PROPOSED CERTIFICATE OF COMPLIANCE NO. 1032

APPENDIX A

INSPECTIONS, TESTS, AND EVALUATIONS

FOR THE HI-STORM FW MPC STORAGE SYSTEM

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1 INSPECTIONS, TESTS, AND EVALUATIONS

1.1 Definitions

Refer to Appendix B for Definitions.

1.2 Neutron Absorber Tests

1.2.1 Neutron Absorber Tests

1.2.1.1 The weight percentage of the boron carbide must be confirmed to be greater than or equal to 10% in each lot of Al/B4C powder.

1.2.1.2 The areal density of the B-10 isotope corresponding to the 10% min. weight density in the manufactured Metamic-HT panels shall be independently confirmed by the neutron attenuation test method by testing at least one coupon from a randomly selected panel in each lot.

1.2.1.3 If the B-10 areal density criterion in the tested panels fails to meet the specific minimum, then the manufacturer has the option to reject the entire lot or to test a statistically significant number of panels and perform statistical analysis for acceptance.

1.2.1.4 All test procedures used in demonstrating compliance with the above requirements shall conform to the cask designer's QA program which has been approved by the USNRC under docket number 71-0784.

1.2.2 Design Important to Neutron Absorber Tests

1.2.2.1 MPC-37

1. Minimum basket cell ID: 8.92 in. (nominal)
2. Minimum basket cell wall thickness: 0.57 in. (nominal)
3. B_4C in the Metamic-HT: 10.0 wt % (min.)

1.2.2.2 MPC-89

1. Minimum basket cell ID: 5.99 in. (nominal)
2. Minimum basket cell wall thickness: 0.38 in. (nominal)
3. B_4C in the Metamic-HT: 10.0 wt % (min.)

1.2.2.3 MPC-32ML

1. Minimum basket cell ID: 9.53 (nominal)
2. Minimum basket cell wall thickness: 0.57 in (nominal)
3. B_4C in the Metamic-HT: 10.0wt% (min.)

1.2.2.4 MPC-37P

1. Minimum basket cell ID: 8.70 in. (nominal)
2. Minimum basket cell wall thickness: 0.77 in. (nominal)
3. B_4C in the Metamic-HT: 10.0 wt % (min.)

1.2.2.5 MPC-44

1. Minimum basket cell ID: 8.00 (nominal)
2. Minimum basket cell wall thickness: 0.49 in (nominal)
3. ~~1.~~3. B_4C in the Metamic-HT: 10.0wt% (min.)

1.3 Special Requirements for First System in Place

The air mass flow rate through the cask system will be determined by direct measurements of air velocity in the overpack cooling passages for the first HI-STORM FW MPC Cask System placed into service by any user with a heat load equal to or greater than 30 kW. The velocity will be measured using direct measurements of air velocity in the inlet vents. An analysis shall be performed of the cask system with the taken measurements to demonstrate that the measurements validate the analytic methods described in Chapter 4 of the FSAR.

The thermal validation test and analysis results shall be submitted in a letter report to the NRC pursuant to 10 CFR 72.4. To satisfy condition 8 for casks of the same system type, in lieu of additional submittals pursuant to 10 CFR 72.4, users may document in their 72.212 report a previously performed test and analysis submitted by letter report to the NRC that demonstrates validation of the analytic methods described in Chapter 4 of the FSAR.

This condition does not apply to the unventilated version of the system.

1.4 Pre-Operational Testing and Training

1.4.1 Dry Run Training Exercise

A dry run training exercise of the loading, closure, handling, unloading, and transfer of the HI-STORM FW MPC Storage System shall be conducted by the licensee prior to the first use of the system to load spent fuel assemblies. The training exercise shall not be conducted with spent fuel in the MPC. The dry run may be performed in an alternate step sequence from the actual procedures, but all steps must be performed. The dry run shall include, but is not limited to the following:

a. Moving the MPC and the transfer cask into the spent fuel pool or cask loading pool.

b. Preparation of the HI-STORM FW MPC Storage System for fuel loading.

c. Selection and verification of specific fuel assemblies to ensure type conformance.

