CHAPTER 10[†]: ACCEPTANCE CRITERIA AND MAINTENANCE PROGRAM

10.0 INTRODUCTION

This chapter identifies the fabrication, inspection, test, and maintenance programs to be conducted on the HI-STORM FW system (overpack, MPC and transfer cask) to verify that the structures, systems and components (SSCs) classified as important to safety have been fabricated, assembled, inspected, tested, accepted, and maintained in accordance with the requirements set forth in this FSAR, the applicable regulatory requirements, and the Certificate of Compliance (CoC). The acceptance criteria and maintenance program requirements specified in this chapter apply to each HI-STORM FW system fabricated, assembled, inspected, tested, and accepted for use under the purview of the HI-STORM FW system CoC.

The controls, inspections, and tests set forth in this chapter, in conjunction with the design requirements described in previous chapters ensure that the HI-STORM FW system will maintain confinement of radioactive material under normal, off-normal, and hypothetical accident conditions; will maintain subcriticality control; will reject the decay heat of the stored radioactive materials to the environment by passive means and maintain radiation doses within regulatory limits.

Both pre-operational and operational tests and inspections are performed throughout HI-STORM FW system operations to assure that the HI-STORM FW system is functioning within its design parameters. These include receipt inspections, nondestructive weld examinations, pressure tests, radiation shielding tests, thermal performance tests, dryness tests, and others. Chapter 9 identifies the tests and inspections. "Pre-operation" as referred to in this chapter defines that period of time from receipt inspection of a HI-STORM FW system until the empty MPC is loaded into a HI-TRAC transfer cask for fuel assembly loading.

The HI-STORM FW system is classified as important-to-safety. Therefore, the individual structures, systems, and components (SSCs) that make up the HI-STORM FW system shall be designed, fabricated, assembled, inspected, tested, accepted, and maintained in accordance with a quality program commensurate with the particular SSC's graded quality category. The licensing drawings identify all important to safety subcomponents of the HI-STORM FW system.

The acceptance criteria and maintenance program described in this chapter comply with the requirements of 10CFR72 [10.0.1] and NUREG-1536 [10.0.2] to the maximum extent possible, as described in Chapter 1.

[†] This chapter has been prepared in the format and section organization set forth in Regulatory Guide 3.61. However, the material content of this chapter also fulfills the requirements of NUREG-1536. Pagination and numbering of sections, figures, and tables are consistent with the convention set down in Chapter 1, Section 1.0, herein. Finally, all terms-of-art used in this chapter are consistent with the terminology of the Glossary.

The acceptance test requirements on the manufactured welds in the HI-STORM FW system are contained in the component licensing drawings in Section 1.5. Additional details on the requirements in the drawings are provided in this chapter, which will be incorporated in the shop manufacturing documents (viz., weld procedures, shop travelers, inspection procedures, and fabrication procedures) to ensure full compliance with this FSAR.

10.1 ACCEPTANCE CRITERIA

This section provides the workmanship inspections and acceptance tests to be performed on the HI-STORM FW system prior to and during loading of the system. These inspections and tests provide the assurance that the HI-STORM FW system has been fabricated, assembled, inspected, tested, and accepted for use under the conditions specified in this FSAR and the Certificate of Compliance issued by the NRC in accordance with the provisions of 10CFR72 [10.0.1].

The testing and inspection acceptance criteria applicable to the MPCs, the HI-STORM FW overpack, and the HI-TRAC VW transfer casks are listed in Tables 10.1.1, 10.1.2, and 10.1.3, respectively, and discussed in more detail in the sections that follow. Chapters 9 and 13 provide operating guidance and the bases for the Technical Specifications, respectively. These inspections and tests are intended to demonstrate that the HI-STORM FW system has been fabricated, assembled, and examined in accordance with the design criteria contained in Chapter 2 of this FSAR. Identification and resolution of manufacturing noncompliances, if any, shall be performed in accordance with the Holtec International Quality Assurance Program approved by the USNRC.

The contents of this chapter related to welding non-destructive examination are presented in the drawing package in Section 1.5. Likewise, the material on testing and maintenance of system components in this FSAR governs the content of the daughter documents such as the Manufacturing Manual and O&M Manual for the system components used in the manufacturing and long-term maintenance of the system components, respectively.

10.1.1 Fabrication and Nondestructive Examination (NDE)

This subsection summarizes the test program required for the HI-STORM FW system.

10.1.1.1 Fabrication Requirements

The following fabrication controls and required inspections shall be performed on the HI-STORM FW system, including the MPCs, overpacks, and HI-TRAC transfer casks, in order to assure compliance with this FSAR and the Certificate of Compliance.

i. Materials of construction specified for the HI-STORM FW system are identified in the drawings in Chapter 1 and shall be procured with certification and supporting documentation as required by the ASME Code [10.1.1] Section II (where applicable),

the requirements of ASME Section III (where applicable), Holtec procurement specifications, and 10CFR72, Subpart G. Materials and components shall be receipt inspected for visual and dimensional acceptability, material conformance to specification requirements, and traceability markings, as applicable. Controls shall be in place to ensure that material traceability is maintained throughout fabrication. Materials for the Confinement Boundary (MPC baseplate, lid, closure ring, port cover plates and shell) shall also be procured in compliance with the requirements of ASME Section III, Article NB-2500.

ii. The MPC Confinement Boundary shall be fabricated and inspected in accordance with ASME Code, Section III, Subsection NB to the extent practicable, as explained in this chapter.

iii. ASME Code welding shall be performed using welders and weld procedures that have been qualified in accordance with ASME Code Section IX and the applicable code (such as ASME Section III Subsection NB for the Confinement Boundary.

iv. Code welds shall be visually examined in accordance with ASME Code, Section V, Article 9. The acceptance criteria for the welds shall be based on the ASME Codes provided in Table 10.1.5. These additional NDE criteria are also specified on the licensing drawings in Section 1.5 for the specific welds. Weld inspections shall be detailed in a weld inspection plan which shall identify the weld and the examination requirements, the sequence of examination, and the acceptance criteria. The inspection plan shall be subject to review and approval by Holtec in accordance with the Company's QA program prior to use. NDE inspections of code welds shall be performed in accordance with written and approved procedures by personnel qualified in accordance with SNT-TC-1A [10.1.2] or other site-specific, NRC-approved program for personnel qualification.

v. The MPC confinement boundary shall be examined and tested by a combination of methods (including helium leak test, pressure test, RT, UT, MT and/or PT, as applicable) to verify that it is free of cracks, pinholes, uncontrolled voids or other defects that could significantly reduce its confinement effectiveness.

vi. Repair of confinement boundary welds shall conform to the requirements of the ASME Code, Section III, Article NB-4450.

vii. Base metal repairs shall be performed and examined in accordance with the applicable reference code set down in Table 10.1.5.

