HOLTEC INTERNATIONAL

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March 24, 2011

ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Reference: 1. NRC Inspection Report No. 72-1014/10-201 and Notice of Violation Letter on 2/24/2011.
2. Holtec letter 5014720 dated March7, 2011 (Request for Clarification)
3. NRC letter to Mark Soler dated March 10, 2011 (Response for Clarification to NRC Inspection Report 72-1014/10-201 and Notice of Violation Letter Dated 2/24/11.)

Subject: Reply to Notice of Violations

We thank you for the information you provide in the notice of violations attached to your letter on the inspection report 72-1014/10-201 (Reference 1) and your subsequent explanatory letter dated March 10, 2011 (Reference 3) on the thermal violation documented in section 3.1.2.5 of Reference 1. While we do not intend to formally dispute these violations, we do include in this letter our perspective and additional information related to the identified issues which might lead the NRC to re-assess the characterization of these issues as violations. With that said, we have proceeded to enter both violations into our corrective action program and this letter provides identified apparent or root causes, corrective actions and, where appropriate, actions to prevent recurrence.

Violation #1 (72.48 Issue):

Discussion:

We should clarify that the text matter introduced in the FSAR Revision 8 using the 72.48 process did not change any methodology to analyze fuel damage from drop accidents as there did not exist any such methodology in the subject FSAR revision. The methodology for evaluating fuel performance had previously been deleted from the FSAR (amendment # 4 and 5) at the direction of the NRC guided by the logic that fuel cladding failure is inconsequential to safety because it is not relied upon as a confinement boundary (the MPC Enclosure Vessel serves that safety function). (Reference ML072200496, ML072180123, ML080850336, ML072290078, ML072290158)

Thus, the calculation of the acceptable g-load to ensure fuel rod integrity after an accident, after the issuance of amendment #2, had become a *non-sequitur* for the safety analysis of the HI-

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STORM 100 system and remains so to this day. In this amendment the MPC had been considered "leaktight" and able to withstand all design basis accident conditions without causing a release of radioactive material to the public. A Holtec client, however, strenuously argued that guidance in the FSAR with respect to the allowable g-load for fuel cladding was necessary for the utility to maintain a connection with its prior plant-specific evaluations. To accommodate the client's request, Holtec added some verbiage in Section 3.5 that recognized an NRC approved methodology (Holtec dockets # 71-9325 and 71-9336 based on NUREG-1864) as robust references for fuel rod integrity predictions. (In this respect, we regret the mention of the LLNL report rather than ISG-12 in the 72.48 commentary).

Because the added technical justification on fuel impact analysis was of no relevance to the safety analysis in the FSAR due to the fact that the MPC is the confinement boundary which remains intact after an accident, Holtec viewed it as merely accommodating a client's need to have a referenced resource without affecting the substance of the safety analysis in the FSAR. For further clarification, a timeline of the events leading up to the addition of the text matter through 72.48# 923 is presented in Appendix A to this letter.

The Inspection Report states that Holtec incorrectly derived the 45g criteria for the HI-STORM 100 system from NUREG-1864. NUREG-1864 is not used in the FSAR as the basis for the g-load HI-STORM 100 limit of 45g. Rather the 45g limit represents the design basis deceleration established by Holtec during the original design of the HI-STORM 100 System (see FSAR Table 3.1.2). In other words, the HI-STORM 100 overpack and the MPC have been designed and analyzed to withstand a maximum vertical impact deceleration of 45g irrespective of a specified fuel cladding failure limit. The SER for Amendment 0, Section 11.2.2, indicates that "Limiting the inertia loading to 60 g or less ensures the fuel cladding remains intact." Holtec was merely reiterating in the technical justification added to Section 3.5 that other industry publications indicate the same. Since a design limit of 45g has been set on the HI-STORM 100 System for all conditions and fuel cladding would not be challenged even under 60 gs (per the above SER), fuel cladding is assured under this more conservative limit.

Cause:

Primary cause: Inadequate procedure. The screening question in the 72.48 process did not provide sufficient guidance to the user in determining whether a change in methodology was occurring.

A contributing cause was Holtec's willingness to accommodate a customer request by adding some new text matter on fuel rod buckling into the FSAR after details had been removed at the request of the NRC. The verbiage of the added text was not sufficiently precise to categorically preclude the inference that a new methodology was being introduced. As a result, what Holtec

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construed to be additional clarification to accommodate a customer request, ended up being interpreted as a methodology change by the NRC inspection team.

