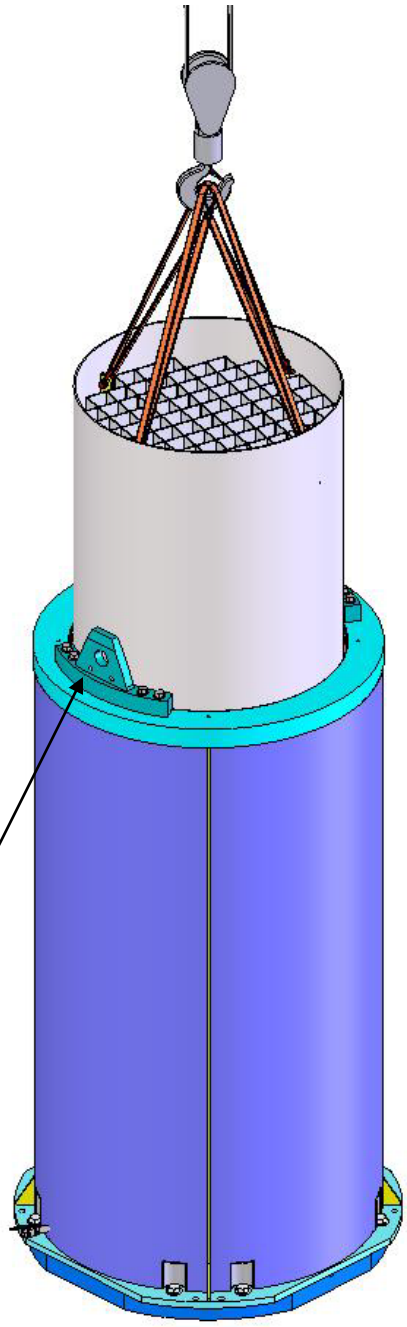


**FIGURE 9.2.1: MPC INSTALLATION IN HI-TRAC**

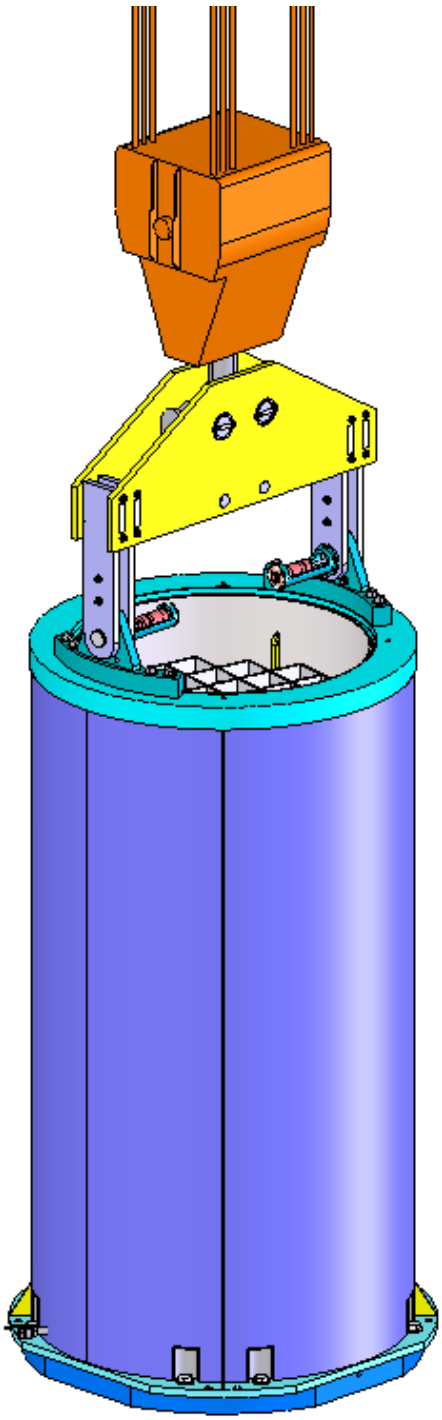

**FIGURE 9.2.2: HI-TRAC LIFTING SHOWN USING A REPRESENTATIVE LIFT YOKE**

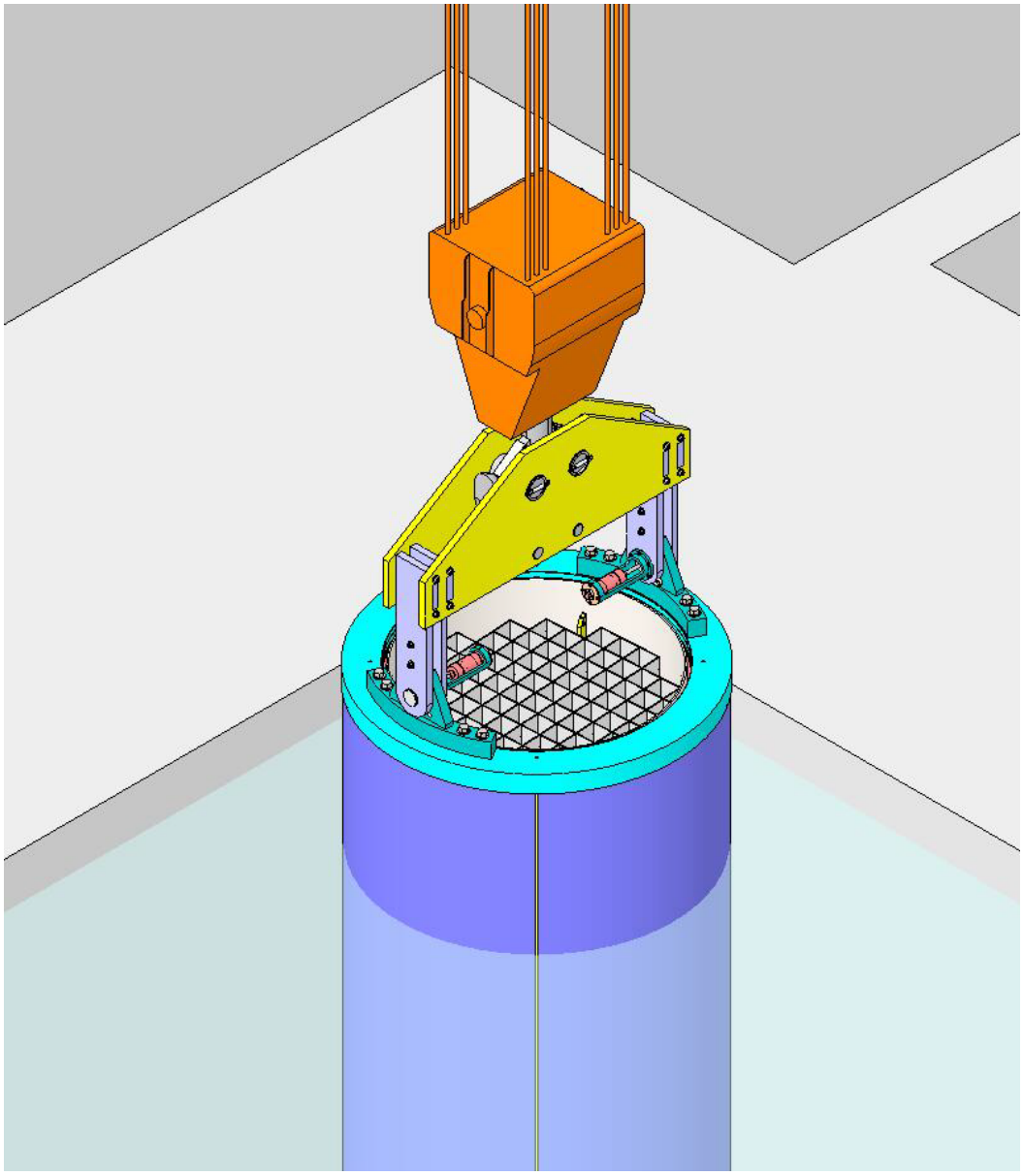

**FIGURE 9.2.3: HI-TRAC PLACEMENT IN THE SPENT FUEL POOL**

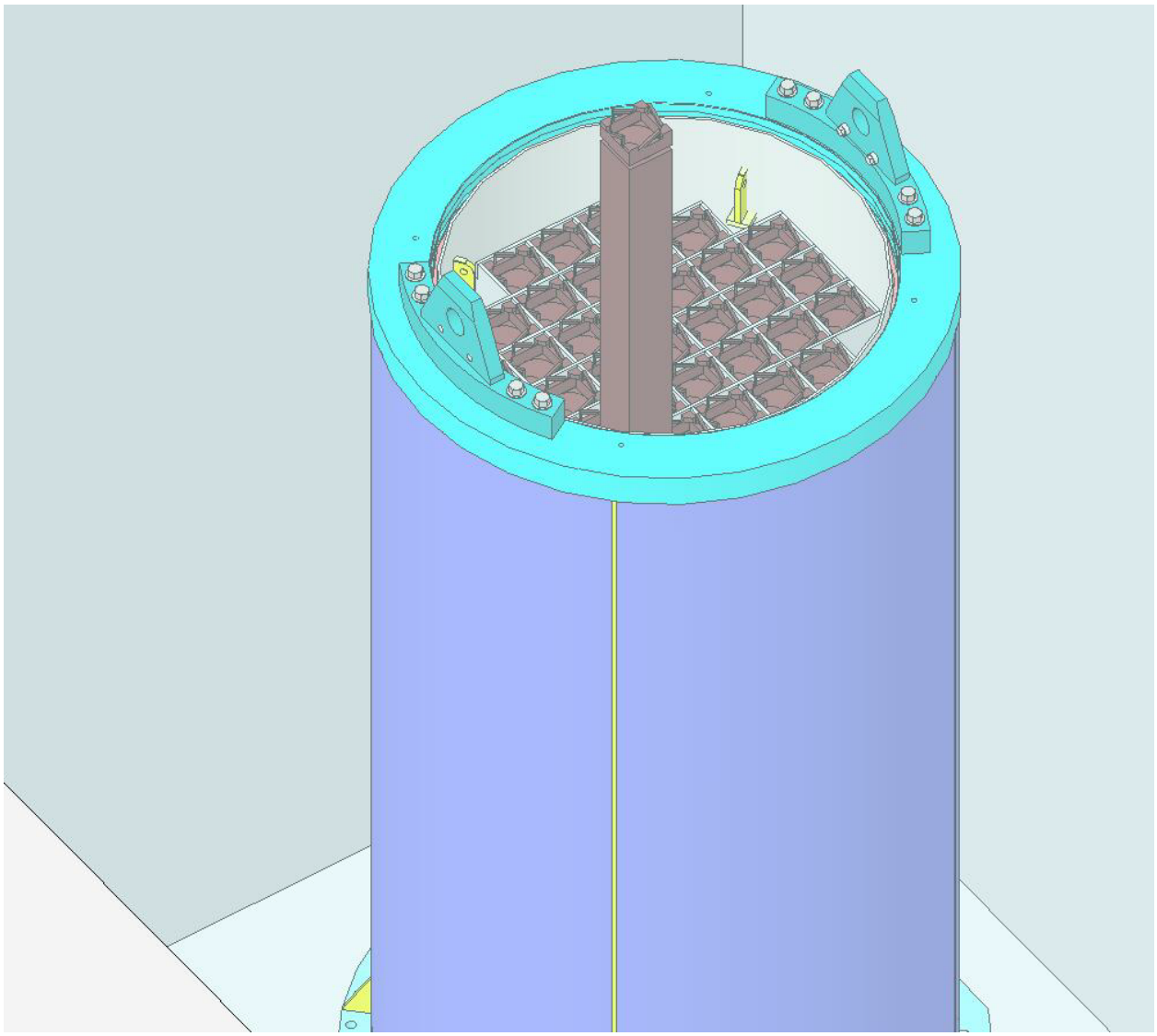

**FIGURE 9.2.4: FUEL ASSEMBLY PLACEMENT IN THE MPC (CRANE NOT SHOWN)**

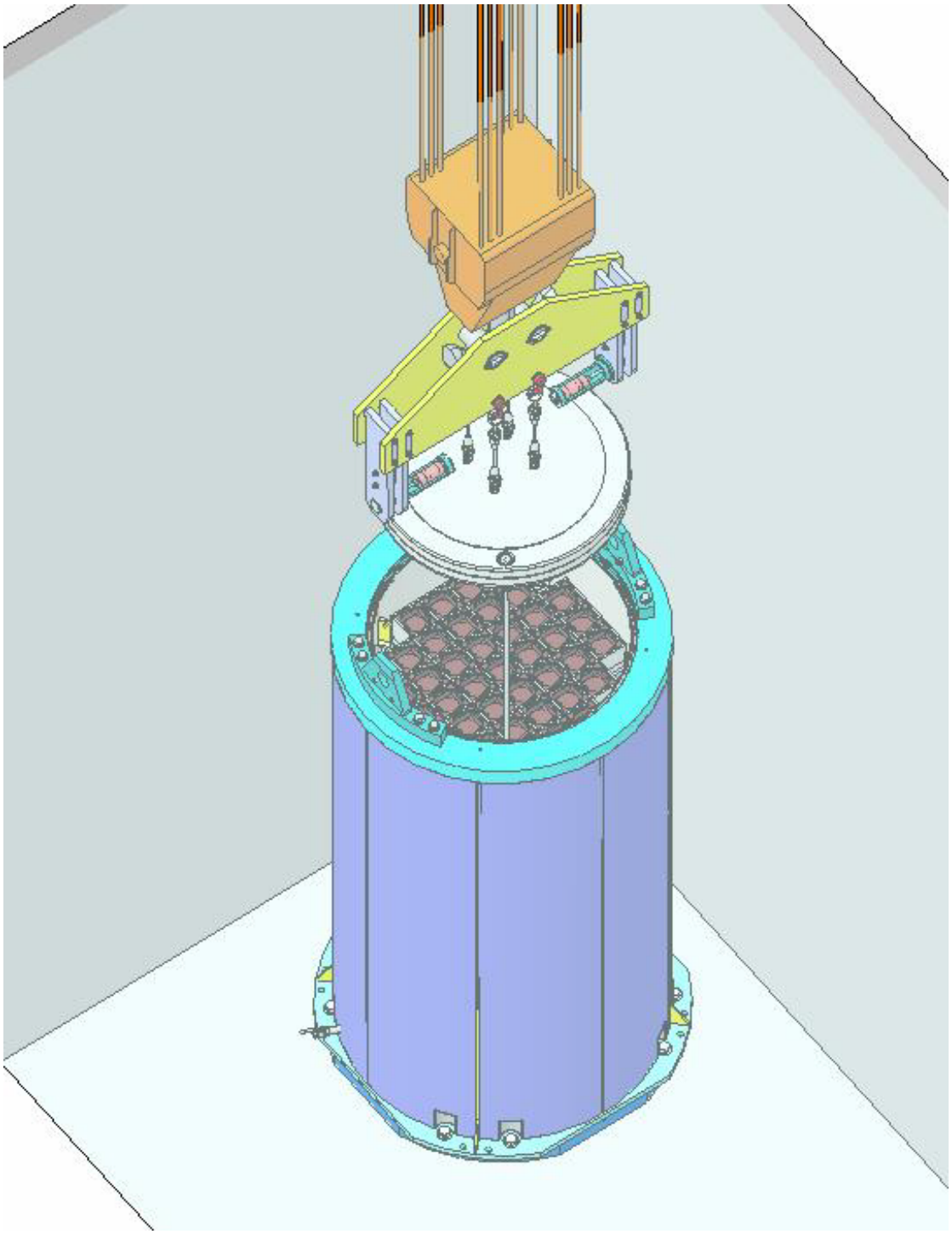

**FIGURE 9.2.5: MPC LID INSTALLATION USING THE LIFT YOKE**

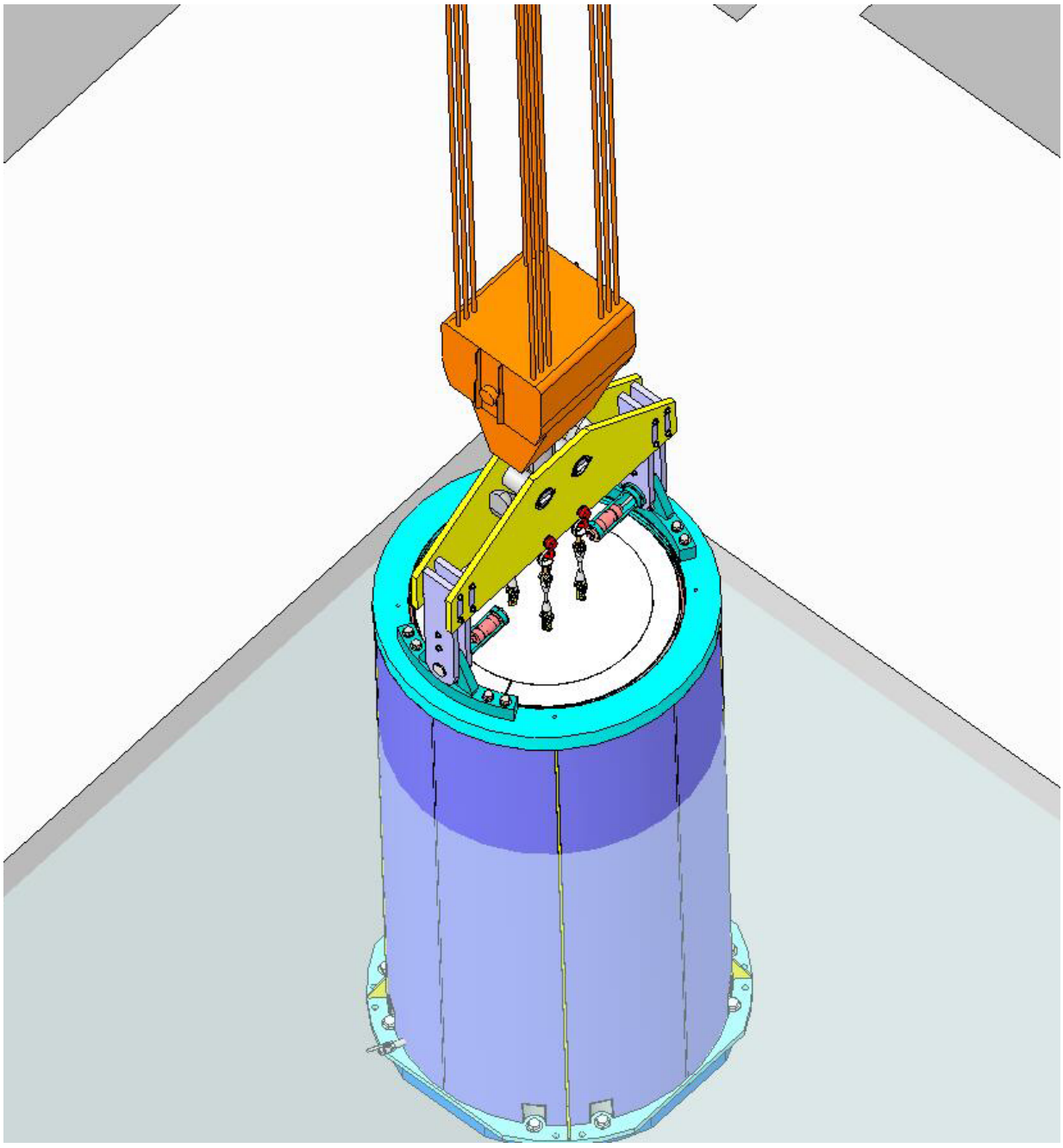

**FIGURE 9.2.6: HI-TRAC REMOVAL FROM THE SPENT FUEL POOL**

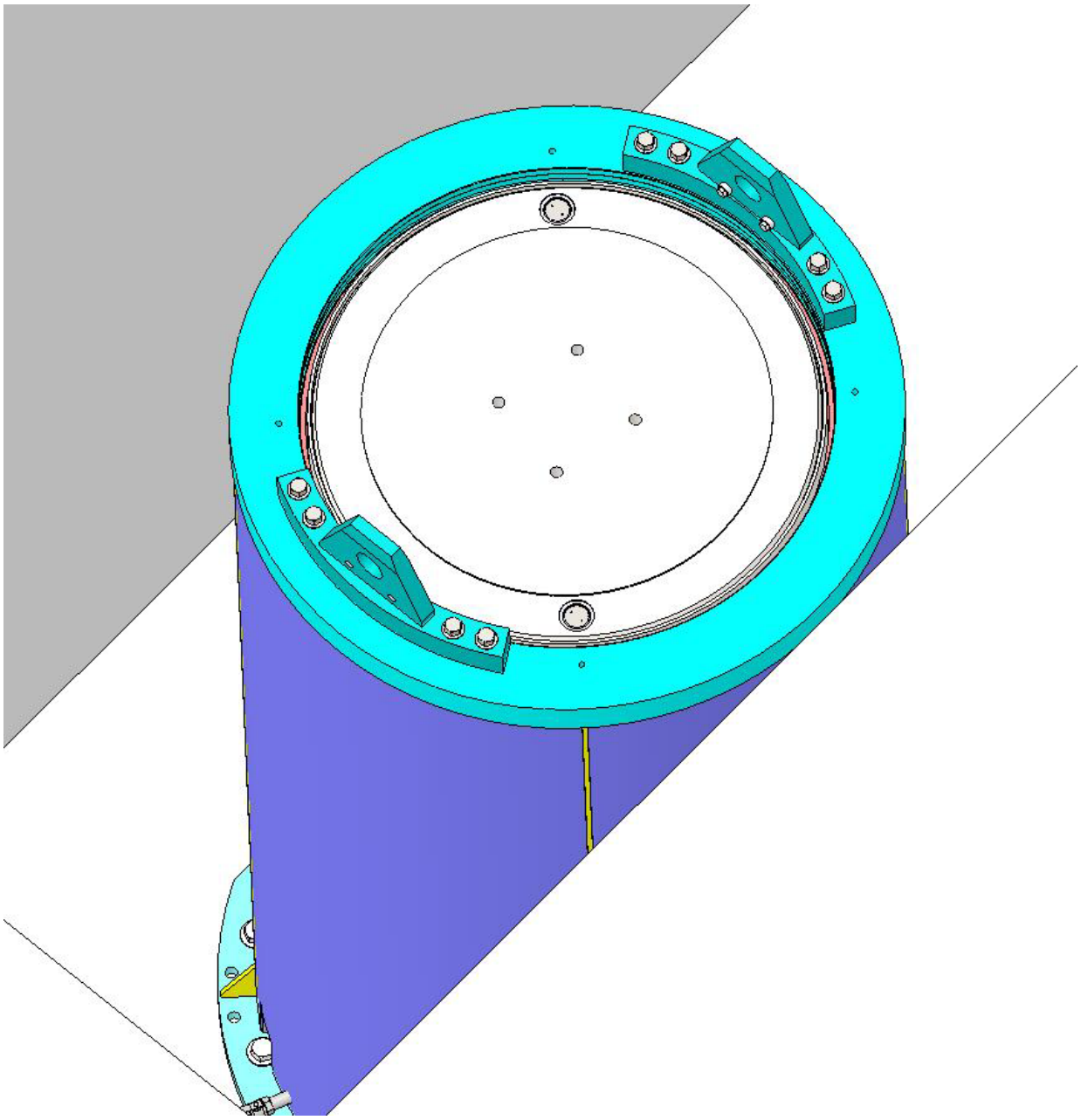

**FIGURE 9.2.7: HI-TRAC PLACEMENT IN THE CASK PREPARATION AREA**

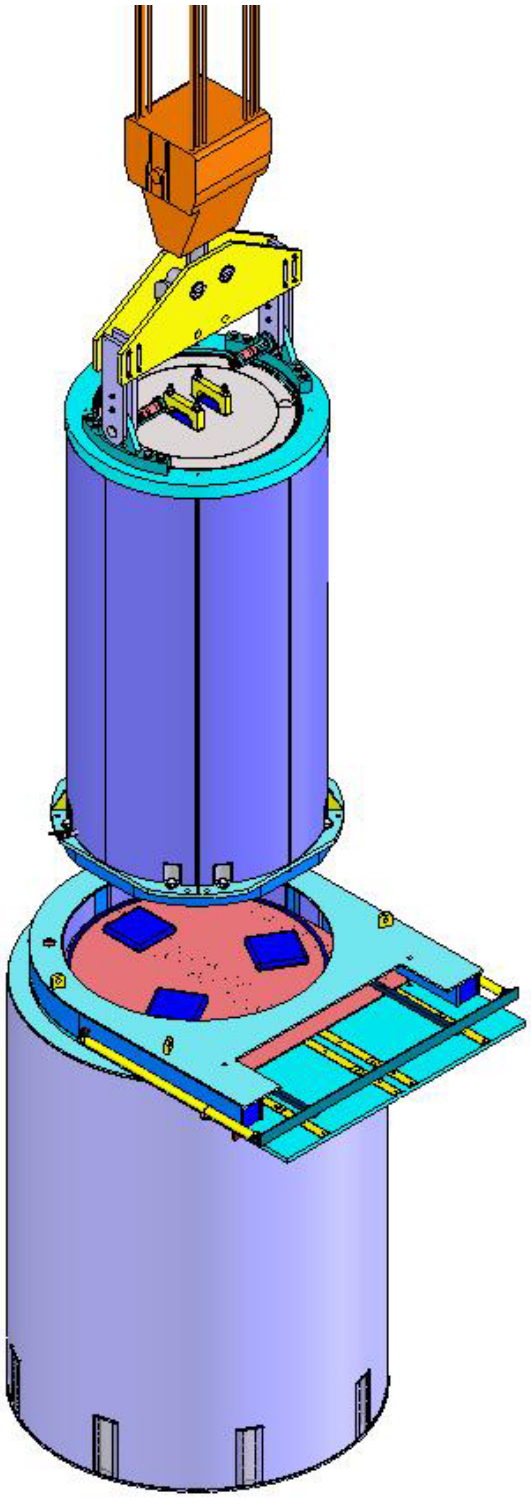

**FIGURE 9.2.8: HI-TRAC PLACEMENT ON THE HI-STORM 100 OVERPACK USING THE MATING DEVICE**

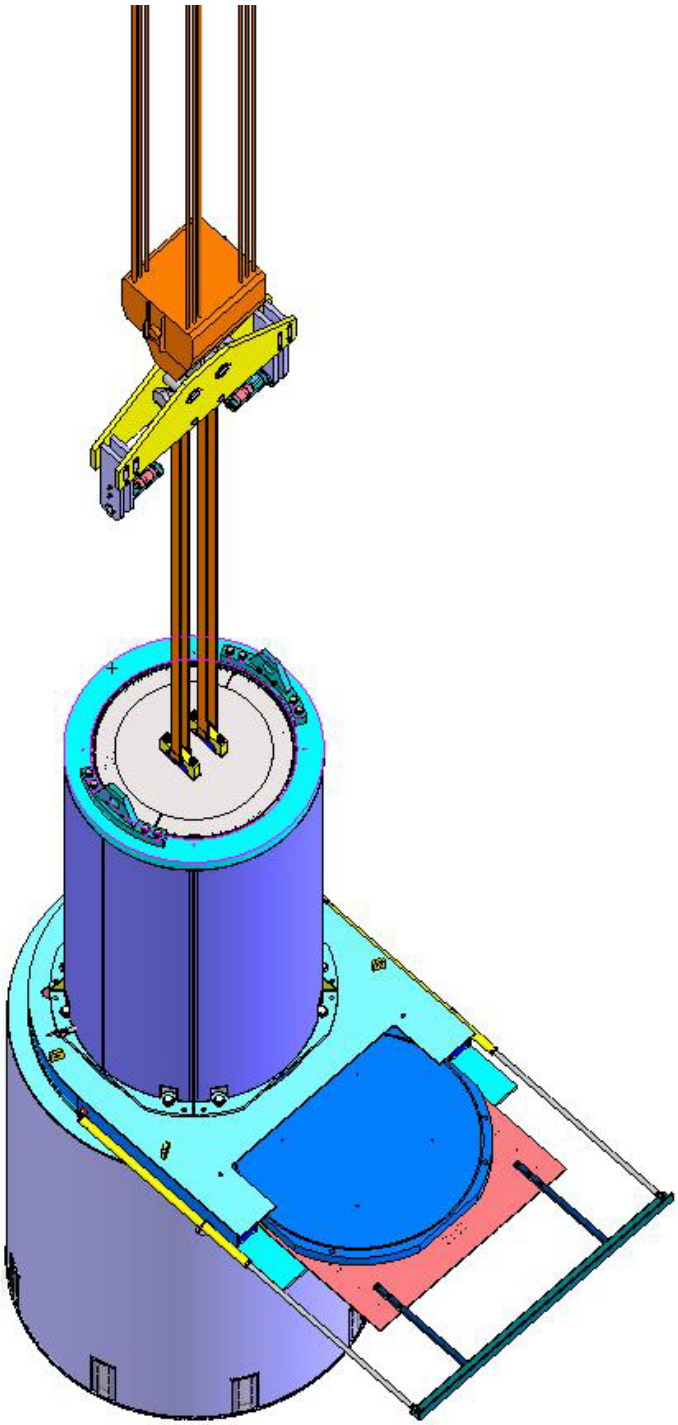

**FIGURE 9.2.9: HI-TRAC READY FOR MPC TRANSFER INTO HI-STORM FW OVERPACK**

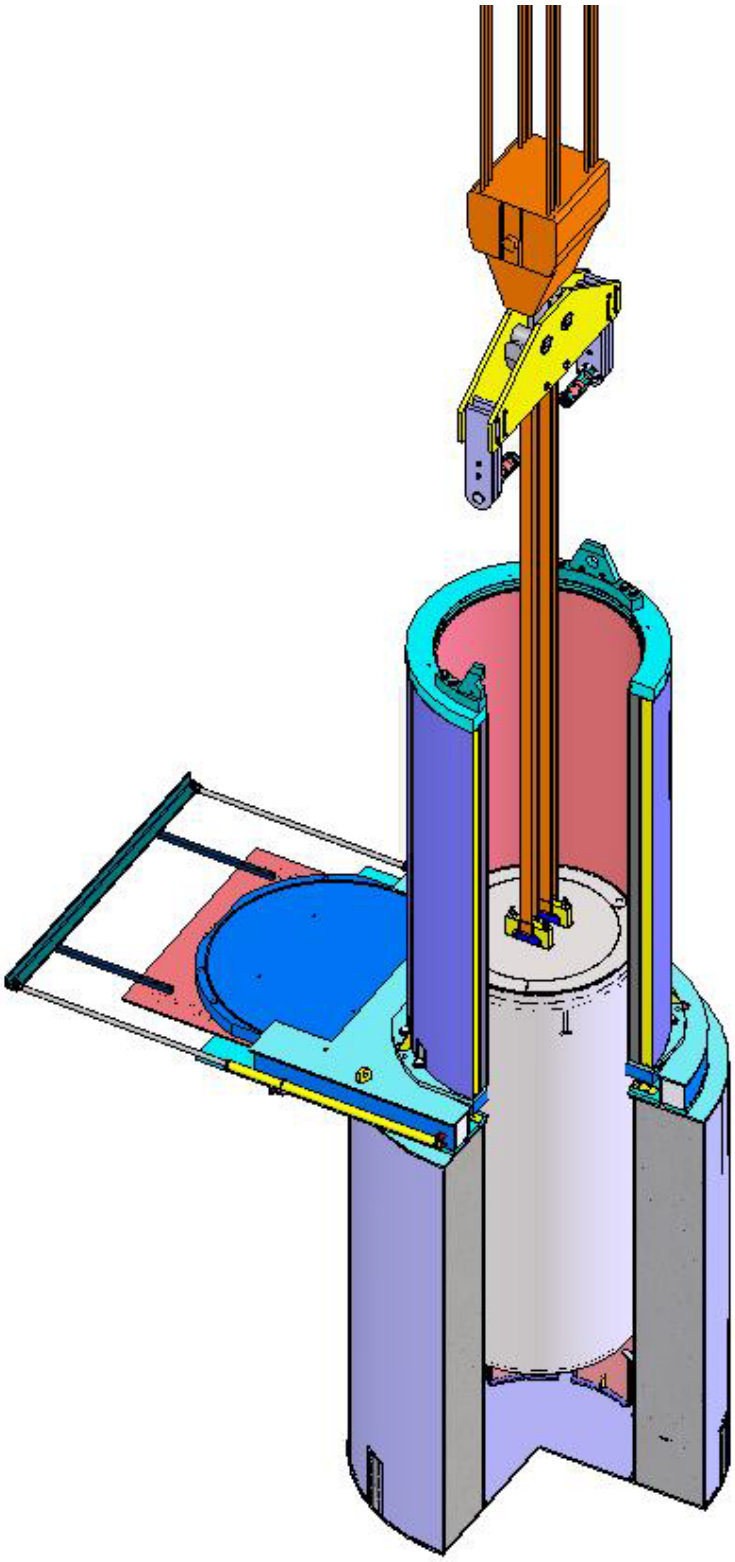