viii. Grinding and machining operations on the MPC Confinement Boundary shall be controlled through written and approved procedures to ensure grinding and machining operations do not reduce local base metal wall thicknesses of the Confinement Boundary below allowable limits. The thicknesses of base metals shall be ultrasonically tested, as necessary, in accordance with written and approved

procedures to verify base metal thickness meets the applicable requirements.

ix. Non-structural tack welds that do not become an integral part of a weld are not required to be removed. Non-structural tack welds that do not become an integral part of a permanent weld shall be examined by an approved visual examination procedure.

x. The HI-STORM FW system shall be inspected for cleanliness and proper packaging for shipping in accordance with written and approved procedures.

xi. Each cask shall be durably marked with the appropriate model number, a unique identification number, and its empty weight per 10CFR72.236(k) at the completion of the acceptance test program.

xii. A documentation package shall be prepared and maintained during fabrication of each HI-STORM FW system to include detailed records and evidence that the required inspections and tests have been performed. The completed documentation package shall be reviewed to verify that the HI-STORM FW system or component has been properly fabricated and inspected in accordance with the design and Code construction requirements. The documentation package shall include, as applicable, but not be limited to:

- Completed Shop Weld Records
- Inspection Records
- Nonconformance Reports
- Material Test Reports
- NDE Reports
- Dimensional Inspection Report

10.1.1.2 MPC Lid-to-Shell Weld Inspection

i. The MPC lid-to-shell (LTS) weld shall be examined using a progressive multi-layer liquid penetrant (PT) examination during welding.

ii. The multi-layer PT must, at a minimum, include the root and final weld layers and one intermediate PT after each approximately 3/8 inch weld depth has been completed as specified in the drawing package in Section 1.5.

The inspection results, including relevant findings (indications) shall be made a permanent part of the cask user's records by video, photographic, or other means which provide an equivalent retrievable record of weld integrity. Mapping is considered an equivalent record which contains the type, size and location of the relevant indications discovered during weld examination. The documentation of relevant indications should be taken during the final interpretation period described in ASME Section V, Article 6, T-676.

The multi-layer PT examination of the LTS weld, in conjunction with other examinations and tests performed on this weld, shall use ASME Section III acceptance criteria (see Table 10.1.4) which provide reasonable assurance that the LTS weld is sound and will perform its design function under all loading conditions. The multi-layer PT examination and evaluation of indications provides reasonable assurance that leakage of the weld or structural failure under the design basis normal, off-normal, and accident loading conditions will not occur.

10.1.1.3 Visual Inspections and Measurements

The HI-STORM FW system components shall be assembled in accordance with the licensing drawing package in Section 1.5. The drawings provide dimensional tolerances that define the limits on the dimensions used in licensing basis analysis. Fabrication drawings provide additional dimensional tolerances necessary to ensure fit-up of parts. Visual inspections and measurements shall be made and controls shall be exercised to ensure that the cask components conform to the dimensions and tolerances specified on the licensing and fabrication drawings. These dimensions are subject to independent confirmation and documentation in accordance with the Holtec QA program approved in NRC Docket No. 71-0784.

The following shall be verified as part of visual inspections and measurements:

- Visual inspections and measurements shall be made to ensure that the systems' effectiveness is not significantly reduced as a result of manufacturing deviations. Any *important-to-safety* component found to be under the specified minimum thickness shall be justified under the rules of 10CFR72.48 or repaired or replaced, as appropriate.
- Visual inspections shall be made to verify that neutron absorber panels and basket shims are present as required by the MPC basket design.
- The system components shall be inspected for cleanliness and preparation for shipping in accordance with written and approved procedures.

The visual inspection and measurement results for the HI-STORM FW system shall become part of the final quality documentation package.

10.1.1.4 Weld Examination

The examination of the HI-STORM FW system welds shall be performed in accordance with the drawing package in Section 1.5 and the applicable codes and standards.

All code weld inspections shall be performed in accordance with written and approved procedures by personnel qualified in accordance with SNT-TC-1A. All required inspections, examinations, and tests shall become part of the final quality documentation package.

The following specific weld requirements shall be followed in order to verify fabrication in accordance with the provisions of this FSAR.

1. Confinement Boundary welds including any attachment welds (and temporary welds to the Confinement Boundary) shall be examined in accordance with ASME Code Section V, with acceptance criteria per ASME Code Section III, Subsection NB, Article NB-5300. Examinations, Visual (VT), Radiographic (RT), and Liquid Penetrant (PT), apply to these welds as defined by the code. These welds shall be repaired in accordance with the requirements of the ASME Code Section III, Article NB-4450 and examined after repair in the same manner as the original weld.

2. Basket welds shall be VT examined and repaired in accordance with written and approved procedures developed specifically for welding Metamic-HT and in accordance with the philosophy of ASME Section IX.

3. Non-code welds shall be examined and repaired in accordance with written and approved procedures as defined in the system Manufacturing Manual.

10.1.2 Structural and Pressure Tests

10.1.2.1 Lifting Locations

The HI-STORM FW system does not utilize any lifting trunnions. The lifting of all HI-STORM FW components is engineered to occur though threaded couplings integral to the strongest part in the component. Thus, as shown in the HI-TRAC VW drawings (Section 1.5) the threaded connection is located in the top forging. These lift locations are accordingly referred to as *tapped anchor locations* (TAL). The TALs to lift the MPCs (in all Holtec designs) is located in the top lid (thickest part) and those for the HI-STORM FW overpack are welded to the radial connector plates (in all HI-STORM models).

Because the TALs are integral to the component, they possess high ductility and, as shown in Chapter 3, meet the factor of safety of 6 to yield and 10 to ultimate, as required by ANSI N14.6 [10.1.3].

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

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

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

Each TAL will be subjected to a dimensional test in the shop using go/no-go gauges to ensure that the threads meet the dimensional requirements. As an alternative to the thread gauge test, the threads may be proof-tested using a torque test to simulate a load equal to three times the design load. Furthermore, the thread in the TAL shall be visually inspected in accordance with a written procedure to ensure absence of burrs, undercuts, and other stress raisers.

The acceptance testing of the TALS in the manner described above will provide adequate assurance against handling accidents.

10.1.2.2 Pressure Testing

10.1.2.2.1 HI-TRAC Transfer Cask Water Jacket

All HI-TRAC transfer cask water jackets shall be hydrostatically tested in accordance with written and approved procedures. The water jacket fill port will be used for filling the cavity with water and the vent port for venting the cavity. The approved test procedure shall clearly define the test equipment arrangement.

