November 26, 2013

Mr. Scott Head, Manager
Regulatory Affairs
Nuclear Innovation North America, LLC
122 West Way, Suite 405
Lake Jackson, TX 77566

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 439 RELATED TO SPENT FUEL POOL RACK TECHNICAL REPORT (HI-2135462) FOR THE NUCLEAR INNOVATION NORTH AMERICA'S SOUTH TEXAS PROJECT UNITS 3 AND 4 COMBINED LICENSE APPLICATION

Dear Mr. Head

By letter dated September 20, 2007, South Texas Project (STP) submitted for approval a combined license application pursuant to 10 CFR Part 52. The U. S. Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed application.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosure to this letter.

To support the review schedule, you are requested to respond within **30** days of the date of this letter. If changes are needed to the safety analysis report, the staff requests that the RAI response include the proposed wording changes.

If you have any questions or comments concerning this matter, I can be reached at 301-415-5207 or by e-mail at Jessica.Umana@nrc.gov or you may contact Tom Tai at 301-415-8484 or Tom.Tai@nrc.gov.

Sincerely,

**/RA/**

Jessica M. Umana, Project Manager
LB3 Branch
Division of New Reactor Licensing
Office of New Reactors

Docket Nos. 52-012
52-013

eRAI Tracking No. 7294

Enclosure:
Request for Additional Information

cc: Richard Bense
William Mookhoek
John Price
Loree Elton

If you have any questions or comments concerning this matter, I can be reached at 301-415-5207 or by e-mail at Jessica.Umana@nrc.gov or you may contact Tom Tai at 301-415-8484 or Tom.Tai@nrc.gov.

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| NAME | SChakrabarti | JXu | JUmana | MSpencer | TTai |
| DATE | 11/15/2013 | 11/15/2013 | 11/22/2013 | 11/22/2013 | 11/26/2013 |

***Approval captured electronically in the electronic RAI system.**

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**Request for Additional Information 7294**
**Issue Date: 11/25/2013**
**Review Section: 09.01.02 - New and Spent Fuel Storage**
**Application Section: FSAR Section 9.1.2**

## QUESTIONS

09.01.02-33

Holtec Report Section 5.3.1, “Assumptions,” states, “The areas between the racks and the SFP walls are quite large, but are likely to be partially occupied by other equipment. To conservatively bound the presence of equipment in these spaces, a uniform rack-to-wall gap of 6" is modeled to provide a higher flow resistance and result in maximized computed temperatures.” While the report addresses this issue for the thermal hydraulic calculations, the report does not address this for the nonlinear dynamic seismic analysis.

The staff requests the applicant to clearly describe the corresponding assumption about rack-to-wall gaps in the nonlinear dynamic seismic analysis, for consideration of potential location of equipment in the large space between the racks and the pool walls.

Provide the technical basis for concluding that the assumption in the design-basis analysis is conservative. If this is not realistic, identify the design control measures to ensure that any necessary changes to the design-basis analysis are properly implemented to account for any future changes in rack-to-wall gaps.

09.01.02-34

Holtec Report, Section 2.6, “Rack Fabrication,” page 2-12, states, “The rack module manufacturing begins with fabrication of the 'box.' The boxes are fabricated from two precision formed channels by seam welding in a machine equipped with copper chill bars and pneumatic clamps to minimize distortion due to welding heat input. Figure 2.6 shows a typical box with flow holes on all four sides near the base of the box. The target minimum weld seam penetration is 80% of the box metal gauge.”

In order for the staff to conclude that the boxes fabricated as stated above are acceptable, the staff requests that the applicant explain, with quantitative detail, how the acceptance criteria for the weld seams are developed to account for:

a) How is the target minimum weld seam penetration of 80% of the box metal gauge guaranteed?

b) How is the material eccentricity at the weld considered in the local stress calculation?

c) What are the significant loads (e.g., fuel assembly impact) which cause membrane and bending stresses across the weld seam?

Include a sample calculation using the worst case condition from the various analyses performed in order to demonstrate the evaluation procedure for the seam weld.

09.01.02-35

FIGURE 1.1.1 – LAYOUT FOR STP 3 & 4 ABWR FUEL STORAGE RACKS, on page 1-3 of the Holtec Report, provides gaps between adjacent racks to be 5 ¼" (+/-1/4").

The applicant is requested to clearly indicate in the figure the elevation of the rack-to-rack gaps. Confirm that these are the gaps between the bumper bars at the top of the racks.

