



**H O L T E C**  
I N T E R N A T I O N A L

October 18, 2001

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United States Nuclear Regulatory Commission  
ATTN: Document Control Desk  
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Subject: USNRC Docket No. 72-1014, TAC L23344  
HI-STORM 100 Certificate of Compliance 1014  
HI-STORM License Amendment Request 1014-1, Revision 2, Draft Supplement 4

References: Holtec Project 5014

Dear Sir:

Pursuant to our telephone conversation of this morning, attached herewith are draft Supplement 4 changes to License Amendment Request (LAR) 1014-1, Revision 2. After your perusal of this material to ensure we have correctly incorporated your comments, we will forward a formal Supplement 4 to the LAR package.

Please contact me at (856) 797-0900, extension 668 with any comments.

Sincerely,

Brian Gutherman, P.E.  
Licensing Manager

Approved:

K.P. Singh, Ph.D., P.E.  
President and CEO

**Technical Concurrence:**

Dr. Indresh Rampall (Thermal Evaluation)

Document I.D.: 5014440

Enclosure: Draft Supplement 4 LAR changes

emcc: Mr. Tim Kobetz, USNRC (w/enclosures)  
Mr. Chris Regan, USNRC (w/encl.)

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CERTIFICATE OF COMPLIANCE  
FOR SPENT FUEL STORAGE CASKS  
Supplemental Sheet

*Re-worded*

10. PRE-OPERATIONAL TESTING AND TRAINING EXERCISE (continued)

- f. MPC welding, NDE inspections, hydrostatic testing, draining, vacuum drying, moisture removal (by vacuum drying or forced helium dehydration, as applicable), helium backfilling, and leakage testing. (A mockup may be used for this dry-run exercise.)
- g. Transfer cask upending/downending on the horizontal transfer trailer or other transfer device, as applicable to the site's cask handling arrangement.
- h. Transfer of the MPC from the transfer cask to the overpack.
- i. Placement of the HI-STORM 100 Cask System at the ISFSI.
- j. HI-STORM 100 Cask System unloading, including cooling fuel assemblies, flooding MPC cavity, removing MPC lid welds. (A mockup may be used for this dry-run exercise.)

9-11. AUTHORIZATION

The HI-STORM 100 Cask System, which is authorized by this certificate, is hereby approved for general use by holders of 10 CFR Part 50 licenses for nuclear reactors at reactor sites under the general license issued pursuant to 10 CFR 72.210, subject to the conditions specified by 10 CFR 72.212, and the attached Appendix A and Appendix B.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

E. William Brach, Director  
Spent Fuel Project Office  
Office of Nuclear Materials Safety  
and Safeguards

Attachments:

1. Appendix A
2. Appendix B

DESIGN FEATURES

3.6 Forced Helium Dehydration System

3.6.1 System Description

Use of the Forced Helium Dehydration (FHD) system, (a closed-loop system) is an alternative to vacuum drying the MPC for moderate burnup fuel ( $\leq 45,000$  MWD/MTU) and mandatory for drying MPCs containing one or more high burnup fuel assemblies. The FHD system shall be designed for normal operation (i.e., excluding startup and shutdown ramps) in accordance with the criteria in Section 3.6.2.

3.6.2 Design Criteria

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- 3.6.2.1 The temperature of the helium gas in the MPC shall be at least  $15^{\circ}\text{F}$  higher than the saturation temperature at coincident pressure.
- 3.6.2.2 The pressure in the MPC cavity space shall be  $\leq 60.3$  psig (75 psia).
- 3.6.2.3 The hourly recirculation rate of helium shall be  $\geq 10$  times the nominal helium mass backfilled into the MPC for fuel storage operations.
- 3.6.2.4 The partial pressure of the water vapor in the MPC cavity will not exceed 3 torr if the helium temperature at the demoisurer outlet is  $\leq 21^{\circ}\text{F}$  for a period of 30 minutes.
- 3.6.2.5 The condensing module shall be designed to de-vaporize the recirculating helium gas to a dew point  $\leq 120^{\circ}\text{F}$ .
- 3.6.2.6 The demoisurizing module shall be configured to be introduced into its helium conditioning function after the condensing module has been operated for the required length of time to assure that the bulk moisture vaporization in the MPC (defined as Phase 1 in FSAR Appendix 2.B) has been completed.
- 3.6.2.7 The helium circulator shall be sized to effect the minimum flow rate of circulation required by these design criteria.
- 3.6.2.8 The pre-heater module shall be engineered to ensure that the temperature of the helium gas in the MPC meets these design criteria.