The hydrostatic test shall be performed after the water jacket has been welded together. The test pressure gage installed on the water jacket shall have an upper limit of approximately twice that of the test pressure. The hydrostatic test pressure shall be maintained for ten minutes. During this time period, the pressure gage shall not fall below the applicable minimum test pressure. At the end of ten minutes, and while the pressure is being maintained at the minimum pressure, weld joints shall be visually examined for leakage. If a leak is discovered, the cavity shall be emptied and an examination to determine the cause of the leakage shall be made. Repairs and retest shall be performed until the hydrostatic test criteria are met.

After completion of the hydrostatic testing, the water jacket exterior surfaces shall be visually examined for cracking or deformation. Evidence of cracking or deformation shall be cause for rejection, or repair and retest, as applicable. Unacceptable areas shall require repair and re-examination per the applicable ASME Code. The HI-TRAC water jacket hydrostatic test shall be repeated until all examinations are found to be acceptable.

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

10.1.2.2.2 MPC Confinement Boundary

Pressure testing (hydrostatic or pneumatic) of the MPC Confinement Boundary shall be performed to verify the lid-to-shell field weld in accordance with the requirements of the ASME Code Section III, Subsection NB, Article NB-6000 and applicable sub-articles, when field welding of the MPC lid-to-shell weld is completed. If hydrostatic testing is used, the MPC shall be pressure tested to 125% of design pressure. If pneumatic testing is used, the MPC shall be pressure tested to 120% of design pressure. The calibrated test pressure gage installed on the MPC Confinement Boundary shall have an upper limit of approximately twice that of the test

pressure. The MPC vent and drain ports will be used for pressurizing the MPC cavity. Water shall be pumped into the MPC drain port until water only is flowing from the MPC vent port. The MPC vent port is then closed and the pressure is increased to the test pressure. While the MPC is under pressure, the MPC lid-to-shell weld shall be examined for leakage. If any leaks are observed, the pressure shall be released and the weld shall be repaired in accordance with the requirements of ASME Code, Section III, Subsection NB. Following completion of the required hold period at the test pressure, the pressure shall be released and the surface of the MPC lid-to-shell weld shall be re-examined by liquid penetrant examination in accordance with ASME Code, Section III, Subsection NB, Article NB-5350 acceptance criteria. Any evidence of cracking or deformation shall be cause for rejection, or repair and retest, as applicable.

If a leak is discovered, the test pressure shall be reduced, the MPC cavity water level lowered, if applicable, the MPC cavity vented, and the weld shall be examined to determine the cause of the leakage and/or cracking. Repairs to the weld shall be performed in accordance with written and approved procedures prepared in accordance with the ASME Code, Section III, Article NB-4450.

The MPC confinement boundary pressure test shall be repeated until all required examinations are found to be acceptable. Test results shall be documented and maintained as part of the loaded MPC quality documentation package.

10.1.3 Materials Testing

The majority of materials used in the HI-TRAC transfer cask and a portion of the material in the HI-STORM overpack are ferritic steels. ASME Code, Section II and Section III require that certain materials be tested in order to assure that these materials are not subject to brittle fracture failures.

Materials of the HI-TRAC transfer cask and HI-STORM overpack, as required, shall be Charpy V-notch tested in accordance with ASME Section IIA and/or ASME Section III, Subsection NF, Articles NF-2300, and NF-2430. The materials to be tested are identified in Table 3.1.9 and applicable weld materials. Table 3.1.9 provides the test temperatures and test acceptance criteria to be used when performing the material testing specified above.

The concrete utilized in the construction of the HI-STORM overpack shall be mixed, poured, and tested as set down in Chapter 1.D of the HI-STORM 100 FSAR (Docket 72-1014) [10.1.6] in accordance with written and approved procedures. Testing shall verify the compressive strength and density meet design requirements. Tests required shall be performed at a frequency as defined in the applicable ACI code.

Qualification tests on Metamic-HT coupons drawn from production runs shall be performed in compliance with Table 10.1.6 requirements to ensure that the manufactured panels shall render their intended function. Testing shall be performed using written and approved procedures consistent with the test methods documented in Holtec's test report [10.1.7].

To ensure the above test requirements are met a sampling plan based on the MIL Standard 105E [10.1.8] is defined and incorporated in the Metamic-HT Manufacturing Manual [1.2.7]. The MIL Standard test protocols are selected to maximize coupon population. The test plan has the following key attributes:

- At the start of the Metamic HT production runs at the manufacturing facility, the number of extrusions subjected to testing is based upon the Tier 1 sample population per Table 10.1.7
- If every one of the seven properties meets its respective MGV value given in Table 10.1.8, then the subject lot of extrusions is determined to be acceptable.
- If all tested coupons in five consecutive lots pass (i.e., each of the seven properties in Table 10.1.8 meets its MGV requirement) then the required coupon population can drop down to the Tier 2 sample population per Table 10.1.7.
- If all tested coupons in an additional five consecutive lots pass, then the required coupon population can drop down to the Tier 3 sample population per Table 10.1.7.
- If all tested coupons in an additional ten consecutive lots pass, then the required coupon population can drop down to the Tier 4 sample population per Table 10.1.7.
- If a coupon fails with respect to any property, then it can be replaced by two coupons from the extrusion that produced the failed coupon. If both of the replacement coupons pass all of the seven MGV properties, then the lot can be accepted. If either of the replacement coupons fails to meet any of the seven properties, then the entire lot is rejected.
- The failure of any coupons in a lot requires that subsequent sampling be conducted per the Tier 1 sample population per Table 10.1.7. A reduction to Tier 2, Tier 3, and Tier 4 sample populations in subsequent lots shall be based on the sampling plan described above.

While the above test regimen appears to be quite stringent, the data obtained thus far, and setting the MGVs as smallest of any measured values means that the pull-back to Tier 1 population would be an exception rather than the norm in the production runs.

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

10.1.4 Leakage Testing

Leakage testing shall be performed in accordance with written and approved procedures and the leakage test methods and procedures of ANSI N14.5 [10.1.5], as follows.

Helium leakage testing of the MPC base metals (shell, baseplate, and MPC lid) and MPC shell to baseplate and shell to shell welds is performed on the unloaded MPC. The acceptance criterion is "leaktight" as defined in ANSI N14.5. The helium leakage test of the vent and drain port cover plate welds shall be performed using a helium mass spectrometer leak detector (MSLD). If a leakage rate exceeding the acceptance criterion 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.

Leakage testing of the field welded MPC lid-to-shell weld and closure ring welds are not required. Leak testing results for the MPC shall be documented and shall become part of the quality record documentation package.

Leakage testing of the vent and drain port cover plate welds shall be performed after welding of the cover plates and subsequent NDE. The description and procedures for these field leakage tests are provided in Chapter 9 of this FSAR and the acceptance criteria are defined in the Technical Specifications for the HI-STORM FW system.