d. Loading specific assemblies and placing assemblies into the MPC (using a dummy fuel assembly), including appropriate independent verification.

e. Remote installation of the MPC lid and removal of the MPC and transfer cask from the spent fuel pool or cask loading pool.

f. MPC welding, NDE inspections, pressure testing, draining, moisture removal (by vacuum drying or forced helium dehydration, as applicable), and helium backfilling. (A mockup may be used for this dry-run exercise.)

g. Transfer of the MPC from the transfer cask to the overpack.

h. Placement of the HI-STORM FW MPC Storage System at the ISFSI.

i. HI-STORM FW MPC Storage System unloading, including flooding MPC cavity and removing MPC lid welds. (A mockup may be used for this dry-run exercise.)

Any of the above steps can be omitted if they have already been successfully carried out at a site to load a HI-STORM 100 System (USNRC Docket 72-1014).

1.5 Helium Leak Test

At completion of welding the MPC shell to baseplate, an MPC confinement weld helium leak test shall be performed using a helium mass spectrometer. The confinement boundary welds leakage rate test shall be performed in accordance with ANSI N14.5 to “leaktight” criterion. If a leakage rate exceeding the acceptance criteria is detected, then the area of leakage shall be determined and the area repaired per ASME Code Section III, Subsection NB, Article NB-4450 requirements. Re-testing shall be performed until the leakage rate acceptance criterion is met.

2 SITE

2.1 Site Specific Parameters and Analyses

Site-specific parameters and analyses that will require verification by the system user are, as a minimum, as follows:

2.1.1.1 The temperature of 80° F is the maximum average yearly temperature for the VENTILATED OVERPACK. The temperature of 70°F is the maximum average yearly temperature for the UNVENTILATED OVERPACK. A Site's yearly average ambient temperature may be used for site-specific analysis.

2.1.1.2 The allowed temperature extremes, averaged over a 3-day period, shall be greater than -40° F and less than 125° F.

2.1.1.3

a. For storage in a free-standing OVERPACK, the resultant horizontal acceleration (vectorial sum of two horizontal Zero Period Accelerations (ZPAs) at a three-dimensional seismic site), a_H, and vertical ZPA, a_V, on the top surface of the ISFSI pad, expressed as fractions of a, shall satisfy the following inequalities:

$$a_H \leq f\,(1 - a_V);\ \text{and}$$

$$a_H \leq r\,(1 - a_V)\,/\,h$$

where f is the Coulomb friction coefficient for the cask/ISFSI pad interface, r is the radius of the cask, and h is the height of the cask center-of-gravity above the ISFSI pad surface. Unless demonstrated by appropriate testing that a higher coefficient of friction value is appropriate for a specific ISFSI, the value used shall be 0.53. If acceleration time-histories on the ISFSI pad surface are available, a_H and a_V may be the coincident values of the instantaneous net horizontal and vertical accelerations. If instantaneous accelerations are used, the inequalities shall be evaluated at each time step in the acceleration time history over the total duration of the seismic event.

If this static equilibrium based inequality cannot be met, a dynamic analysis of the cask/ISFSI pad assemblage with appropriate recognition of soil/structure interaction effects shall be performed to ensure that the casks will not tip over or undergo excessive sliding under the site's Design Basis Earthquake.

b. For a free-standing OVERPACK under environmental conditions that may degrade the pad/cask interface friction (such as due to icing) the response of the casks under the site's Design Basis Earthquake shall be established using the best estimate of the friction coefficient in an appropriate analysis model. The analysis should demonstrate that the earthquake will not result in cask tipover or cause excessive sliding such that impact between casks could occur. Any impact between casks should be considered an accident for which the maximum total deflection, d, in the active fuel region of the basket panels shall be limited by the following inequality: $d \leq 0.005\,\ell$, where ℓ is the basket cell inside dimension.

c. For those ISFSI sites with design basis seismic acceleration values that may overturn or cause excessive sliding of free-standing casks, the anchored ~~HI-STORM FW~~ OVERPACK shall be utilized. Each OVERPACK shall be anchored with studs and compatible nuts of material suitable for the expected ISFSI environment. The embedment design shall comply with Appendix B of ACI-349-97. A later edition of this Code may be used, provided a written reconciliation is performed.