Extent of Conditions:

See corrective action #4 below.

Corrective Actions and Actions to Prevent Recurrence:

1. Revise HSP-321 (Holtec's 72.48 Procedure) to provide additional clarification in the screening and evaluation questions regarding "change in methodology". Specifically, the procedure and screening/evaluation questions shall imbed additional barriers in our process to align our understanding of paragraph 72.48(C)(2)(viii) in the regulations on the change of method with the NRC's position in the future . Towards this end, the working template of our 72.48 form has now been fortified with a series of additional probing questions to detect the occurrence of "a change in method" which may visit upon us in the variety of possible guises in the future. We expect that this improvement in our 72.48 evaluation infrastructure will help avert future problems in this critical area of CoC management. Expected completion date: April 15, 2011

2. Provide additional training to personnel qualified to author or review 72.48s. Expected completion date: April 7, 2011.

3. Revise the corresponding ECO and 72.48. Text added as a result of the ECO shall be eliminated. In order to accommodate the customer, the following text (or similar) will be added; "The assured integrity of the MPC Confinement Boundary eliminates the reliance on the fuel cladding to prevent release of radiological matter to the environment. Therefore, there is no need for providing a method for computing the allowable g-load for the fuel rods and none is included in this FSAR. A user interested in determining the permissible inertia load for a specific fuel assembly inside a storage system can refer to the following recent work in the regulatory literature: a) NUREG-1864; b) NRC Docket Numbers 71-9336 and 71-9325." Expected completion date: April 18, 2011

4. An extent of conditions evaluation was completed for all Engineering Change Orders (ECOs) generated in the last two years in which text was added to the FSAR in order to determine whether any such cases included a potential change in method. The results of the evaluation determined that no similar conditions existed. In order to increase the number of samples, ECOs with text additions to the FSAR generated in the two years prior to those already reviewed will also be evaluated in order to assure that no similar conditions exist. Expected completion date: April 30, 2011.

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Violation #2 (Thermal issues):

Discussion:

Issue #1 (Appendix I): This violation pertains to the use of a 2-D Fluent thermal model to simulate vacuum drying. The 2-D modeling in the old versions of the code limited the user to specifying a single value of equivalent thermal conductivity (to represent the combined effect of conduction and radiation as a function of temperature) in the planar and radial directions to simulate the heat dissipation in the basket modeled as a porous medium. This modeling restriction in Fluent forced Holtec to incorporate the effect of axial conductivity, which is understated in the Fluent solution, by the use of the planar conductivity to represent the axial value as well as through the use of a classical perturbation formalism. This work is captured in the referenced Appendix I and the discussion in FSAR Appendix 4.B (FSAR Revisions 1 through 6, subsection 4.B.5) clearly discusses the use of the calculations in Appendix I in the design basis. The use of such analytical supplements to "enhance" numerical solutions was quite common when the computer codes were still rather wanting in their ability to simulate 3-D problems autonomously. The analysis reflected the state of technology at that time. While 2-D analyses are not as sophisticated in today's context, they served an indispensable purpose up to the time when they began to be supplanted with 3-D models.

Appendix I was originally sent to support the increased heat load associated with Amendment #1 (ML011910103) and has been explicitly recognized as a valid method of analysis in the SER for Amendment #5 (ML082030170). We have excerpted the relevant text from the above mentioned SER below for your convenience:

> "4.8.1 Vacuum Drying
>
> The applicant developed an axisymmetric FLUENT thermal model of the MPC, employing the MPC in-plane conductivity as an isotropic fuel basket conductivity (i.e., conductivity in the basket radial and axial directions is equal), to determine peak cladding temperature at design basis heat loads. To avoid excessive conservatism in the computed FLUENT solution, partial recognition for higher axial heat dissipation is adopted in the peak cladding calculations."

Please note that the last sentence from above refers to the methodology discussed in Appendix I.