10.1.5 Component Tests

10.1.5.1 Valves, Pressure Relief Devices, and Fluid Transport Devices

There are no fluid transport devices associated with the HI-STORM FW system. The only valve-like components in the HI-STORM FW system are the specially designed caps installed in the MPC lid for the drain and vent ports. These caps are recessed inside the MPC lid and covered by the fully-welded vent and drain port cover plates. No credit is taken for the caps' ability to confine helium or radioactivity. After completion of drying and backfill operations, the drain and vent port cover plates are welded in place on the MPC lid and are liquid penetrant examined and leakage tested to verify the MPC Confinement Boundary.

There are multiple pressure relief devices installed in the upper ledge surface of the HI-TRAC transfer cask water jacket. One is provided for venting air and water due to pressure build-up from thermal expansion of the water in the water jacket. The other relief devices are provided for venting of the neutron shield jacket fluid under hypothetical fire accident conditions in which the design pressure of the water jacket may be exceeded. The set pressures for the pressure relief devices are listed on the HI-TRAC VW drawings in Section 1.5.

10.1.5.2 Seals and Gaskets

There are no confinement seals or gaskets included in the HI-STORM FW system.

10.1.6 Shielding Integrity

The HI-STORM FW overpack and MPC have two designed shields for neutron and gamma ray attenuation. The HI-STORM FW overpack concrete provides both neutron and gamma shielding. The overpack's inner and outer steel shells, and the steel shield shell, provide radial gamma shielding. Concrete and steel plates provide axial neutron and gamma shielding.

The HI-TRAC VW transfer cask uses three different materials for primary shielding. All HI-TRAC VW transfer cask designs include a radial steel-lead-steel shield and a removable steel bottom lid. Testing requirements on shielding materials are presented below.

Concrete:

The dimensions of the HI-STORM overpack steel shells and the density of the concrete shall be verified to be in accordance with FSAR drawings in Section 1.5 prior to concrete installation. The dimensional inspection and density measurements shall be documented. Also, see Subsection 10.1.3 for concrete material testing requirements.

Lead:

The installation of the lead in the HI-TRAC transfer cask shall be performed using written and qualified procedures in order to ensure that voids are minimized. The lead shall be examined to preclude macrovoids (through holes) in the material using written and qualified procedures.

The lead shall be installed in such a manner that there are no macro-voids (through holes) and that the cask is not subjected to a severe thermal cycle.

Steel:

Steel plates utilized in the construction of the HI-STORM FW system shall be dimensionally inspected to assure compliance with the requirements specified on the Design Drawings.

General Requirements for Shield Materials:

1. Test results for concrete density and lead examinations for macrovoids, as applicable, shall be documented and become part of the quality documentation package.

2. Dimensional inspections of the cavities containing the shielding materials shall assure that the design required amount of shielding material is being incorporated into the fabricated item.

Shielding effectiveness tests shall be performed after initial loading operations in accordance with description below and the operating procedures in Chapter 9.

10.1.6.1 Shielding Effectiveness Tests

Operational neutron and gamma shielding effectiveness tests shall be performed after fuel loading using written and approved procedures at the host plant site. Calibrated neutron and gamma dose rate meters shall be used to measure the actual neutron and gamma dose rates at the surface of the HI-STORM FW overpack and HI-TRAC VW. Measurements shall be taken at the locations specified in the Radiation Protection Program for comparison against the prescribed limits. The test is considered acceptable if the dose rate readings are less than or equal to the calculated limits. If dose rates are higher than the limits, the required actions provided in the Radiation Protection Program shall be carried out. Dose rate measurements shall be documented and shall become part of the quality record of the loaded cask.

10.1.6.2 Neutron Absorber Manufacturing Requirements

Essential characteristics of Metamic-HT are described in Chapter 1 of this FSAR. As described in Chapter 1, Metamic-HT is made from high purity aluminum using a powder metallurgy process that results in pinning of the materials grain boundaries by dispersoids of nanoparicles of aluminum oxide. The manufacturing of Metamic-HT is governed by a set of quality validated Holtec Standard procedures contained in the Metamic-HT Manufacturing Manual [1.2.7].

The key constituents of Metamic-HT, namely aluminum powder and Boron Carbide powder are procured under their respective purchasing specifications that define the required particle size distributions and set down the prohibited materials & impurities, as well as tolerable level of impurities. The supplier of raw materials must be qualified under Holtec's quality program for important to safety materials and components or the material shall be commercially dedicated by Holtec in accordance with the Holtec Quality Assurance program.

A description of the manufacturing processes for Metamic-HT is presented in the Metamic-HT Sourcebook [1.2.6] and implemented in the Metamic-HT Manufacturing Manual [1.2.7].

As required by the procedures set down in its manufacturing manual [1.2.6], each panel of Metamic-HT neutron absorber material shall be visually inspected for damage such as scratches, cracks, burrs, presence of imbedded foreign materials, voids and discontinuities that could significantly affect its functional effectiveness.

Metamic-HT panels will be manufactured according to a Holtec purchase specification that incorporates all requirements set forth in this FSAR. The manufacturing of Metamic-HT is subject to all quality assurance requirements under Holtec International's NRC approved quality program.

The tests conducted on Metamic-HT to establish the compliance of the manufactured panels with Holtec's Purchasing Specification are intended to ensure that *critical characteristics* of the final product will meet the minimum guaranteed values (MGVs) set forth in this FSAR (Table 1.2.8). The tests are performed at both the raw material and manufactured extrusion/panel stages of production with the former serving as the insurer of the properties in the final product and the latter serving the confirmatory function. Table 10.1.6 provides a summary of the required tests, their frequency and their intended purpose. The terms "batch" and "lot" referred to in Table 10.1.6 have the following meanings in the context of the manufacturing of Metamic-HT.

- Lot: A lot of B_4C or of aluminum powder is the bulk of material provided by the raw material supplier with a specific property characterization data sheet. A Lot of B_4C or aluminum powder is typically in excess of 5,000 lbs.

- Batch: A batch of B_4C/Al mix is made from a distinct combination of lots of B_4C and aluminum powder. All batches of mix derived from the same distinct combination of lots of B_4C and aluminum are considered "sister" batches.

- A lot of Metamic-HT: A lot of Metamic-HT panels is a set of panels made from one or more sister batches of B_4C/Al.

Note
The text in 10.1.6.3, printed in bold below, is incorporated into the HI-STORM FW CoC by reference (CoC Appendix B, Section 3.2.3) and may not be deleted or altered in any way without prior NRC-approval via CoC amendment. The affected verbiage is, therefore, shown in bold type to distinguish it from other text.

10.1.6.3 Neutron Absorber Manufacturing and Tests

Each plate of neutron absorber shall be visually inspected for damage such as scratches, cracks, burrs, peeled cladding, foreign material embedded in the surfaces, voids, delamination, and surface finish, as applicable.