(continued)

DESIGN FEATURES

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3.6 Forced Helium Dehydration System (continued)

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3.6.3 Fuel Cladding Temperature

*A steady-state thermal analysis of the MPC under the forced helium flow scenario shall be performed using the methodology described in HI-STORM 100 FSAR Subsections 4.4.1.1.1 through 4.4.1.1.4, with due recognition of the forced convection process during FHD system operation. This analysis shall demonstrate that the peak temperature of the fuel cladding under the most adverse condition of FHD system operation, is below the peak cladding temperature limit for normal conditions of storage.*

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Acceptance testing deleted.

## Appendix 2.B The Forced Helium Dehydration (FHD) System

### 2.B.1 System Overview

The Forced Helium Dehydration (FHD) system is used to remove the remaining moisture in the MPC cavity after all of the water that can practically be removed through the drain line using a hydraulic pump has been expelled in the water blowdown operation. The FHD system is required to be used for MPCs containing at least one high burnup fuel assembly and is optional for MPCs containing all moderate burnup fuel assemblies.

Expelling the water from the MPC using a conventional pump would remove practically all of the contained water except for the small quantity remaining on the MPC baseplate below the bottom of the drain line and an even smaller adherent amount wetting the internal surfaces. A skid-mounted, closed loop dehydration system will be used to remove the residual water from the MPC such that the partial pressure of the trace quantity of water vapor in the MPC cavity gas is brought down to  $\leq 3$  torr. The FHD system, engineered for this purpose, shall utilize helium gas as the working substance.

The FHD system, schematically illustrated in Figure 2.B.1, can be viewed as an assemblage of four thermal modules, namely, (i) the condensing module, (ii) the demister module, (iii) the helium circulator module and (iv) the pre-heater module. The condensing module serves to cool the helium/vapor mixture exiting the MPC to a temperature well below its dew point such that water may be extracted from the helium stream. The condensing module is equipped with suitable instrumentation to provide a direct assessment of the extent of condensation that takes place in the module during the operation of the FHD system. The demister module, engineered to receive partially cooled helium exiting the condensing module, progressively chills the recirculating helium gas to a temperature that is well below the temperature corresponding to the partial pressure of water vapor at 3 torr.

The motive energy to circulate helium is provided by the helium circulator module, which is sized to provide the pressure rise necessary to circulate helium at the requisite rate. The last item, labeled the pre-heater module, serves to pre-heat the flowing helium to the desired temperature such that it is sufficiently warm to boil off any water present in the MPC cavity.

The pre-heater module, in essence, serves to add supplemental heat energy to the helium gas (in addition to the heat generated by the stored SNF in the MPC) so as to facilitate rapid conversion of water into vapor form. The heat input from the pre-heater module can be adjusted in the manner of a conventional electric heater so that the recirculating helium entering the MPC is sufficiently dry and hot to evaporate water, but not unduly hot to place unnecessary thermal burden on the condensing module.

