HI-STORM 100 LAR 1014-5
RAIs #2 Responses

Holtec International
June 28, 2006

General

- G-1 16x16 CE System 80+
  - Request for increased assembly length will be withdrawn
  - Other proposed changes related to assembly class 16x16A are kept

Chapter 1 – General Desription

- 1-1 “Equivalent” materials
  - Definition of equivalent materials added to Table 1.0.1
  - A note is added to Table 2.I.7 (Materials for HI-STORM 100U) to reference the definition
- 1-2 Include Bill of Materials for HI-STORM 100U
  - Proposed FSAR already contains all critical characteristics for ITS materials of the HI-STORM 100U
    - Materials: Material type in DWG 4501; Material Specification in Table 2.I.7
    - Dimensions: In DWG 4501
    - ITS Category: In Table 2.I.7

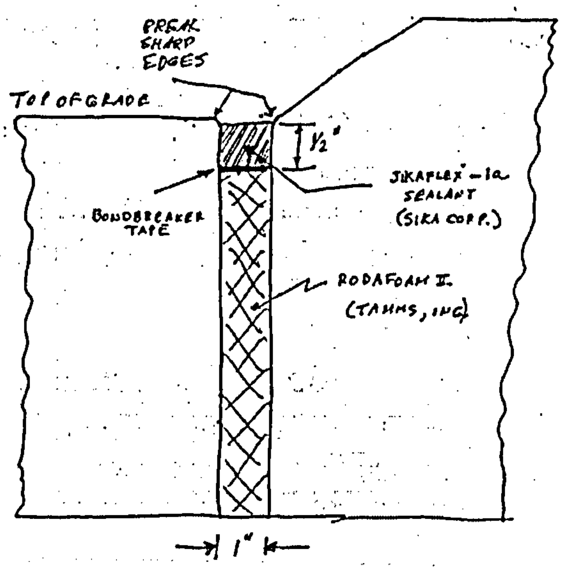
June 28, 2006 3

Chapter 2 – Principal Design Criteria

- 2-1 Details of joint between top pad and transporter riding surface
  - Details are added to Licensing Drawing 4501
- 2-2 Visual Inspection of caulking around the CEC
  - Visual surveillance requirements are already specified in Table 9.I.1 of Supplement 9.I. They require annual surveillance of the interface

June 28, 2006 4

RAI 2-1



Chapter 3 – Structural Design

- 3-1 Reinforcement in concrete encasement of CEC
  - Proposed FSAR is revised to incorporate corrosion protected reinforcement in the form of mesh or fibers
- 3-2 Re-include details on DWG 4501
  - Details are re-included

Chapter 3 – Structural Design (cont.)

- 3-3 Calc Package Content Clarification
  - Calculation Package is specific to HI-STORM 100 U – is being revised to clarify that any new supplements going forward are only to support HI-STORM 100 U
- 3-12 "Method" in calculation package
  - METHOD Section(s) expanded to be more specific for each calculation. Not only approach but also key assumptions used

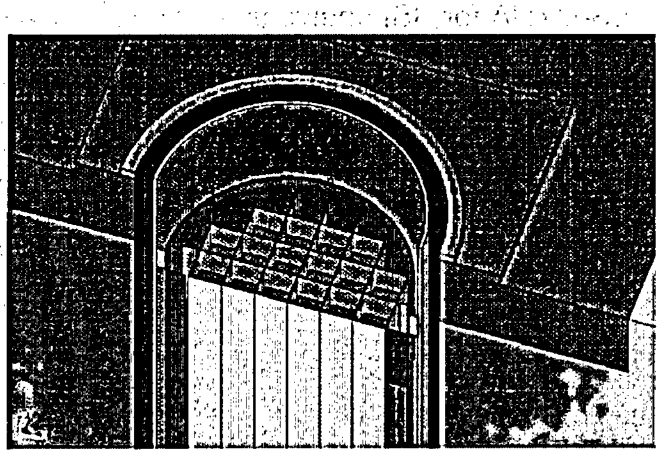
Chapter 3 – Structural Design (cont.)