**FIGURE 9.2.10: MPC TRANSFER INTO HI-STORM FW OVERPACK (CUT-AWAY VIEW)**

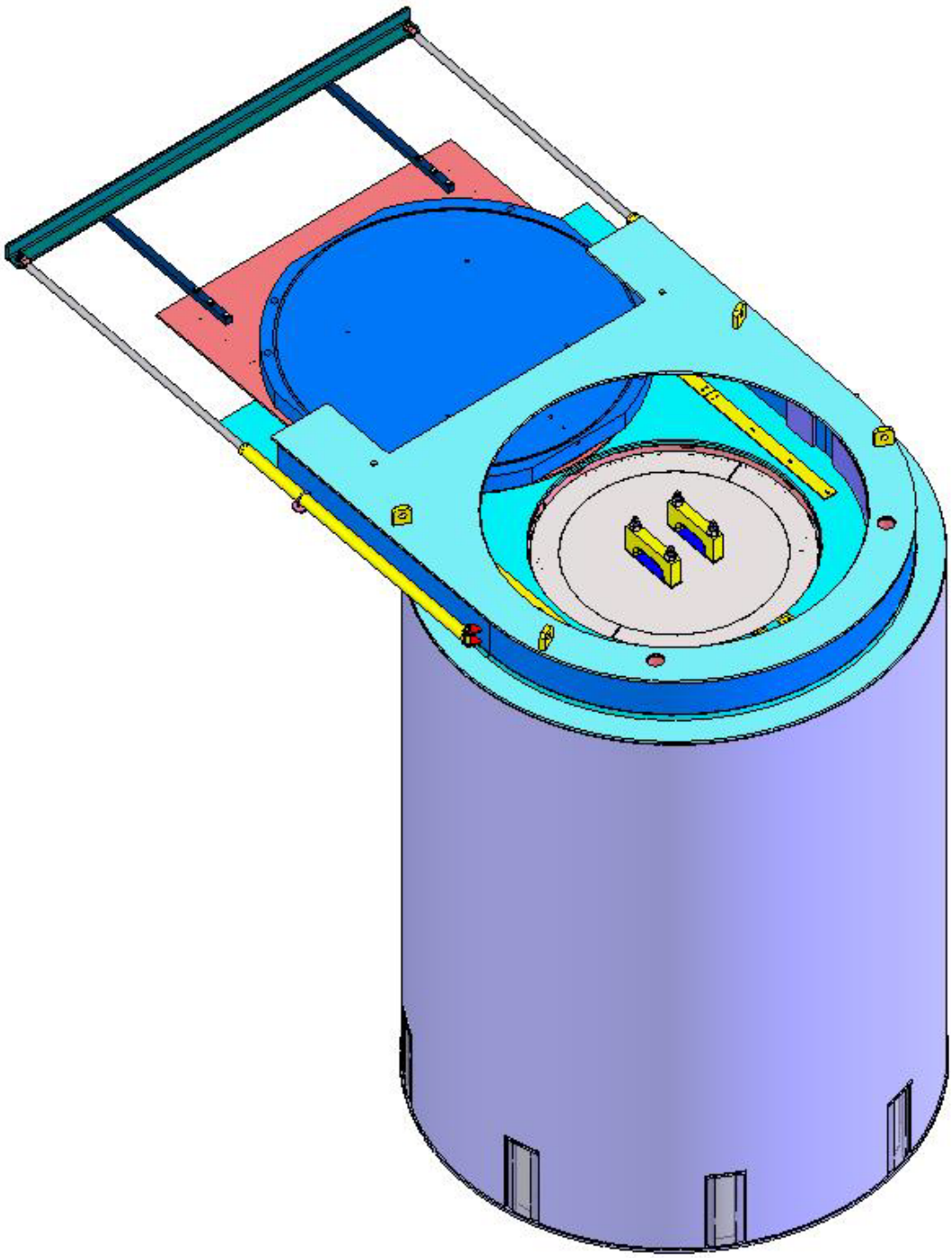

**FIGURE 9.2.11: MPC SHOWN FULLY LOWERED INTO HI-STORM (HI-TRAC NOT SHOWN)**

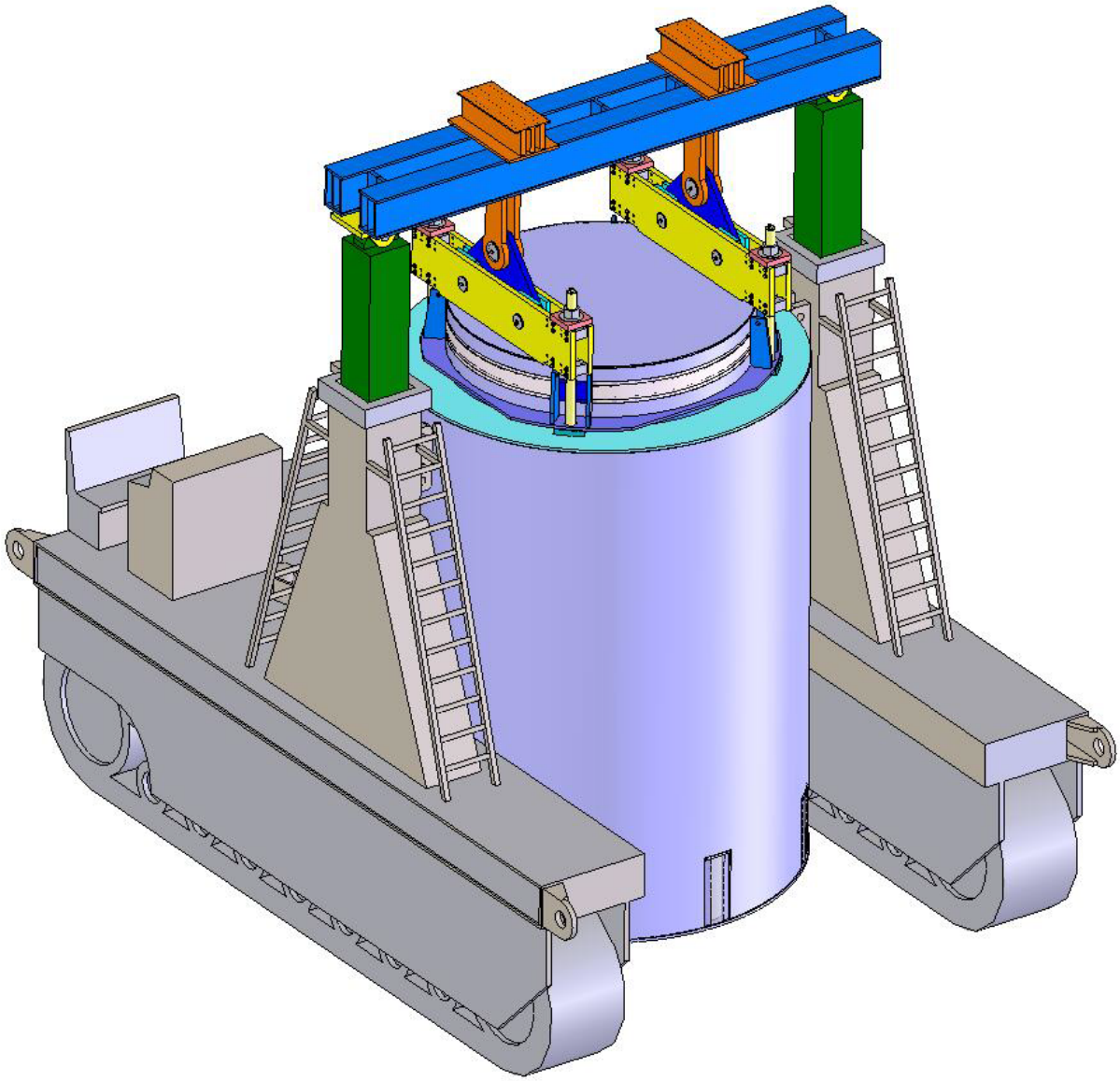

**FIGURE 9.2.12: HI-STORM FW OVERPACK MOVEMENT SHOWN WITH A REPRESENTATIVE CASK TRANSPORTER**

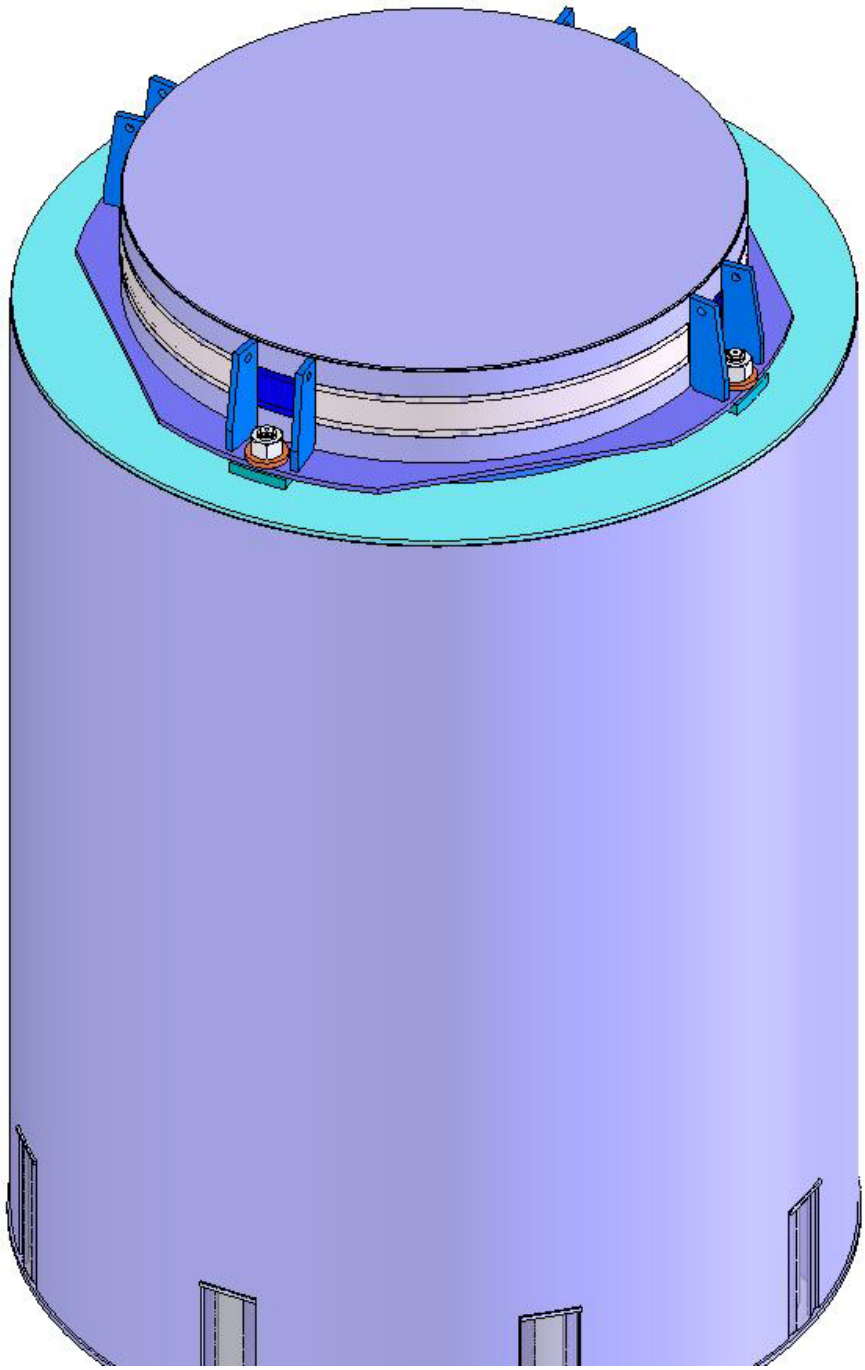

**FIGURE 9.2.13: HI-STORM SHOWN IN STORAGE WITH THE LID INSTALLED**

## 9.3 ISFSI OPERATIONS

The HI-STORM FW system heat removal system is a totally passive system. Maintenance on the HI-STORM FW system is typically limited to cleaning and touch-up painting of the overpacks, repair and replacement of damaged vent screens, and removal of vent blockages (e.g., leaves, debris). The heat removal system operability surveillance should be performed after any event that may have an impact on the safe functioning of the HI-STORM FW system. These include, but are not limited to, wind storms, heavy snow storms, fires inside the ISFSI, seismic activity, flooding of the