NUREG/CR-5661 identifies the main reason for a penalty in the neutron absorber B-10 density as the potential of neutron streaming due to non-uniformities in the neutron absorber, and recommends comprehensive acceptance tests to verify the presence and uniformity of the neutron absorber for credits more than 75%. Since a 90% credit is taken for Metamic-HT®, the following criteria must be satisfied:

- The boron carbide powder used in the manufacturing of Metamic-HT® must have sufficient fine particle size distribution to preclude neutron streaming.

- The B_4C weight percent shall be 10% (minimum).

- The B_4C powder must be uniformly dispersed locally, i.e., must not show any particle agglomeration. This precludes neutron streaming.

- The B_4C powder must be uniformly dispersed macroscopically, i.e., must have a consistent concentration throughout the entire neutron absorber panel.

To ensure that the above requirements are met the following tests shall be performed (see Table 10.1.6):

- **All lots of boron carbide powder shall be analyzed to meet particle size distribution requirements.**

- **All lots of B_4C will be certified as containing Boron with a minimum 18.3% of isotopic B-10 per the purchase specification.**

- **Wet chemistry testing of a sample from each mixed batch shall be performed to verify the correct boron carbide weight percent of 10% is attained. The mixing of the batch is controlled via approved procedures.**

- **The thickness of each final panel will be measured in at least six places, with two at one end, two at the other end and two in the middle, and shown to meet the minimum basket wall thickness.**

The measurements of B_4C content, particle size, thickness, and uniformity of B_4C distribution (via wet chemistry test) shall be made using written and approved procedures. If any one of the above criterion is not met, the panel will not be used. If the wet chemistry results for a mixed batch do not meet the criteria, all panels from the entire mixed batch will not be used. This ensures the required B_4C content of the Metamic-HT panels is achieved.

As additional verification one coupon from each lot shall be tested via neutron attenuation testing to verify the expected B_4C content is attained. The neutron attenuation testing will be performed using a 1 inch diameter thermal neutron beam that is calibrated using a solid B_4C plate, and the results will be compared to a known standard whose B_4C content has been checked and verified. This test shall be performed to verify the continued acceptability of the manufacturing process. The B_4C content attained by the neutron attenuation tests will be compared to the wet chemistry results. If a coupon fails the neutron attenuation test, all panels from this lot will be rejected.

Each plate of neutron absorber shall be visually inspected for damage such as scratches, cracks, burrs, peeled cladding, foreign material embedded in the surfaces, voids, and delaminations. Panels are also visually inspected for contamination on the surface. Panels not meeting the acceptance criteria will be rejected. Panels are inspected before being shipped to the cask manufacturing facility and they are subject to an additional receipt inspection prior to installation.

10.1.7 Thermal Acceptance Tests

The thermal performance of the HI-STORM FW system, including the MPCs and HI-TRAC transfer cask, is demonstrated through analysis in Chapter 4 of this FSAR. Dimensional inspections to verify the item has been fabricated to the dimensions provided in the drawings shall be performed prior to system loading.

The first manufactured MPC, either MPC-37 or MPC-89, will be thermally tested using an approved QA controlled Holtec procedure [10.1.9]. The following are the basic steps of this procedure.

1. The MPC will be arrayed in the vertical orientation on the test pad with interface insulation to minimize heat loss from the bottom.
2. Twelve storage cells (three in each quadrant) will be loaded with bayonet electric heaters each calibrated to deliver one kilowatt heat uniformly over its length. The heaters will be situated co-axially within each storage cell. Thus the heat generation in the MPC shall be quadrant-symmetric.

3. The top of the MPC shall be enclosed by an insulated lid. Calibrated thermocouples will be fastened to selected cell walls in each quadrant in a symmetric manner.
4. The test will be run for a sufficiently long time such that steady state conditions are reached. The ambient temperature and the thermocouple readings will be taken as specified in the test procedure.
5. The test condition will be simulated on the design basis FLUENT model of the MPC in Chapter 4 and the temperatures at all of the thermocouple locations predicted by FLUENT will be compared with the test data.
6. The amounts by which the FLUENT temperatures exceed the corresponding measured temperatures (positive margin) collectively define the margin of conservatism in the FSAR analysis model. A negative margin will warrant an immediate report to the NRC and appropriate licensing action pursuant to Holtec's QA program.

Following the loading and placement on the storage pad of the first HI-STORM system placed in service as specified in CoC Condition #8, the operability of the natural convective cooling of the HI-STORM FW system shall be verified by the performance of an air mass flow rate test. A description of the test is described in Chapter 9.

In addition, the technical specifications require periodic surveillance of the overpack air inlet and outlet vents or, optionally, implementation of an overpack air temperature monitoring program to provide continued assurance of the operability of the HI-STORM FW heat removal system.

10.1.8 Cask Identification

Each MPC, HI-STORM overpack, and HI-TRAC transfer cask shall be marked with a model number, identification number (to provide traceability back to documentation), and the empty weight of the item in accordance with the marking requirements specified in 10 CFR 72.236(k).

Table 10.1.1
MPC INSPECTION AND TEST ACCEPTANCE CRITERIA

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

Table 10.1.1 (continued)
MPC INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operations
Structural	a) Assembly and welding of MPC components is performed per ASME Code Section IX and III, Subsection NB, as applicable. b) Materials analysis (steel, neutron absorber, etc.), is performed and records are kept in a manner commensurate with "important to safety" classifications.	a) None.	a) A multi-layer liquid penetrant (PT) examination of the MPC lid-to-shell weld is performed per ASME Section V, Article 2. Acceptance criteria for the examination are defined in Subsection 10.1.1, and in the Licensing Drawings. b) ASME Code NB-6000 pressure test is performed after MPC closure welding. Acceptance criteria are defined in the Code.
Leak Tests	a) Helium leakage testing of the MPC base metal (shell, baseplate and MPC lid),MPC shell to baseplate welds and MPC shell to shell welds is performed on the unloaded MPC. Acceptance criterion is in accordance with “leaktight” definition in ANSI N14.5.	a) None.	a) Helium leakage testing is performed on the vent and drain port cover plates to MPC lid field welds. See Technical Specification for guidance on acceptance criteria.
Criticality Safety	a) The boron content is verified at the time of neutron absorber material manufacture. b) The installation of MPC cell panels is verified by inspection.	None.	None.
Shielding Integrity	a) Material compliance is verified through CMTRs. b) Dimensional verification of MPC lid thickness is performed.	None.	None.