2.1.1.4 The maximum permitted depth of submergence under water shall not exceed 125 feet.

2.1.1.5 The maximum permissible velocity of floodwater, V, for a flood of height, h, shall be the lesser of V1 or V2, where:

$$V_1 = (1.876\ W^*)^{1/2} / h$$

$$V_2 = (1.876\ f\ W^*/\ D\ h)^{1/2}$$

and W* is the apparent (buoyant weight) of the loaded overpack (in pounds force), D is the diameter of the overpack (in feet), and f is the interface coefficient of friction between the ISFSI pad and the overpack, as used in step 3.a above. Use the height of the overpack, H, if h>H.

2.1.1.6 The potential for fire and explosion while handling a loaded OVERPACK or TRANSFER CASK shall be addressed, based on site-specific considerations. The user shall demonstrate that the site-specific potential for fire is bounded by the fire conditions analyzed by the Certificate Holder, or an analysis of the site-specific fire considerations shall be performed.

2.1.1.7

a. For storage in a free-standing OVERPACK, the user shall demonstrate that the ISFSI pad parameters used in the non-mechanistic tipover analysis are bounding for the site or a site specific non-mechanistic tipover analysis shall be performed using the dynamic model described in FSAR Section 3.4. The maximum total deflection, d, in the active fuel region of the basket panels shall be limited by the following inequality: $d \leq 0.005\ \ell$, where ℓ is basket cell inside dimension.

b. For storage in an anchored OVERPACK, a tipover event is not credible. However, the ISFSI pad shall be designed to meet the embedment requirements of the anchored design.

2.1.1.8 In cases where engineered features (i.e., berms and shield walls) are used to ensure that the requirements of 10CFR72.104(a) are met, such features are to be considered important-to-safety and must be evaluated to determine the applicable quality assurance category.

2.1.1.9 LOADING OPERATIONS, TRANSPORT OPERATIONS, and UNLOADING OPERATIONS shall only be conducted with working area ambient temperatures ≥ 0° F.

2.1.1.10 For those users whose site-specific design basis includes an event or events (e.g., flood) that result in the blockage of any OVERPACK inlet or outlet air ducts for an extended period of time (i.e, longer than the total Completion Time of LCO 3.1.2), an analysis or evaluation may be performed to demonstrate adequate heat removal is available for the duration of the event. Adequate heat removal is defined as fuel cladding temperatures remaining below the short term temperature limit. If the analysis or evaluation is not performed, or if fuel cladding temperature limits are unable to be demonstrated by analysis or evaluation to remain below the short term temperature limit for the duration of the event, provisions shall be established to provide alternate means of cooling to accomplish this objective.

2.1.1.11 Users shall establish procedural and/or mechanical barriers to ensure that during LOADING OPERATIONS and UNLOADING OPERATIONS, either the fuel cladding is covered by water, or the MPC is filled with an inert gas.

2.1.1.12 The entire haul route shall be evaluated to ensure that the route can support the weight of the loaded system and its conveyance.

2.1.1.13 The loaded system and its conveyance shall be evaluated to ensure under the site specific Design Basis Earthquake the system does not tipover or slide off the haul route.

2.1.1.14 The HI-STORM FW/HI-TRAC VW stack which occurs during MPC TRANSFER shall be evaluated to ensure under the site specific Design Basis Earthquake the system does not tipover. A probabilistic risk assessment cannot be used to rule out the occurrence of the earthquake during MPC TRANSFER.