ISFSI, and/or observed animal or insect infestations. The responses to these conditions involve first assessing the dose impact to perform the corrective action (inspect the HI-STORM FW overpack, clear the debris, check the cask pitch, and/or replace damaged vent screens), perform the corrective action, verify that the system is operable (check ventilation flow paths and radiation). In the unlikely event of significant damage to the HI-STORM FW, the situation may warrant removal of the MPC, and repair or replacement of the damaged HI-STORM FW overpack. If necessary, the procedures in Section 9.2 may be used to reposition a HI-STORM FW overpack for minor repairs and maintenance. In extreme cases, Section 9.4 may be used as guidance for unloading the MPC from the HI-STORM FW.

**Note:**
The heat removal system operability surveillance involves performing a visual examination on the HI-STORM FW exit and inlet vent screens to ensure that the vents remain clear or verifying the temperature rise from ambient to outlet is within prescribed limits if using a temperature monitoring system. The metallic vent screens if damaged may allow leaves, debris, or animals to enter the duct and block the flow of air to the MPC.

**ALARA Warning:**
Operators should practice ALARA principles when inspecting the vent screens. Binoculars or boroscopes may be used to allow the operator to perform the surveillance from a low dose area.

1. Perform the heat removal operability surveillance in accordance with the CoC.

2. ISFSI Security Operations shall be performed in accordance with the approved site security program plan.

## 9.4 PROCEDURE FOR UNLOADING THE HI-STORM FW FUEL IN THE SPENT FUEL POOL

### 9.4.1 Overview of HI-STORM FW System Unloading Operations

**ALARA Note:**
The procedure described below uses the weld removal system to remove the welds necessary to enable the MPC lid to be removed. 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-STORM FW system unloading procedures describe the general actions necessary to prepare the MPC for unloading, flood the MPC cavity, remove the lid welds, unload the spent fuel assemblies, and recover the HI-TRAC VW and empty MPC. 