As stated in Reference 3, and confirmed by Holtec, the running of a 3-D FLUENT model predicted results very close to those of the 2-D model without the inclusion of the methods described in Appendix I. We respectfully submit that this result may suggest that both 3-D and 2-D models are equally conservative. We should emphasize that no user has loaded a canister

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whose cladding temperature exceeded the ISG 11 Rev 3 limit because of inclusion of Appendix I solution in the FSAR temperature tables. Appendix I has no legacy of materially violating an NRC ISG.

Issue #2: Upon approval of Amendment #5, more restrictive operating conditions and limits were applied to vacuum drying even though the analysis of record had not changed. The original analysis, approved under Amendment #1, indicated that under steady state conditions PCT limits would not be exceeded during vacuum drying; therefore there was no reason for Holtec to propose time limits for vacuum drying as part of the amendment request for Amendment #1 and further, since no changes were made to the vacuum drying operating and conditions subsequent to this approval, Holtec continued to have no reason to propose such limits in the subsequent amendment requests.

Issue #4 (Use of Nitrogen): It should be noted that the SER for Amendment 0 acknowledges the use of both helium and nitrogen as an inert gas to use for MPC blow down. Amendment 5 also acknowledges that the MPC blow down is performed with an inert gas. The reference NRC inspection report on Page 10 states that although there is assurance that vacuum drying conditions bounds the blow down conditions using nitrogen or helium, acceptance criteria is not addressed in the FSAR. While it is true that the FSAR does not describe or analyze specifically the use of nitrogen in the thermal chapter, in all cases the acceptance criteria for the fuel is that the PCT remains below the limits of ISG-11, Revision 3, and that the cladding remains in an inert atmosphere. Both of these criteria are met with the use of nitrogen as a blow down gas. Below is a table which provides the PCT for the operational condition of blow down using helium or nitrogen and the associated PCT.

Heat load (kW)	Condition	PCT (°F)	PCT limit (°F)
≤ 28.74	N2 @ 1 atm	894	1058
≤ 28.74	He @ 1 atm	927	1058

Cause:

Issue #1 (Appendix I): Limitations of technology when calculations were initially completed led Holtec to incorporate the additional analysis to attempt to provide for an assumed complete and more accurate result.

Issue #2 (Incorporation of Changes into earlier amendments): Inadequate procedure and understanding of regulatory expectations when more limiting requirements are mandated for subsequent amendments. No guidance provided within regulatory or Holtec documents as to how

to address necessary changes to earlier amendments. Current regulations do not allow for revisions to already approved amendments.

Issue #3 (LCO evaluations): Inadequate procedure. No guidance provided within Holtec documents to address extent of evaluation necessary for operation activities covered by LCOs.

Contributing cause: When the 40 hour limit was imposed by the NRC in Amendment #5, Holtec did not consider the 40 hour limit to be a timeframe that would actually occur since actual vacuum drying times being recorded by users were significantly less than the 40 hours and increases in heat load should in fact reduce drying times further. As such, no consideration was given for the "what if" scenarios.

Issue #4 (Use of Nitrogen): Calculations used to support vacuum drying were considered to bound other inert gases and that it would be intuitively obvious to personnel familiar with the thermal discipline. As such, Holtec's technical personnel did not consider the need to detail this in Chapter 4 of the FSAR.

Extent of Conditions: Each of the identified issues identified are considered to be isolated due to the nature of the issue with the exception of Issue #3. An extent of condition evaluation will be completed against all LCOs to confirm that no other unanalyzed conditions exist.

Corrective Actions and Actions to Prevent Recurrence:

1. Data was collected from sites and calculations have been completed using the 2-D model, without use of Appendix I, for loaded canisters. These calculations have shown that there has been no violation of the ISG -11 Rev 3 limit for short term operations at any loaded site.

2. The calculations discussed in (1) do show that, going forward, some modifications to heat load limits are necessary. Because the old solution is a part of approved amendments and corresponding FSARs, the old documentation cannot be edited to reconcile it with the revised guidelines. Holtec has issued an information notice to the users advising them of the modified heat load limits during vacuum drying. Users are also informed that if they load canisters greater than 23 kW, they shall institute a 40 hour drying time limit consistent with Amendment #5. Holtec Information Bulletin HIB-48 has been issued to the HUG membership on March 21, 2011. A copy of HIB-48 is provided as an attachment to this letter.