3 LIST OF ASME ALTERNATIVES FOR MULTI-PURPOSE CANISTERS (MPC)

TABLE 3-1
List of ASME Code Alternatives for Multi-Purpose Canisters (MPCs)

MPC Enclosure Vessel	Subsection NCA	General Requirements. Requires preparation of a Design Specification, Design Report, Overpressure Protection Report, Certification of Construction Report, Data Report, and other administrative controls for an ASME Code stamped vessel.	Because the MPC is not an ASME Code stamped vessel, none of the specifications, reports, certificates, or other general requirements specified by NCA are required. In lieu of a Design Specification and Design Report, the HI-STORM FSAR includes the design criteria, service conditions, and load combinations for the design and operation of the MPCs as well as the results of the stress analyses to demonstrate that applicable Code stress limits are met. Additionally, the fabricator is not required to have an ASME-certified QA program. All important-to-safety activities are governed by the NRC-approved Holtec QA program. Because the cask components are not certified to the Code, the terms “Certificate Holder” and “Inspector” are not germane to the manufacturing of NRC-certified cask components. To eliminate ambiguity, the responsibilities assigned to the Certificate Holder in the Code, as applicable, shall be interpreted to apply to the NRC Certificate of Compliance (CoC) holder (and by extension, to the component fabricator) if the requirement must be fulfilled. The Code term “Inspector” means the QA/QC personnel of the CoC holder and its vendors assigned to oversee

TABLE 3-1 **List of ASME Code Alternatives for Multi-Purpose Canisters (MPCs)**			
			and inspect the manufacturing process.
MPC Enclosure Vessel	NB-1100	Statement of requirements for Code stamping of components.	MPC Enclosure Vessel is designed and will be fabricated in accordance with ASME Code, Section III, Subsection NB to the maximum practical extent, but Code stamping is not required.
MPC basket supports and lift lugs	NB-1130	NB-1132.2(d) requires that the first connecting weld of a non-pressure retaining structural attachment to a component shall be considered part of the component unless the weld is more than 2t from the pressure retaining portion of the component, where t is the nominal thickness of the pressure retaining material. NB-1132.2(e) requires that the first connecting weld of a welded nonstructural attachment to a component shall conform to NB-4430 if the connecting weld is within 2t from the pressure retaining portion of the component.	The lugs that are used exclusively for lifting an empty MPC are welded to the inside of the pressure-retaining MPC shell, but are not designed in accordance with Subsection NB. The lug-to-Enclosure Vessel Weld is required to meet the stress limits of Reg. Guide 3.61 in lieu of Subsection NB of the Code.
MPC Enclosure Vessel	NB-2000	Requires materials to be supplied by ASME-approved material supplier.	Materials will be supplied by Holtec approved suppliers with Certified Material Test Reports (CMTRs) in accordance with NB-2000 requirements.

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MPC Enclosure Vessel	NB-2121	Provides permitted material specification for pressure-retaining material, which must conform to Section II, Part D, Tables 2A and 2B	Certain duplex stainless steels are not included in Section II, Part D, Tables 2A and 2B. These stainless steel alloys are evaluated in the HI-STORM FW FSAR and meet the required design criteria for use in the HI-STORM FW system.
MPC Enclosure Vessel	NB-3100 NF-3100	Provides requirements for determining design loading conditions, such as pressure, temperature, and mechanical loads.	These requirements are subsumed by the HI-STORM FW FSAR, serving as the Design Specification, which establishes the service conditions and load combinations for the storage system.
MPC Enclosure Vessel	NB-4120	NB-4121.2 and NF-4121.2 provide requirements for repetition of tensile or impact tests for material subjected to heat treatment during fabrication or installation.	In-shop operations of short duration that apply heat to a component, such as plasma cutting of plate stock, welding, machining, and coating are not, unless explicitly stated by the Code, defined as heat treatment operations.

TABLE 3-1 List of ASME Code Alternatives for Multi-Purpose Canisters (MPCs)			
MPC Enclosure Vessel	NB-4220	Requires certain forming tolerances to be met for cylindrical, conical, or spherical shells of a vessel.	The cylindricity measurements on the rolled shells are not specifically recorded in the shop travelers, as would be the case for a Code-stamped pressure vessel. Rather, the requirements on inter-component clearances (such as the MPC-to-transfer cask) are guaranteed through fixture-controlled manufacturing. The fabrication specification and shop procedures ensure that all dimensional design objectives, including inter-component annular clearances are satisfied. The dimensions required to be met in fabrication are chosen to meet the functional requirements of the dry storage components. Thus, although the post-forming Code cylindricity requirements are not evaluated for compliance directly, they are indirectly satisfied (actually exceeded) in the final manufactured components.