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. The principal operational steps are summarized below.

The MPC is recovered from HI-STORM FW either at the ISFSI or the fuel building using the same methods as described in Section 9.2 (in reverse order). The HI-STORM FW lid is removed and the mating device is positioned on the HI-STORM FW. MPC slings are attached to the MPC lift attachment and positioned on the MPC lid. HI-TRAC VW is positioned on top of HI-STORM FW and the slings are brought through the top of the HI-TRAC VW. The MPC is raised into HI-TRAC VW, the mating device drawer is closed, and the bottom lid is bolted to the HI-TRAC VW. The HI-TRAC VW is removed from on top of HI-STORM FW.

HI-TRAC VW and its enclosed MPC are returned to the designated preparation area and the MPC lift rigging is removed. Water is added into the annulus space between the MPC and HI-TRAC VW, if required. The annulus and HI-TRAC VW top surfaces are covered to protect them from debris produced when removing the MPC lid weld. The weld removal system is installed and the MPC vent and drain ports are accessed. 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. A vent line is attached to the vent port and the MPC is vented to the fuel building ventilation system or spent fuel pool as determined by the site's radiation protection personnel. The MPC is filled with water (borated as required) at a controlled rate to avoid over-pressuring the MPC. The weld removal system then removes the MPC lid-to-shell weld. The weld removal system is removed with the MPC lid left in place.

The top surfaces of the HI-TRAC VW and MPC are cleared of metal shavings. The inflatable annulus seal is installed and pressurized. The MPC lid is rigged to the lift yoke and the lift yoke is engaged to HI-TRAC VW lift blocks. If weight limitations require, the neutron shield jacket is drained of water. HI-TRAC VW is placed in the spent fuel pool and the MPC lid is removed. All fuel assemblies are returned to the spent fuel storage racks and the MPC fuel cells are cleared of

any assembly debris and crud. HI-TRAC VW and MPC are returned to the designated preparation area where the MPC water is removed. The annulus water is drained and the MPC and overpack are decontaminated.

### 9.4.2 HI-STORM FW Recovery from Storage

1. Recover the MPC from HI-STORM FW as follows:

   a. Perform a transport route walkdown to ensure that the cask transport conditions are met.

   b. Transfer HI-STORM FW to the fuel building or site designated location for the MPC transfer.

   c. Position HI-STORM FW under the lifting device.

   d. Remove the HI-STORM FW lid.

   e. Install the mating device with bottom lid on top of the HI-STORM FW.

   f. Remove the MPC lift attachment plugs and install the MPC lift rigging to the MPC lid.

2. At the site's discretion, perform a HI-TRAC VW receipt inspection and cleanliness inspection in accordance with a site-specific inspection checklist.