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3. An ECO and 72.48 shall be processed to include discussion in Chapter 4 of the FSAR on the use of nitrogen to blowdown the canister prior to vacuum drying so that a firm nexus between Chapter 8 (Operations) and Chapter 4 (Thermal Analysis) exists. Expected completion date: May 10, 2011.

4. The preliminary guidance on multiple vacuum drying cycles is provided in HIB-48. This HIB will be updated after calculations are complete to provide an example of the cycling process. Expected completion date: May 30, 2011.

5. Revise Holtec Standard Procedure HSP-322 (Dry Storage and Transportation SAR Control and COC Amendment Requests) to address the following:

   a) Use of the HIB process to provide users necessary changes to earlier amendments;
   b) Provide guidance on necessity to evaluate Technical Specification LCOs and applicable Bases through final potential actions.

   Expected completion date: April 30, 2011.

6. Review all LCOs and verify evaluations have been completed for all potential applicable circumstances.

   Expected completion date of review: May 10, 2011.

We would be pleased to answer any additional questions in this response. We appreciate your assistance in helping us improve our QA processes through a diligent inspection and a transparent dialog.

Sincerely,

Mark Soler
Director of Quality Assurance

Attachments: Holtec Information Bulletin HIB-48
cc: Eric Benner; Chief; Rules, Inspections, and Operations Branch, DSFST, NMSS

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Appendix A to Document 5014721: Time Line for Fuel Buckling 72.48 (Page 1 of 2)

7/31/2007 – NRC initiates conversation with Holtec on "HI-STORM 100 Emergent Structural Fuel Buckling Analysis Issue"

8/2/2007 – Follow-up call between NRC and Holtec takes place. NRC indicates in the conversation record, "The staff proposed that the solution for the purposes of approving the Part 72 Certificate of Compliance (CoC) amendment request was simply to remove the analysis in FSAR section 3.5 and any reference to it." The two outstanding LARs at this time are 1014-5 which ultimately became Amendment #4 and 1014-3 which ultimately became Amendment #5.

8/13/2007 – Holtec submits supplemental information for LAR 1014-5 via Holtec Letter 5014632. "The primary change, the replacement of the contents of Section 3.5 with new text, is as discussed in a Holtec/SFST telecom. The remaining changes in the attachment are the removal of now obsolete references to Section 3.5 from other areas of proposed FSAR." As a result of the proposed change, the resulting Section 3.5 consists of only 1 page. There are no discussions left in the FSAR that link the 45g limit to fuel performance, but the value of 45g remains as design basis for the confinement analysis. The new Section 3.5 addresses the confinement performance with reference to Section 7 ("Since the MPC confinement vessel remains intact, and the design bases temperatures and pressure are not exceeded, leakage from the MPC confinement boundary is not credible", and "there is no mechanistic failure that results in a breach of, and associated leakage of radioactive material from the MPC confinement boundary.").

8/15/2007 – Holtec submits supplemental information for LAR 1014-3 via Holtec Letter 5014633. Letter contains same statement as above.

01/08/2008 – Certificate of Compliance 72-1014 Amendment #4 becomes effective.

2/2008 – Holtec writes ECO 5014-152 to give users the changes to the FSAR which will apply to their future loadings as approved by the amendments. The ECO removes the same calculations from Section 3.5 so that it is consistent with FSAR Revision 6 which was published to incorporate the changes from Amendment #4. No 72.48 was completed because this screened out as editorial/administrative change since the change was guided by NRC and approved in Amendment #4.

3/2008 to 7/2008 – A user of the HI-STORM 100 System requested that we perform a 72.48 to address ECO-5014-152. The ECO was revised and 72.48 #874 was written. This was a screening only since the change did not have an adverse impact on the design function or method of performing of controlling the design function. The confinement boundary of the HI-STORM 100

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System has always been the MPC and during accident conditions it was always assumed that 100% of the rods would rupture, therefore this analysis was never required to support a finding

under Part 72. In addition ISG-2 requires that the fuel be retrievable after normal and off-normal conditions of storage and ISG-3 requires that the MPC is recoverable after an accident.

Fall of 2009 – The same user of the HI-STORM 100 System continued to question the original removal of the text from Section 3.5 even though it was directed by NRC and supplied with two LARs and requested that we provide a basis for the fuel surviving a load of 45gs.