Table 10.1.1 (continued) MPC INSPECTION AND TEST ACCEPTANCE CRITERIA			
Function	**Fabrication**	**Pre-operation**	**Maintenance and Operations**
Thermal Acceptance	a)None.	a) None.	a) None.
Fit-Up Tests	a) Fit-up of the following components is verified during fabrication. - MPC lid - vent/drain port cover plates - MPC closure ring b) A gauge test of all basket fuel compartments.	a) Fit-up of the following components is verified during pre-operation. -MPC lid -MPC closure ring -vent/drain cover plates	a) None.
Canister Identification Inspections	a) Verification of identification marking applied at completion of fabrication.	a) Identification marking shall be checked for legibility during pre-operation.	a) None.

Table 10.1.2
HI-STORM FW OVERPACK INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operations
Visual Inspection and Nondestructive Examination (NDE)	Structural Steel Components: a) All structural welds shall be visually examined per ASME Section V, Article 9 with acceptance criteria per ASME Section III, Subsection NF, NF-5360. b) All structural weld s requiring PT examination as shown on the Licensing Drawings shall be PT examined per ASME Section V, Article 6 with acceptance criteria per ASME Section III, Subsection NF, NF-5350. c) All structural welds requiring MT examination as shown on the drawings shall be MT examined per ASME Section V, Article 7 with acceptance criteria per ASME Section III, Subsection NF, NF-5340. d) NDE of weldments shall be defined on design drawings using ANSI NDE symbols and/or notations. Concrete Components: The following processes related to concrete components shall be implemented in accordance with the provisions of Appendix 1.D of [10.1.6]. Concrete testing shall be in accordance with Table 1.D.1. Activities shall be conducted in accordance with written and approved procedures. a) Assembly and examination. b) Mixing, pouring, and testing.	a) The overpack shall be visually inspected prior to placement in service. b) Fit-up with mating components (e.g., lid) shall be performed directly whenever practical or using templates or other means. c) overpack protection at the licensee's facility shall be verified. d) Exclusion of foreign material shall be verified prior to placing the overpack in service at the licensee's facility.	a) Indications identified during visual inspection shall be corrected, reconciled, or otherwise dispositioned. b) Exposed surfaces shall be monitored for coating deterioration and repair/recoat as necessary.

Table 10.1.2 (continued)
HI-STORM FW OVERPACK INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operations
Visual Inspection and Nondestructive Examination (NDE) (continued)	General: a) Cleanliness of the overpack shall be verified upon completion of fabrication. b) Packaging of the overpack at the completion of shop fabrication shall be verified prior to shipment.		
Structural	a) Verification of structural materials shall be performed through receipt inspection and review of certified material test reports (CMTRs) obtained in accordance with the item's quality category. b) Concrete compressive strength tests shall be performed per Appendix 1.D of [10.1.6].	a) No structural or pressure tests are required for the overpack during pre-operation.	a) No structural or pressure tests are required for the overpack during operation.
Leak Tests	a) None.	a) None.	a) None.
Criticality Safety	a) No neutron absorber tests of the overpack are required for criticality safety during fabrication.	a) None.	a) None.
Shielding Integrity	a) Concrete density shall be verified per Appendix 1.D of [10.1.6], at time of placement. b) Shell thicknesses and dimensions between inner and outer shells shall be verified as conforming to design drawings prior to concrete placement.	a) None	a) A shielding effectiveness test shall be performed after the initial fuel loading.

Table 10.1.2 (continued)
HI-STORM FW OVERPACK INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operations
Thermal Acceptance	a) Inner shell I.D. and vent size, configuration and placement shall be verified.	a) No pre-operational testing related to the thermal characteristics of the overpack is required.	a) Air temperature rise test(s) shall be performed after initial loading of the first HI-STORM FW system in accordance with the operating procedures in Chapter 9. b) Periodic surveillance shall be performed by either (1) or (2) below, at the licensee's option. (1) Inspection of overpack inlet and outlet air vent openings for debris and other obstructions. (2) Temperature monitoring.
Cask Identification	a) Verification that the overpack identification is present in accordance with the drawings shall be performed upon completion of assembly.	a) The overpack identification shall be checked prior to loading.	a) The overpack identification shall be periodically inspected per licensee procedures and repaired or replaced if damaged.
Fit-up Tests	a) Lid fit-up with the overpack shall be verified following fabrication.	a) None.	a) None.

Table 10.1.3
HI-TRAC VW TRANSFER CASK INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	Fabrication	Pre-operation	Maintenance and Operations
Visual Inspection and Nondestructive Examination (NDE)	a) All structural welds shall be visually examined per ASME Section V, Article 9 with acceptance criteria per ASME Section III, Subsection NF, NF-5360. b) All structural welds requiring PT examination as shown on the Design Drawings shall be PT examined per ASME Section V, Article 6 with acceptance criteria per ASME Section III, Subsection NF, NF-5350. c) All structural welds requiring MT examination as shown on the Design Drawings shall be MT examined per ASME Section V, Article 7 with acceptance criteria per ASME Section III, Subsection NF, NF-5340. d) NDE of weldments shall be defined on design drawings using standard ANSI NDE symbols and/or notations e) Cleanliness of the transfer cask shall be verified upon completion of fabrication. f) Packaging of the transfer cask at the completion of fabrication shall be verified prior to shipment.	a) The transfer cask shall be visually inspected prior to placement in service. b) Transfer cask protection at the licensee's facility shall be verified. c) Transfer cask cleanliness and exclusion of foreign material shall be verified prior to use.	a) Visual inspections of the transfer cask shall be performed to assure continued compliance with drawing requirements.

Table 10.1.3 (continued)
HI-TRAC VW TRANSFER CASK INSPECTION AND TEST ACCEPTANCE CRITERIA

Function	**Fabrication**	**Pre-operation**	**Maintenance and Operations**
Structural	a) Verification of structural materials shall be performed through receipt inspection and review of certified material test reports (CMTRs) obtained in accordance with the item's quality category. b) A pressure test of the neutron shield water jacket shall be performed upon completion of fabrication.	a) None.	None.
Leak Tests	a) None.	a) None.	a) None.
Criticality Safety	a) None.	a) None.	a) None.
Thermal Acceptance	a) The thermal properties of the transfer cask are established by calculation and inspection, and are not tested during fabrication.	a) None.	a) None
Cask Identification	a) Verification that the transfer cask identification is present in accordance with the drawings shall be performed upon completion of assembly.	a) The transfer cask identification shall be checked prior to loading.	a) The transfer cask identification shall be periodically inspected per licensee procedures and repaired or replaced if damaged.
Fit-up Tests	a) Fit-up tests of the transfer cask bottom lid shall be performed during fabrication.	None.	a) Fit-up of the bottom lid shall be verified prior to use.