**Note:**
If the HI-TRAC VW is expected to be operated in an environment below 32 $^{o}$F, the water jacket shall be filled with an ethylene glycol solution (25% ethylene glycol). Otherwise, the jacket shall be filled with demineralized water.

3. If previously drained, fill the neutron shield jacket with plant demineralized water or an ethylene glycol solution (25% ethylene glycol) as necessary. Ensure that the fill and drain plugs are installed.

4. Engage the lift yoke to HI-TRAC VW.

5. Align HI-TRAC VW over HI-STORM FW and mate the overpacks.

6. Unbolt the bottom lid and open the mating device drawer.

7. Attach the ends of the MPC sling to the lifting device.

8. Raise the MPC into HI-TRAC VW.

9. Verify the MPC is in the full-up position.

10. Close the mating device.

11. Bolt the bottom lid to the HI-TRAC VW.

12. Lower the MPC onto the bottom lid.

13. Disconnect the MPC lift rigging from the MPC lid.

14. Remove HI-TRAC VW from the top of the HI-STORM FW.

### 9.4.3 Preparation for Unloading

1. Prepare for MPC cool-down as follows:

**Warning:**
At the start of annulus filling, the annulus fill water may flash to steam due to high MPC shell temperatures. Users may select the location and means of performing the annulus fill. Users may also elect the source of water for the annulus. Water addition should be preformed in a slow and controlled manner until water steam generation has ceased.

2. If necessary, set the annulus water level to approximately 4 inches below the top of the MPC shell and install the annulus shield. Cover the annulus and HI-TRAC VW top surfaces to protect them from debris produced when removing the MPC lid weld.

3. Access the MPC as follows:

**ALARA Note:**
The following procedures describe weld removal using a machine tool head. Other methods may also be used. The metal shavings may need to be periodically removed.

**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. Using the marked locations of the vent and drain ports, core drill the closure ring and port cover plates.

b. Remove the closure ring sections and the vent and drain port cover plates.

**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.

4. Take an MPC gas sample as follows:

**Note:**
Users may select alternate methods of obtaining a gas sample.

a. Attach the RVOAs.

b. Attach a sample bottle to the vent port RVOA.

c. 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.

5. Fill the MPC cavity with water as follows:

**Caution:**
The MPC interior shall be filled with helium or another suitable inert gas to avoid exposing the fuel to oxidizing agents while at elevated temperatures. Exposing fuel at elevated temperatures to oxidizing agents can lead to deleterious oxidation of the fuel.

a. Open the vent and drain port caps using the RVOAs.

**Caution:**
The introduction of water into the MPC may create water vapor. Re-flooding operations shall be closely controlled to ensure that the internal pressure in the MPC does not exceed design limits. The water flow rate shall be adjusted to maintain the internal pressure below design limits. See LCO 3.1.3 and SAR section 4.5.5.

**Caution:**
To mitigate unfavorable thermal shocking of the fuel cladding during re-flooding operations the re-flood water shall be at a temperature ≥80°F. See Section 3.4.4 for related fuel cladding evaluations.

b. Route the vent port line several feet below the spent fuel pool surface or to the radwaste gas facility. Attach the vent line to the MPC vent port and slowly open the vent line valve to depressurize the MPC.

**Note:**
When unloading MPCs requiring soluble boron, the boron concentration of the water shall be checked in accordance with LCO 3.3.1 before and during operations with fuel and water in the MPC. Testing must be completed within four hours prior to unloading and every 48 hours after in accordance with the LCO until all the fuel is removed from the MPC. Two independent measurements shall be taken to ensure that the requirement of 10 CFR 72.124(a) is met.

c. Attach the water fill line from a water source with water temperature ≥80°F to the MPC drain port and slowly open the water supply valve and establish a pressure less than 90 psi. (Refer to LCO 3.3.1 for boron concentration requirements). Fill the MPC until bubbling from the vent line has terminated. Close the water supply valve on completion.

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.

**Caution:**
A radiolysis of water may occur in high flux conditions inside the MPC creating combustible gases. Appropriate monitoring for combustible gas concentrations shall be performed prior to, and during MPC lid removal operations. The space below the MPC lid shall be purged with inert gas prior to, and during MPC lid removal operations, including grinding, and other hot work, to provide additional assurance that flammable gas concentrations will not develop in this space.

e. Connect a combustible gas monitor to the MPC vent port and check for combustible gas concentrations prior to and periodically during weld removal activities. Purge the gas space under the lid as necessary.

f. Remove the MPC lid-to-shell weld using the weld removal system.

g. Remove any metal shavings from the top surfaces of the MPC and HI-TRAC VW.

6. Install the inflatable annulus seal.
7. Place HI-TRAC VW in the spent fuel pool as follows:

a. If necessary for plant weight limitations, drain the water from the neutron shield jacket.

b. Engage the lift yoke to HI-TRAC VW lifting blocks, remove the MPC lid lifting plugs and attach the MPC lid slings.

c. Position HI-TRAC VW into the spent fuel pool in accordance with site-approved rigging procedures.

d. Disengage the lift yoke. Visually verify that the lift yoke is fully disengaged.

e. Remove the lift yoke, MPC lid and drain line from the pool in accordance with directions from the site's Radiation Protection personnel.

f. Disconnect the drain line from the MPC lid.

g. Store the MPC lid components in an approved location. Disengage the lift yoke from MPC lid.

### 9.4.4 MPC Unloading

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

2. Remove any debris or corrosion products from the MPC cells.

### 9.4.5 Post-Unloading Operations

1. Remove HI-TRAC VW and the unloaded MPC from the spent fuel pool as follows:

   a. Engage the lift yoke to the HI-TRAC VW lift blocks.

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

   c. Raise HI-TRAC VW until HI-TRAC VW flange is at the surface of the spent fuel pool.

**ALARA Warning:**
Activated debris may have settled on the top face of HI-TRAC VW during fuel unloading.

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

   e. Raise the top of HI-TRAC VW and MPC to the level of the spent fuel pool deck.

   f. Close the annulus overpressure system reservoir valve, if used.

   g. Lower the water level in the MPC approximately 12 inches to prevent splashing during cask movement.

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

   h. Remove HI-TRAC VW from the spent fuel pool under the direction of radiation protection personnel.

   i. Disconnect the annulus overpressure system from the HI-TRAC VW.

j. Place HI-TRAC VW in the designated preparation area.

k. Disengage the lift yoke.

l. Perform decontamination on HI-TRAC VW and the lift yoke.

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

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

o. Drain the water in the annulus area by connecting the drain line to the HI-TRAC VW drain connector.

p. Remove the MPC from HI-TRAC VW and decontaminate the MPC as necessary.

q. Decontaminate HI-TRAC VW.

r. Return any HI-STORM FW equipment to storage as necessary.

## 9.5 REFERENCES


[9.0.1] U.S. Nuclear Regulatory Commission, "Standard Review Plan for Dry Cask Storage Systems", NUREG-1536, Final Report, January 1997.

[9.1.1] U.S. Code of Federal Regulations, Title 10 "Energy", Part 72, "Licensing Requirements for Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste,"

[9.1.2] 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.

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

[9.5.1] U.S. Code of Federal Regulations, Title 10 " Energy", Part 20, "Standards for Protection Against Radiation,"