12/2009 - ECO 5014-172 was written to add additional clarifying text to Section 3.5 and 72.48 #923 was initiated. Analysis performed and approved in our transport certificates (71-9336 and 71-9325), using the method from NUREG-1864, had shown that fuel rods based on a strain based analysis method would survive a g-load of at least 60gs; therefore we drew the conclusion in the FSAR that the fuel could also withstand a g-load of 45gs. This 72.48 was a screening only since the change did not have an adverse impact on the design function or method of performing of controlling the design function. See clarifying discussion on NUREG-1864 and the development of the 45g criteria in the main part of this letter.

HOLTEC INFORMATION BULLETIN (HIB)*

Parsing the present to protect the future

Title of the Bulletin: Clarifications of Blow Down Provisions and Heat Loads Associated with Permissible Vacuum Drying Durations

CoC Holder:	Holtec International	HIB No. (sequential):	48	**Revision Log:**	Name	Date
System Name:	HI-STORM 100	Ref. Nuclear Plant:	Various	Author (Rev. 0):	TSM	3/18/2011
				Reviewer (Rev 0):	DMM	3/18/2011
Holtec Program No.:	5014	Period of Occurrence (m/y):	N/A	Author (Rev. 1):		
				Reviewer (Rev 1):		
Affected Component(s):	N/A	Affected equipment or part	N/A	Author (Rev. 2):		
				Reviewer (Rev 2):		

POLICY STATEMENT & APPLICABILITY

The Holtec Information Bulletin (HIB) is principally used by the company to document relevant industry events pertaining to fuel storage at nuclear plants and to disseminate the knowledge gleaned from such events to the Holtec Users' Group (HUG) membership, the company's personnel, affected suppliers, and other stakeholders. While the great majority of the events cataloged in the HIBs focus on our system, a HIB may be issued on industry events involving another nuclear supplier system where the lesson learned can be beneficially applied in the Company's fuel storage program. A HIB is prepared, internally reviewed, and issued expeditiously after an event is determined by the company to be significant to warrant dissemination. HUG members are encouraged to contact NPD Program Manager to suggest events that merit a HIB. Revised versions of the HIB may be distributed as the analysis and evaluation of the event proceeds.

A HIB may also be issued to inform/alert our stakeholders of non-event derived information that is deemed to merit immediate release to assist the Company's customers. Such information may pertain to enhancements in system design/operations proactively developed by the Company or to identify latent errors/weaknesses in the Company's information base discovered from ongoing operations.

Finally, the Company uses the HIB as the vehicle, if applicable, to notify Part 71, Part 72 and Part 50 licensees of immediate and/or interim corrective actions to be taken in response to a development (such as notification of a potential Part 21 filing). HIBs are prepared by the Nuclear Power Division of Holtec International and are aimed to help improve the fuel management program of the Company and all of its customers/suppliers. Accordingly, the Company expects its clients and suppliers to take appropriate action pursuant to this bulletin. This bulletin is subject to internal reviews to ensure accuracy and clarity, and, as such, may be used in the corrective action process, if applicable, under the Company's QA program. This form is stored in g:\generic\HIB\ directory.

URGENCY LEVEL OF THIS NOTIFICATION

Level (use the legend ** below): 3, Should be incorporated prior to next loading campaign, if applicable.

** 1. High (Immediate attention required by user); 2. Medium (Action by users should occur within a week of receipt); 3. Low (Any required actions should occur as soon as practical); 4. Non- consequential/For Information (No action is required by user)

Note: Severity level indicates the needed urgency of acting on this bulletin to insure safety of operating or soon -to- be - commissioned SSCs provided by Holtec.

[1] Form last revised on Feb 14, 2011.

ISSUE BACKGROUND & CATEGORIZATION

Background: This HIB is being issued to address recent communications from the NRC Staff with respect to currently approved vacuum drying analysis as a result of Holtec's triennial Quality Assurance Program Inspection (Reference NRC Inspection Report 72-1014/10-201).

The following items from the referenced NRC Inspection Report are addressed herein:
(1) The inspection team's questioning of the applicability of a specific calculation ("Appendix I") that was performed in 2001-2002 timeframe to support the approval of LAR 1014-1 which became Amendment #1 to CoC 1014.
(2) The vacuum drying time limits imposed (40 hours) during the approval of Amendment # 5 for all MPCs containing heat loads greater than 23 kW.
(3) Operational guidance to follow if the vacuum drying duration limits in (2) are exceeded.
(4) MPC blow down with inert gas.