TABLE 3-1
List of ASME Code Alternatives for Multi-Purpose Canisters (MPCs)

MPC Enclosure Vessel	NB-4122	Implies that with the exception of studs, bolts, nuts and heat exchanger tubes, CMTRs must be traceable to a specific piece of material in a component.	MPCs are built in lots. Material traceability on raw materials to a heat number and corresponding CMTR is maintained by Holtec through markings on the raw material. Where material is cut or processed, markings are transferred accordingly to assure traceability. As materials are assembled into the lot of MPCs being manufactured, documentation is maintained to identify the heat numbers of materials being used for that item in the multiple MPCs being manufactured under that lot. A specific item within a specific MPC will have a number of heat numbers identified as possibly being used for the item in that particular MPC of which one or more of those heat numbers (and corresponding CMTRS) will have actually been used. All of the heat numbers identified will comply with the requirements for the particular item.
MPC Lid and Closure Ring Welds	NB-4243	Full penetration welds required for Category C Joints (flat head to main shell per NB-3352.3)	MPC lid and closure ring are not full penetration welds. They are welded independently to provide a redundant seal.
MPC Closure Ring, Vent and Drain Cover Plate Welds	NB-5230	Radiographic (RT) or ultrasonic (UT) examination required.	Root (if more than one weld pass is required) and final liquid penetrant examination to be performed in accordance with NB-5245. The closure ring provides independent redundant closure for vent and drain cover plates. Vent and drain port cover plate welds are helium leakage tested. As an alternative, the helium leakage test does not have to be performed if the REDUNDANT PORT COVER DESIGN is used.

TABLE 3-1 List of ASME Code Alternatives for Multi-Purpose Canisters (MPCs)			
MPC Lid to Shell Weld	NB-5230	Radiographic (RT) or ultrasonic (UT) examination required.	Only progressive liquid penetrant (PT) examination is permitted. PT examination will include the root and final weld layers and each approx. 3/8" of weld depth.

MPC Enclosure Vessel and Lid	NB-6111	All completed pressure retaining systems shall be pressure tested.	The MPC vessel is welded in the field following fuel assembly loading. Pressure tests (Hydrostatic or pneumatic) will not be performed because lack of accessibility for leakage inspections precludes a meaningful pressure retention capability test. The different models of MPCs available in the industry are not subject to pressure tests because of the dose to the crew, the proven ineffectiveness of the pressure tests to reveal any leaks and the far more effective tests performed on the MPC confinement boundary, such as: All MPC enclosure vessel welds (except closure ring and vent/drain cover plate) are inspected by volumetric examination. All MPC shell and baseplate materials are UT tested. Finally,the MPC lid-to-shell weld shall be verified by progressive PT examination. PT must include the root and final layers and each approximately 3/8 inch of weld depth. The inspection results, including relevant findings (indications) shall be made a permanent part of the user's records by video, photographic, of other means which provide an equivalent 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 vent/drain cover plate and the closure ring welds are confirmed by liquid penetrant examination. The inspection of the weld must be performed by qualified personnel and shall meet the acceptance requirements of ASME Code Section III, NB-5350.
MPC Enclosure Vessel	NB-7000	Vessels are required to have overpressure protection.	No overpressure protection is provided. Function of MPC enclosure vessel is to contain

TABLE 3-1 List of ASME Code Alternatives for Multi-Purpose Canisters (MPCs)			
			radioactive contents under normal, off-normal, and accident conditions of storage. MPC vessel is designed to withstand maximum internal pressure considering 100% fuel rod failure and maximum accident temperatures.
MPC Enclosure Vessel	NB-8000	States requirements for nameplates, stamping and reports per NCA-8000.	The HI-STORM FW system is to be marked and identified in accordance with 10CFR71 and 10CFR72 requirements. Code stamping is not required. QA data package to be in accordance with Holtec approved QA program.