The FHD system described in the foregoing performs its intended function by continuously removing water entrained in the MPC through successive cooling, moisture removal and reheating of the working substance in a closed loop. In a classical system of the FHD genre, the moisture removal operation occurs in two discrete phases. In the beginning of the FHD system's operation (Phase 1), the helium exiting the MPC is laden with water vapor produced by boiling

of the entrained bulk water. The condensing module serves as the principal device to condense out the water vapor from the helium stream in Phase 1. Phase 1 ends when all of the bulk water in the MPC cavity is vaporized. At this point, the operation of the FHD system moves on to steadily lowering the relative humidity and bulk temperature of the circulating helium gas (Phase 2). The demoisturizer module, equipped with the facility to chill flowing helium, plays the principal role in the dehydration process in Phase 2.

### 2.B.2 Design Criteria

The design criteria set forth below are intended to ensure that design and operation of the FHD system will drive the partial pressure of the residual vapor in the MPC cavity to  $\leq 3$  torr if the temperature of helium exiting the demoisturizer has met the value and duration criteria provided in the HI-STORM technical specifications. The FHD system shall be designed to ensure that during normal operation (i.e., excluding startup and shutdown ramps) the following criteria are met:

- i. The temperature of helium gas in the MPC shall be at least 15°F higher than the saturation temperature at coincident pressure.
- ii. The pressure in the MPC cavity space shall be less than or equal to 60.3 psig (75 psia).
- iii. The recirculation rate of helium shall be sufficiently high (minimum hourly throughput equal to ten times the nominal helium mass backfilled into the MPC for fuel storage operations) so as to produce a turbulated flow regime in the MPC cavity.
- iv. The partial pressure of the water vapor in the MPC cavity will not exceed 3 torr if the helium temperature at the demoisturer outlet is  $\leq 21^\circ\text{F}$  for a period of 30 minutes.

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In addition to the above system design criteria, the individual modules shall be designed in accordance with the following criteria:

- i. The condensing module shall be designed to de-vaporize the recirculating helium gas to a dew point of 120°F or less.
- ii. The demoisturizer module shall be configured to be introduced into its helium conditioning function *after* the condensing module has been operated for the required length of time to assure that the bulk moisture vaporization in the MPC (defined as Phase 1 in Section 2.B.1) has been completed.
- iii. The helium circulator shall be sized to effect the minimum flow rate of circulation required by the system design criteria described above.
- iv. The pre-heater module shall be engineered to ensure that the temperature of the helium gas in the MPC meets the system design criteria described above.

### 2.B.3 Analysis Requirements

The design of the FHD system shall be subject to the confirmatory analyses listed below to ensure that the system will accomplish the performance objectives set forth in this FSAR.

- i. System thermal analysis in Phase 1: Characterize the rate of condensation in the condensing module and helium temperature variation under Phase 1 operation (i.e., the scenario where there is some unevaporated water in the MPC) using a classical thermal-hydraulic model wherein the incoming helium is assumed to fully mix with the moist helium inside the MPC.
- ii. System thermal analysis in Phase 2: Characterize the thermal performance of the closed loop system in Phase 2 (no unvaporized moisture in the MPC) to predict the rate of condensation and temperature of the helium gas exiting the condensing and the demoinsturizer modules. Establish that the system design is capable to ensure that partial pressure of water vapor in the MPC will reach  $\leq 3$  torr if the temperature of the helium gas exiting the demoinsturizer is predicted to be at a maximum of 21°F for 30 minutes.
- iii. Fuel Cladding Temperature Analysis: A steady-state thermal analysis of the MPC under the forced helium flow scenario shall be performed using the methodology described in HI-STORM 100 FSAR Subsections 4.4.1.1.1 through 4.4.1.1.4 with due recognition of the forced convection process during FHD system operation. This analysis shall demonstrate that the peak temperature of the fuel cladding under the most adverse condition of FHD system operation (design maximum heat load, no moisture, and maximum helium inlet temperature), is below the peak cladding temperature limit for normal conditions of storage.