- 3-4, 3-7, 3-8, 3-11, 3-13
  - Holtec is revising FSAR and TS to ensure that every site owner shall perform a site specific analysis using the methodology set forth in the FSAR and used in the representative solutions presented in the FSAR. All inferences that the site owner can opt to demonstrate that the representative solutions are bounding (and therefore, no new solution must be performed) are being removed from the TS.
  - The representative solution in the FSAR will be the solution already presented with the addition of the divider shell, the MPC upper and lower guides, the MPC, the fuel basket, and fuel in each cell. The MPC-32 will be the representative MPC and all nominal gaps will be simulated.

Chapter 3 – Structural Design (cont.)

- 3-4, 3-7, 3-8, 3-11, 3-13 (cont.)
  - The top-of-foundation is still driven and is assumed to be bedrock (no flexibility); one VVM is considered; the lid is included with the correct load path and mass modeled. SINCE THIS IS TO REPRESENT A TYPICAL SOLUTION SOLELY TO PROVIDE AN APPLICATION OF THE METHODOLGY, NO EVALUATION OF THE EFFECT OF MULTIPLE VVM'S, FLEXIBLE PAD, EXTENT OF SURROUNDING SUBSTRATE, SUBSTRATE UNDER PAD DOWN TO BEDROCK IS INCLUDED. The applicable methodology is spelled out in the written response to RAIs 3-4 and 3-7, and is to be put in the FSAR, and specifically referred to in the TS.

Expanded Representative Simulation (MPC Lid removed for clarity)



Chapter 3 – Structural Design (cont.)

- 3-5 Rigid Baseplate and Gussets
  - Representative solution will include gussets explicitly, and calculation package will address gusset and weld analysis based on maximum impact load. Maximum lateral force drives the qualification.
  - CEC qualification is performance based; local shell stresses in vicinity of gusset are secondary in nature.
- 3-6 Single VVM
  - If single VVM has large enough factors of safety (>2.0), then case of multiple VVMs, although results may be slightly altered, will not require structural analysis and the site need not deal with multiple VVMs.

Chapter 3 – Structural Design (cont.)

- 3-9 LS-DYNA for SSI analyses
  - NUREG/CR-6896, Assessment of Seismic Analysis Methodology for Deeply Embedded Nuclear Power Plants, 2/2006 provides comparisons of SASSI and LS-DYNA when all non-linear aspects are suppressed. Conclusion is that results are in good agreement. LS-DYNA should be used for shallow site (11 meters) and strong motions because interfaces that can open and close have a significant effect.

Chapter 3 – Structural Design (cont.)

- 3-11 Seismic Analysis with Concrete around CEC
  - Effect of concrete encasement conservatively included in revised representative solution by increasing density of CEC shell.
- 3-14 Drawing showing concrete around CEC
  - Figure is added to show concrete around CEC

June 28, 2006 13

Chapter 3 – Structural Design (cont.)

- 3-15 Concrete Encasement Reference
  - Additional reference will be provided in the RAI response that highlights the advantage of concrete cover for steel as corrosion protection
  - Concrete encasement will have reinforcement to prevent shrinkage and cracks
  - Note that there is a 1/8 inch corrosion allowance on the steel
- 3-16 Lower MPC Guides as NITS
  - Guides upgraded to ITS C
- 3-17 Licensing Drawing Details
  - Details will be restored

June 28, 2006 14

Chapter 4 – Thermal Evaluation

- 4-1 Drawings with Grid Spacer Information
  - TBD
- 4-2 Convergence of CFD Fuel Model Runs
  - Extended FLUENT solution indicate no significant changes in shear stress
  - Studies presented in the revised FSAR show that even for an increase of the resistance of about 23%, the temperature increases by no more than 12 F, which is small compared to the margins of about 50 to 90 F.
- 4-3 Updated Calculation Packages
  - Will be provided