Table 10.1.4 HI-STORM FW MPC NDE REQUIREMENTS			
Weld Location	**NDE Requirement**	**Applicable Code**	**Acceptance Criteria (Applicable Code)**
Shell longitudinal seam	RT PT (surface)	ASME Section V, Article 2 (RT) ASME Section V, Article 6 (PT)	RT: ASME Section III, Subsection NB, Article NB-5320 PT: ASME Section III, Subsection NB, Article NB-5350
Shell circumferential seam	RT PT (surface)	ASME Section V, Article 2 (RT) ASME Section V, Article 6 (PT)	RT: ASME Section III, Subsection NB, Article NB-5320 PT: ASME Section III, Subsection NB, Article NB-5350
Baseplate-to-shell	RT PT (surface)	ASME Section V, Article 2 (RT) ASME Section V, Article 6 (PT)	RT: ASME Section III, Subsection NB, Article NB-5320 PT: ASME Section III, Subsection NB, Article NB-5350
Lid-to-shell	PT (root and final pass) and multi-layer PT. PT (surface following pressure test)	ASME Section V, Article 6 (PT)	PT: ASME Section III, Subsection NB, Article NB-5350
Closure ring-to-shell	PT (final pass)	ASME Section V, Article 6 (PT)	PT: ASME Section III, Subsection NB, Article NB-5350
Closure ring-to-lid	PT (final pass)	ASME Section V, Article 6 (PT)	PT: ASME Section III, Subsection NB, Article NB-5350
Closure ring radial welds	PT (final pass)	ASME Section V, Article 6 (PT)	PT: ASME Section III, Subsection NB, Article NB-5350
Port cover plates-to-lid	PT (root and final pass)	ASME Section V, Article 6 (PT)	PT: ASME Section III, Subsection NB, Article NB-5350
Lift lug and lift lug baseplate	PT (surface)	ASME Section V, Article 6 (PT)	PT: ASME Section III, Subsection NB, Article NB-5350
Vent and drain port cover plate plug welds	PT (surface)	ASME Section V, Article 6 (PT)	PT: ASME Section III, Subsection NB, Article NB-5350

Table 10.1.5

REFERENCE ASME CODES FOR CODE WELD INSPECTIONS AND INSPECTION CRITERIA OF HI-STORM FW COMPONENTS

Component	Applicable Reference Code for Inspection Criteria	Applicable Code for Inspection Process
MPC Confinement Boundary	ASME Section III Subsection NB	Section V
HI-STORM FW Overpack Steel Weldment	ASME Section III Subsection NF for Class 3 Structures	Section V
HI-TRAC VW Transfer Cask (Steel Weldment)	ASME Section III Subsection NF for Class 3 Structures	Section V

Table 10.1.6 Metamic-HT Testing Requirements					
	Item Tested	**Property Tested For**	**Frequency of Test**	**Purpose of Test**	**Acceptance Criterion**
i.	B_4C powder (raw material) (see note 1)	Particle size distribution	One sample per lot	To verify material supplier's data sheet	Per Holtec's Purchasing Specification
		Purity	One sample per lot	To verify material supplier's data sheet	ASTM C-750
ii.	Al Powder (raw material)	Particle Size Distribution	One sample per lot	To verify material supplier's data sheet	Per Holtec's Purchasing Specification
		Purity	One sample per lot	To verify material supplier's data sheet	Must be 99% (min.) pure aluminum
iii.	B_4C/Al Mix	B_4C Content (by the wet chemistry method)	One sample per batch	To ensure wt.% B_4C requirements compliance so as to ensure the manufactured panel will meet B10 areal density requirements.	The weight density of B_4C must lie in the range specified in the drawing package in Section 1.5.
iv.	Finished Metamic-HT panel	Thickness and width, straightness, camber and bow	Each Panel	To ensure fabricability of the basket	Per Holtec's Purchasing Specification
		Mechanical & Impact Properties, See Table 10.1.8.	Per Sampling Plan (see Note 2)	To ensure structural performance.	MGV per Table 10.1.8
		B-10 areal density (by neutron attenuation)	One coupon from each Metamic-HT manufactured lot	To ensure criticality safety	The B_4C content must meet the minimum wt% specification in Table 1.2.2.
		Thermal Conductivity	One Sample from each Metamic-HT manufactured lot	To ensure thermal performance	MGV per Table 1.2.8

Notes:

1. The B_4C testing requirements apply if the raw material supplier is not in Holtec's (Or Nanotec's) Approved Vendor List.
2. Sampling Plan is included in the Metamic-HT Manufacturing Manual [1.2.7].

Table 10.1.7 Tier System for Coupon Testing		
Tier No.	Number of Extrusions Tested as a Percent of Number of Extrusions in the Lot	Number of Continuous Lots that Must Pass to Drop Down to the Next Tier
1	20	5
2	12.5	5
3	5	10
4	1	N/A

Table 10.1.8 Minimum Guaranteed Values Required for Certification of Production Runs of Metamic-HT (All testing performed at ambient temperature.)		
	Property	MGV
1	Yield Strength, ksi	See Table 1.2.8 for MGV values
2	Tensile Strength, ksi	
3	Young's Modulus, ksi	
4	Elongation, %	
5	Charpy Impact Strength, ft-lb	
6	Lateral Expansion, mils	
7	Area Reduction, %	

10.2 MAINTENANCE PROGRAM

An ongoing maintenance program shall be defined and incorporated into the HI-STORM FW system Operations and Maintenance Manual, which shall be prepared and issued prior to the first use of the system by a user. This document shall delineate the detailed inspections, testing, and parts replacement necessary to ensure continued structural, thermal, and confinement performance, radiological safety, and proper handling of the system in accordance with 10CFR72 regulations, the conditions in the Certificate of Compliance, and the design requirements and criteria contained in this FSAR.

The HI-STORM FW system is totally passive by design: There are no active components or monitoring systems required to assure the performance of its safety functions. As a result, only minimal maintenance will be required over its lifetime, and this maintenance would primarily result from the effects of weather. Typical of such maintenance would be the reapplication of corrosion inhibiting materials on accessible external surfaces. Visual inspection of the vent screens is required to ensure the air inlets and outlets are free from obstruction (or alternatively, temperature monitoring may be utilized). Such maintenance requires methods and procedures that are far less demanding than those currently in use at power plants.

Maintenance activities shall be performed under the licensee's NRC-approved quality assurance program. Maintenance activities shall be administratively controlled and the results documented. The maintenance program schedule for the HI-STORM FW system is provided in Table 10.2.1.

10.2.1 Structural and Pressure Parts

Prior to each fuel loading, a visual examination in accordance with a written procedure shall be required of the HI-TRAC TALs and the bottom lid bolts and bolt holes. The examination shall inspect for indications of overstress such as cracks, deformation, wear marks, and missing or damaged threads. Repairs or replacement in accordance with written and approved procedures shall be required if an unacceptable condition is identified.