09.01.02-36

Holtec Report Section 2.1, "Introduction," states, "The overall design of the SFP storage rack modules is similar to those presently in service in the spent fuel pools at numerous other nuclear plants. Holtec has provided thousands of storage cells of this design to various nuclear plants around the world."

Given the considerable amount of normal operating experience around the world, the staff requests the applicant to describe:

(1) if there is any operating experience related to any adverse impact on structural integrity of the racks, and

(2) how the STP fuel rack design addresses such previously observed problems. Discuss whether there is any potential for interaction between stainless steel and Metamic that would degrade the stainless steel rack materials, and if so, how the degraded condition is considered in the design.

09.01.02-37

Holtec Report Section 2.6, "Rack Fabrication," describes the design of the spent fuel racks in the context of the fabrication methodology. Several statements in Section 2.6 require clarification and/or further explanation, in order for the staff to completely understand the rack design, including the welding of the various components to produce the finished rack.

(a) The third paragraph states, "Each box constitutes a storage location, as shown in Figure 2.2. Furthermore, when the boxes are secured together via tie bars (shown in Figures 2.10 and 2.11) into racks, there are also storage locations between the boxes." The staff notes that Figure 2.3 identifies "filler panels" that are required to complete the cells on the periphery of the rack. However, there is no description of the filler panel design and method of joining to the otherwise completed rack. Provide design and fabrication details for the filler panels, comparable to the information provided for the rest of the rack.

(b) The fourth paragraph states, "The baseplate is attached to the box assemblage by fillet welding the perimeter of the box assemblage to the baseplate as shown in Figure 2.9." Figure 2.9 includes the note. "WHERE POSSIBLE ON ALL RACKS". Based on past fabrication of similar racks, show a plan view of the actual fillet weld path around the perimeter of the box assemblage. What weld geometry assumption is used in the calculation of stress in the fillet weld?

(c) The sixth (last) paragraph states, “Appropriate NDE (nondestructive examination) occurs on all welds including visual examination of sheathing welds, box longitudinal seam welds, box assemblage-to-baseplate welds, and tie bar welds, as well as liquid penetrant examination of support leg welds.” The staff interpreted this to mean that all the welds, including the support leg welds, receive visual examination, but only the support leg welds receive liquid penetrant inspection. Please confirm the staff’s interpretation or clarify the NDE program. Also explain why liquid penetrant examination is applied to, and only to, the support leg welds.

09.01.02-38

Holtec Report “CHAPTER 7: MECHANICAL ACCIDENT EVALUATION” describes the evaluation conducted for the accidental drop of a fuel assembly over the top of a spent fuel storage rack. The staff requests the applicant to clarify several aspects of the evaluation, to assist the staff in making its determination of acceptability.

Section 7.1.2.1, “Calculation of Incident Impact Velocity,” identifies the equations used to calculate the impact velocities for the 3 postulated drop scenarios. The staff is not clear how these equations were actually applied in the calculation.

(1) Is the first equation used for the shallow drop case to get the velocity at the top of the rack, and then the second equation used to get the velocity increase from the top of the rack down to the baseplate, for the deep drop scenarios?

(2) What is the technical reference for and the value of “$C_D$” used in the first equation?

(3) Is the function “f” in the second equation derived from testing or theory? Cite the reference. How sensitive is the value of “f” to small changes in the parameters that are identified (x, v, $d_1$, $d_2$, $A_1$, $A_2$)?

09.01.02-39

Holtec Report “CHAPTER 6: STRUCTURAL/SEISMIC EVALUATION” describes the analysis methodology, STP racks modeling, and the seismic analysis results. The staff requests the applicant to clarify several aspects of the evaluation, to assist the staff in making its determination of acceptability.

(a) Section 6.2.1, “Fuel Acceptance Criteria,” states, “It is noted that the spent fuel assemblies are not expected to suffer any damage while stored inside the spent fuel storage racks. This is because the lateral impact loads that occur inside a spent fuel storage rack are much smaller than the impact loads associated with transportation packages certified under 10 CFR 71. For example, the HI-STAR 100 transportation package is qualified for a 9-meter drop accident resulting in a 60g impact load [6.2.2].” Is the transportation package loaded with embrittled spent fuel? What is the 9-meter drop orientation – transportation package vertical or transportation package horizontal? Is support of the fuel inside the transportation package comparable to the support conditions in a spent fuel rack cell?