For Item (1), it should be noted that the calculation in Appendix I only applies to vacuum drying conditions which require annulus flushing. For vacuum drying with standing water in the annulus and for forced helium dehydration, Appendix I is not utilized. Therefore, any results or limits under those conditions remain unchanged.

When Amendment #5 was approved, with additional limitations placed on vacuum drying operations, as stated in (2), the HI-STORM 100 FSAR was updated to include the conditions of approval. In compliance with the referenced NRC Inspection Report all users are hereby informed that the same limitations invoked for Amendment #5 are required to be observed under all previous CoC amendments. The Vacuum Drying operations limits in Amendments 6 and 7 are the same as in Amendment #5 of the CoC.

Event Category (Use Legend A* Below): H

**Legend A*:* H: Holtec system related; P: Peer system related; G: Industry generic; Q: Guided by the Company's (proactive) quality initiative program

PROBABLE CAUSE (IF APPLICABLE)

Not Applicable

Cause Category (Use Legend B† Below): (Describe Below)

†***Legend B*:** (1) Weakness in Mechanical Design (inappropriate or unachievable tolerances, drafting error, etc.); (2) Unsuitable analysis (erroneous input data, inappropriate analysis methodology, or defect in the computer code utilized); (3) Improper material selection (poor weldability, machinability, lamination concerns, etc.); (4) Inadequacy in the client's ISFSI operation procedure; (5) Inadequacy in a procedure provided by Holtec; (6) Administrative deficiency (such as failure to transmit information to the Client); (7) Human Error; (8) Manufacturing Deficiency; (9) Error in procurement, (10) Not event based, part of quality enhancement initiative, (11) miscellaneous.

LESSONS LEARNED & GUIDANCE

(Describe Holtec's Planned Activities and guidance to other stakeholders to Implement the Lessons Learned)

To address both items (1) and (2) above, Holtec recommends to users performing vacuum drying to adhere to the operational practices stated below as applicable based on the heat loads in the following table **regardless of which amendment they are loading to**:

MPC Model and Total Heat Load (kW)	Maximum Heat Load in Individual Cells (kW)[3] (also referred to as the Specific Heat Load in the FSAR)	Minimum HI-TRAC Annulus Cooling Requirement[1]	Time Limit (hours) for continuous vacuuming
MPC-24: ≤20.88	0.870	Standing Water	None
MPC-68: ≤21.52	0.316	Standing Water	None
MPC-24: > 20.88 and ≤23	0.958	Flushing Water with exit temperature < 125 °F	None
MPC-24E/EF: ≤23	0.958	Flushing Water with exit temperature < 125 °F	None
MPC-32/32F: ≤23	0.718	Flushing Water with exit temperature < 125 °F	None
MPC-68/68F/68FF: > 21.52 and ≤23	0.338	Flushing Water with exit temperature < 125 °F	None
MPC-24: > 23 and ≤27.77	1.157	Flushing Water with exit temperature < 125 °F	40
MPC-24E/EF: > 23 and ≤28.17	1.173	Flushing Water with exit temperature < 125 °F	40
MPC-32/32F: > 23 and ≤26[2]	0.8125	Flushing Water with exit temperature < 125 °F	40
MPC-68/68F/68FF: > 23 and ≤26[2]	0.382	Flushing Water with exit temperature < 125 °F	40

[1]In the above table, where standing water is required, flushing may be used instead.
[2]TS/CoC for Amendments 5, 6, and 7 contain an editorial error which limits the total canister heat load to 26 kW during vacuum drying, for MPC-32 and MPC-68. This was reported in HIB-43. Although this is an editorial error only, Holtec still recommends that the limits above be applied to vacuum in all cases to conform to the TS as currently written.
[3]The heat load in the individual cells may be above this value if the total cask heat load is less than specified and a specific thermal analysis is performed by Holtec indicating the PCT limits will not be exceeded for the heat load distribution.