As described in Chapters 7 and 12 of this FSAR, there are no credible normal, off-normal, or accident events which can cause the structural failure of the MPC. Therefore, periodic structural or pressure tests on the MPCs following the initial acceptance tests are not required as part of the storage maintenance program.

10.2.2 Leakage Tests

There are no seals or gaskets used on the fully-welded MPC confinement system. As described in Chapters 7 and 12, there are no credible normal, off-normal, or accident events which can cause the failure of the MPC Confinement Boundary welds. Therefore, leakage tests are not required as part of the storage maintenance program.

10.2.3 Subsystem Maintenance

The HI-STORM FW system does not include any subsystems, which provide auxiliary cooling. Normal maintenance and calibration testing will be required on the vacuum drying, forced helium drying, helium backfill, and leakage testing systems per their O&M manuals. Rigging, remote welders, cranes, and lifting beams shall also be inspected prior to each loading campaign to ensure proper maintenance and continued performance is achieved. Auxiliary shielding provided during on-site transfer operations with the HI-STORM FW require no maintenance. If the cask user chooses to use an air temperature monitoring system in lieu of visual inspection of the air inlet and outlet vents, the thermocouples and associated temperature monitoring instrumentation shall be maintained and calibrated in accordance with the user's QA program commensurate with the equipment's safety classification and designated QA category. See also Subsection 10.2.6.

10.2.4 Pressure Relief Devices

The pressure relief devices used on the water jackets for the HI-TRAC VW transfer cask shall be calibrated as specified in the HI-TRAC VW O&M Manual to ensure pressure relief settings are accurate prior to the cask's use.

10.2.5 Shielding

The gamma and neutron shielding materials in the HI-STORM FW overpack, HI-TRAC VW, and MPC are not subject to measurable degradation over time or as a result of usage.

Radiation monitoring of the ISFSI by the licensee in accordance with 10CFR72.104(c) provides ongoing evidence and confirmation of shielding integrity and performance. If increased radiation doses are indicated by the facility monitoring program, additional surveys of overpacks shall be performed to determine the cause of the increased dose rates.

The water level in the HI-TRAC VW water jacket shall be verified during each loading campaign in accordance with the licensee's approved operations procedures.

The neutron absorber panels installed in the MPC baskets are not expected to degrade under normal long-term storage conditions. Therefore, no periodic verification testing of neutron poison material is required on the HI-STORM FW system.

10.2.6 Thermal

In order to assure that the HI-STORM FW system continues to provide effective thermal performance during storage operations, surveillance of the air vents (or alternatively, by temperature monitoring) shall be performed in accordance with written procedures.

For those licensees choosing to implement temperature monitoring as the means to verify overpack heat transfer system operability, a maintenance and calibration program shall be established in accordance with the plant-specific Quality Assurance Program, the equipment's quality category, and manufacturer's recommendations.

Table 10.2.1

HI-STORM SYSTEM MAINTENANCE PROGRAM SCHEDULE

Task	Frequency
Overpack cavity visual inspection	Prior to fuel loading
Overpack bolt visual inspection	Prior to installation during each use
Overpack external surface (accessible) visual examination	Annually, during storage operation
Overpack vent screen visual inspection for damage, holes, etc.	Monthly
HI-STORM FW Shielding Effectiveness Test	In accordance with Technical Specifications after initial fuel loading
HI-TRAC cavity visual inspection	Prior to each handling campaign
HI-TRAC TAL visual inspection	Prior to each handling campaign
HI-TRAC bottom lid bolts and bolt holes	Prior to each handling campaign
HI-TRAC pressure relief device calibration	Per the device manufacturer's recommendation.
HI-TRAC internal and external visual inspection for compliance with design drawings	Annually
HI-TRAC water jacket water level visual examination	During each handling campaign in accordance with licensee approved operations procedures
Overpack visual inspection of identification markings	Annually
Overpack Air Temperature Monitoring System	Per licensee's QA program and manufacturer's recommendations

10.3 REGULATORY COMPLIANCE

Chapter 10 of this FSAR has been prepared to summarize the commitments of Holtec International to design, construct, and test the HI-STORM FW system in conformance with the Codes and Standards identified in Chapter 2. Completion of the defined acceptance test program for each HI-STORM FW system will provide the assurance that the SSCs important to safety will perform their intended function without limitation. The performance of the maintenance program by the licensee for each loaded HI-STORM FW system will provide the assurance for the continued safe long-term storage of the stored SNF.

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

1. Section 10.1 of this FSAR describes Holtec International's proposed program for pre-operational testing and initial operations of the HI-STORM FW system. Section 10.2 describes the proposed HI-STORM FW system's maintenance program.

2. Structures, systems, and components (SSCs) of the HI-STORM FW system designated as important to safety will be designed, fabricated, erected, assembled, inspected, tested, and maintained to quality standards commensurate with their safety category. The licensing drawings in Section 1.5 and Table 9.2.1 of this FSAR identify the safety importance and quality classifications of SSCs of the HI-STORM FW system and its ancillary equipment, respectively. Tables 1.2.6 and 1.2.7 present the applicable standards for their design, fabrication, and inspection of the HI-STORM FW system components.

3. Holtec International will examine and test the HI-STORM FW system to ensure that it does not exhibit any defects that could significantly reduce its confinement effectiveness. Section 10.1 of this FSAR describes the MPC Confinement Boundary assembly, inspection, and testing.

4. Each cask shall bear a nameplate indicating its model number, unique identification number, and empty weight.

5. It can be concluded that the acceptance tests and maintenance program for the HI-STORM FW system are in compliance with 10CFR72 [10.0.1], and that the applicable acceptance criteria have been satisfied. The acceptance tests and maintenance program will provide reasonable assurance that the HI-STORM FW system will allow safe storage of spent fuel throughout its certified term. This can be concluded based on a review that considers the overarching regulations, appropriate regulatory guides, applicable codes and standards, and accepted practices.

10.4 REFERENCES

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

[10.0.2] NUREG-1536, "Standard Review Plan for Dry Cask Storage Systems", January 1997.

[10.1.1] American Society of Mechanical Engineers, " Boiler and Pressure Vessel Code," Sections II, III, V, IX, and XI, 2007 Edition.

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

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

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

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

[10.1.6] "Final Safety Analysis Report for HI-STORM 100 Cask Storage System", Holtec Report No. HI-2002444 (latest revision).

[10.1.7] "Metamic-HT Qualification Sourcebook", Holtec Report No. HI-2084122, Latest Revision (Holtec Proprietary)[1]

[10.1.8] "Sampling Procedures and Tables for Inspection by Attributes", Military Standard MIL-STD-105E, (10/5/1989).

[10.1.9] "HI-STORM FW MPC Thermal Test Procedure", Holtec Procedure HPP-5018-1, Rev. 0.

[1]Supporting document submitted with the HI-STAR 180 License Application (Docket 71-9325).