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### 2.B.4 Acceptance Testing

The first FHD system designed and built for the MPC drying function required by HI-STORM's technical specifications shall be subject to confirmatory testing as follows:

- a. A representative quantity of water shall be placed in a manufactured MPC (or equivalent mock-up) and the closure lid and RVOAs installed and secured to create a hermetically sealed container.
- b. The MPC cavity drying test shall be conducted for the worst case scenario (no heat generation within the MPC available to vaporize water).
- c. The drain and vent line RVOAs on the MPC lid shall be connected to the terminals located in the pre-heater and condensing modules of the FHD system, respectively.
- d. The FHD system shall be operated through the moisture vaporization (Phase 1) and subsequent dehydration (Phase 2). The FHD system operation will be stopped after the temperature of helium exiting the demoinsturizer module has been at or below 21°F

for thirty minutes (nominal). Thereafter, a sample of the helium gas from the MPC will be extracted and tested to determine the partial pressure of the residual water vapor in it. The FHD system will be deemed to have passed the acceptance testing if the partial pressure in the extracted helium sample is less than or equal to 3 torr.

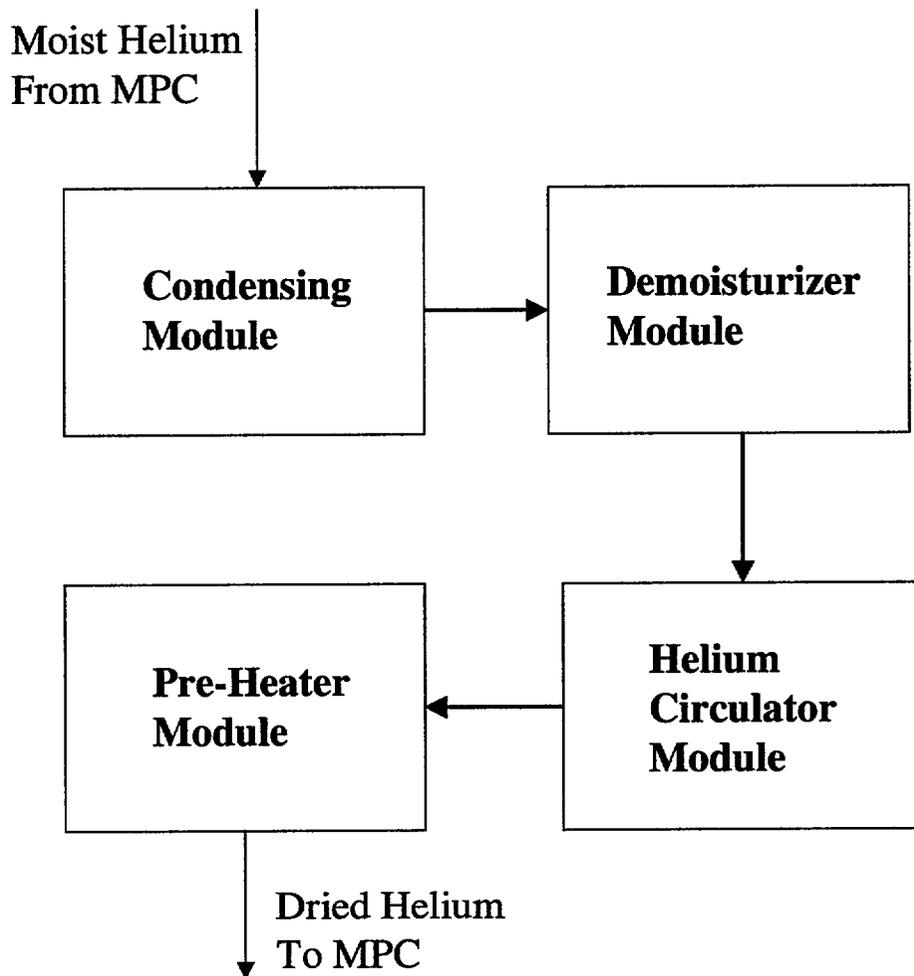


FIGURE 2.B.1: SCHEMATIC OF THE FORCED HELIUM DEHYDRATION SYSTEM