[Item 3]:
Vacuum drying entails a severe increase in the fuel cladding temperature because the convection component of heat transmission becomes inoperative under vacuum. For this reason the FSAR contains explicit limits on the allowable heat load for which vacuum drying is permitted (see Section **4.5.1.1.4 of the FSAR**). Measures such as augmented cooling of the annulus by flowing water are also specified in the FSAR when necessary to maintain the peak cladding temperature below the ISG-11 Rev 3 limit. However, the aggregate heat load is not the only parameter that governs the peak cladding temperature; the distribution of heat load, i.e., the specific heat load in each storage cell, is equally important. The results provided in the FSAR pertain to the case where the specific heat load (heat generated by one fuel assembly) in every location is equal to (or less than) the average. In other words, the heat load generated by each assembly, q, is equal to or less than Q/n, where Q and n are the aggregate canister heat load and the number of storage cells in the canister, respectively. The FSAR does not (and cannot) contain the results for the infinite number of cases of variable heat load distribution where the specific heat load straddles q. In such cases, an MPC specific calculation for the actual (or an enveloping) heat load distribution should be performed using the NRC approved thermal- hydraulic model and the temperature limit in ISG-11 Rev 3 for short term operations must be met.

In the FSAR, no limitation on the vacuum drying duration is placed if the heat load is sufficiently low (see Section 4.5.1.1.4 of the FSAR). A limit of 40 hours was placed by the NRC in CoC amendment #5 at heat loads exceeding 23 kW as a precautionary measure to protect the fuel cladding. If the 40 hour limit is applicable due to heat load limits, the user must have operational procedures in place for additional vacuum drying cycles and it may be necessary to introduce helium to the canister to boost heat rejection before the allotted time for initial drying is reached. We recommend pressuring the canister with helium to approximately 2 atmospheres (A lower or higher level of pressurization may be used to accord with the desired rate of cooling). The helium in the canister helps cool the cladding to a target value (we recommend T minus 50 °C, where T is the cladding temperature reached at the end of initial 40 hours of vacuum drying) to keep the range of cladding temperature variation under the 65 °C permitted in ISG-11 Revision 3. The time needed to achieve the required cool down will be denoted by D. Vacuuming may be re-initiated after the minimum cool down time has elapsed. Let us denote the time elapsed to raise the cladding temperature back to T as E. If the required dryness level is not reached in this second vacuuming cycle then it will be necessary to go through another cool down cycle of duration D. Each vacuuming cycle must be limited to duration E and be followed by a cool down cycle of duration D (Duration D is a direct function of the helium pressurization level selected for the cool down cycle). A maximum of 10 cycles of temperature is allowed per ISG 11 Rev 3. Therefore, if 9 cycles of vacuuming followed by cool down fail (an unlikely scenario) to achieve acceptable dryness then it will be necessary to resort to the Forced Helium Dehydration method to prevent further thermal cycling. Because the values of D and E are dependent on the specific heat load distribution in the canister, it is necessary to model the specific heat load distributions in the canister using the FLUENT model, described in the FSAR, to compute the fuel cladding temperature (PCT).

For item (4), it should be noted that the SER for Amendment 0 acknowledges the use of both helium and nitrogen as an inert gas to use for MPC blow down. Amendment 5 also acknowledges that the MPC blow down is performed with an inert gas. The reference NRC inspection report on Page 10 states that although there is assurance that vacuum drying conditions bounds the blow down conditions using nitrogen or helium acceptance criteria is not addressed in the FSAR. The FSAR does not describe or analyze specifically the use of nitrogen in the thermal chapter however in all cases the acceptance criteria for the fuel is that the PCT remains below the limits of ISG-11, Revision 3 and that the cladding remains in an inert atmosphere. Both of these criteria are met with the use of nitrogen as a blow down gas. Below is a table which provides the PCT for the operational condition of blow down using helium or nitrogen and the associated PCT.

Heat load (kW)	Condition	PCT (°F)	PCT limit (°F)
≤28.74*	N2 @ 1 atm	894	1058
≤28.74	He @ 1 atm	927	1058

* Heat loads greater than 28.74 kW requires the use of FHD wherein users blow down using helium to ensure no nitrogen contamination and proceed to FHD operations. If FHD operation fails, then the Technical specification (TS) mandates that the MPC is backfilled with helium to the required TS level.

DISTRIBUTION: All members of the Holtec User Group (HUG), other stakeholder (clients, suppliers, etc). This bulletin is classified as non-proprietary (can be forwarded to third parties as appropriate).

ATTACHMENTS (List all attachments, if any): None