June 28, 2006 15

Chapter 6 – Criticality Evaluations

- 6-1 a) Notes on Drawings regarding F-Series Shells
  - Transportation LAR to remove the special meaning of the F-shells is in preparation
  - Notes will be removed once the LAR is approved
- 6-1 b) and e) Thoria Rod Canister
  - There is only one such canister, which is loaded into a MPC-68F. FSAR will be clarified accordingly.
- 6-2 c) and d) Chapter 6 references to MPC-32F and MPC-68FF
  - Will be revised

June 28, 2006 16

Chapter 9 – Acceptance Criteria and Maintenance Program

- 9-1 CEC Installation Inspection
  - One VVM per ISFSI to be inspected by visual and UT at an interval not exceeding 20 years

June 28, 2006 17

Chapter 12 – Operating Controls and Limits

- 12-1 & 12-2 & 12-3 Editorial Corrections and Changes
  - Will be incorporated
- 12-4 "Long-Term" Storage
  - Introduced in last LAR to distinguish it from "short-term operation"
  - Defined in Table 1.0.1
  - Used in NUREG 1536 (Chapter 4, Section IV and Section V) in the same manner

June 28, 2006 18

Methodology - A

i. Utilize an established Code such as SHAKE2000 to establish the seismic time-history profile of the substrate continuum *in the absence of any* VVM cavity.

ii. For the analysis of the site with a VVM, select the lateral boundaries of the substrate that are sufficiently large in relation to a single VVM so that the effect of an inclusion (VVM) does not perturb the seismic motion at the boundary.

iii. Prepare a single VVM model with foundation pad modeled using brick elements as a "plate-like" structure, and with the substrate modeled down to the bedrock. Boundary conditions at the boundary of the modeled substrate should be of a non-reflective nature.

iv. The VVM itself is modeled in accordance with the provisions set forth in the response to RAI 3.7 below (i.e., all rattling masses, divider shell, etc., are explicitly modeled).

v. The dynamic model is implemented on a Code that has been benchmarked to provide accurate response for buried structures with substrate/structure interfaces that may open and close such as LS-DYNA (see response to RAI 3-9). The Code shall contain capabilities to include gaps between the substrate and the structure and non-linear material behavior.

vi. Impose seismic inputs at the bedrock, and obtain the response time-history. Process the outputs to obtain the safety factors in the manner of the response to RAI 3-7 below.

vii. All safety factors must be greater than or equal to 2.0 to justify the use of a single VVM model for an ISFSI that will house multiple VVMs. Reinforce the VVM, as required, and rerun the problem until all factors of safety for components in the load path are greater than or equal to 2.0.

Methodology - B

i. The Cavity Enclosure Container (CEC) is modeled using finite elements to simulate its shell, bottom plate, the Divider shell, and MPC guides in an explicit manner.

ii. The MPC shell, baseplate, and top lid are modeled using appropriate finite elements.

iii. The fuel basket, a multi-flange beam made of intersecting plate elements, is modeled with appropriate finite elements arrayed to simulate inter-plate connectivity (through longitudinal fillet welds) in an explicit manner. The particular basket modeled is the MPC-32.

iv. Each fuel assembly is modeled inside its fuel basket cell cavity with the nominal fuel/cell gap assembly captured in the model.

v. The nominal small gaps between the fuel basket and the MPC are also explicitly modeled, as is the gap between the MPC and the CEC at the upper and lower MPC guide locations.

vi. Each fuel assembly is represented by an equivalent homogenous, isotropic prismatic beam of an equivalent elastic modulus that matches its fundamental natural frequency with that of the actual fuel assembly (approximately 1 Hz).

vii. The VVM closure lid is also modeled to capture its mass distribution and its lateral load transfer function during the seismic event.

viii The other features of the enveloping soil substrate grade and the top concrete pad remain as described in Subsection 3.I.4.7 of the draft FSAR; the subgrade/CEC interface is permitted to open and close (i.e., it is not bonded) to simulate the real life structure in a faithful manner, and the top of foundation is driven by the same specified seismic event.