(b) Section 6.2.2, “Rack Acceptance Criteria,” states, “The worst thermal stress field in a fuel rack is obtained when an isolated storage location has a fuel assembly generating heat at maximum postulated rate and surrounding storage locations contain no fuel. Heated water makes unobstructed contact with the inside of the storage walls, thereby producing maximum possible temperature difference between adjacent cells.”

Section 6.7.3.2, "Analysis of Thermal Effects," states, "A conservative estimate of weld stresses along the length of an isolated hot cell can be obtained by considering a beam strip uniformly heated by 50°F, which is restrained from growth along one long edge. The above thermal gradient is based on the results of the thermal-hydraulic analysis, which show that the difference between the local cell maximum temperature (184°F per Table 5.5.1 in chapter 5 of this report) and the corresponding bulk pool temperature (150.8°F) is less than this value;" and "Using shear beam theory and subjecting the strip to a uniform temperature rise AT = 50°F, one can calculate an estimate of the maximum value of the average shear stress in the strip." In order for the staff to determine the adequacy of the thermal analysis performed by the applicant, the staff requests the applicant to provide the following:

(1) Clarify whether the calculation in Chapter 5 is based on the same assumption (i.e., an isolated storage location has a fuel assembly generating heat at the maximum postulated rate and surrounding storage locations contain no fuel). From the bulk pool temperature, it would appear that this is not the case. Correct the text of the report as necessary, to clearly describe the basis for the 50°F temperature differential used in the calculation.

(2) Provide a figure in the report that clearly shows the simplified beam model used for the thermal stress calculation, including coordinate system, boundary conditions, dimensions and loading.

(3) Explain the origin of the denominator "0.931" in the equation for maximum shear stress shown on page 6-26 of the report.

(c) Section 6.7.9, "Weld Stresses," Paragraph a, "Baseplate-to-Rack Cell Welds," shows a picture of fillet welds on 4 sides of the cell attaching to the baseplate. From the description of the fabrication sequence in Section 2.6, "Rack Fabrication," 4th paragraph, the staff understood that only the perimeter of the assembled rack is fillet-welded to the baseplate. The text states, "The baseplate is attached to the box assemblage by fillet welding the perimeter of the box assemblage to the baseplate as shown in Figure 2.9." Clarify that all 4 sides of every cell are fillet-welded to the baseplate, consistent with the picture shown in Section 6.7.9. Correct the text in the 4th paragraph of Section 2.6 and add a figure that clearly indicates this. Describe the fabrication sequence that accomplishes this. The current description appears to indicate that all cells forming a rack are joined together prior to welding to the baseplate.

(d) Section 6.7.10, "Potential for Cell Wall Buckling," presents a summary of a hand calculation using a classical buckling formula, with K = 3.44. There is no technical basis provided for using this value of K. Add a figure to the report depicting the simplified buckling model, showing the coordinate system, dimensions, boundary conditions, and loading. Provide the technical basis for the conservatism of the simplified model, the assumed boundary conditions, and the selected value of K.

(e) Table 6.6.2, "Maximum Values of Lateral Displacements," presents extremely limited displacement data. To assist the staff in its technical review, expand this table to include the top-of-rack and baseplate maximum displacements for each of the 21 cases analyzed.

09.01.02-40

In section 6.2.3.1.2, “Level D Service Limit,” of HOLTEC Report, HI2135462, the applicant calculated a factor of 1.8, which is the quotient of (Level D shear stress limit of material yield strength) / (Level A shear stress limit of material yield strength) = $0.72S_y$ / $0.4S_y$. However, a factor from the quotient of (Level D shear stress limit of material ultimate strength) / (Level A shear stress limit of material ultimate strength) = $0.42S_u$ / $0.3S_u$ would be 1.4. The staff requests that the applicant provide a discussion assuring that a factor of 1.8 is a conservative to determine the weld allowable stress limit for Service Level D.

09.01.02-41

Holtec Report Section 2.3 lists the applicable codes and standards. Explain why different versions of ASME codes are used, i.e., 1989 and 2007 editions for Section III and 2010 Edition for Section II.

09.01.02-42

Holtec Report Section 6.2.2, "Rack Acceptance Criteria," on Page 6-4, indicates an upward force of 13.35 kN for the stuck fuel assembly load case. However, Section 9.1.2.3.2 of STP 3 & 4 FSAR Revision 9 indicates that the rack is designed to withstand a pullup force of 17.79 kN and a horizontal force of 4.45 kN for the stuck fuel assembly load case. Correct the inconsistency or provide the technical basis for the use of upward force of only 13.35 kN and for ignoring the horizontal load of 4.45 kN.