AP1000DCDFileNPEm Resource

From: Altmayer, Scott A [altmaysa@westinghouse.com]
Sent: Wednesday, July 14, 2010 2:06 PM
To: Buckberg, Perry; Patel, Pravin
Cc: Loza, Paul G.
Subject: Eight Fuel Rack Audit Draft RAIs (with detail date info)
Attachments: RAI-TR54-26 R2B-NRC DRAFT-reformat-date.doc; RAI-SRP9.1.2-SEB1-02 R2B-NRC DRAFT-reformat-date.doc; RAI-TR44-08 R2B NRC final draft-reformat-date.doc; RAI-TR44-09 R2A-NRC DRAFTeng-nustart-reformat-date.doc; RAI-TR44-16 R3B-NRC DRAFT-reformat-date.doc; RAI-TR44-17 R3C NRC final-revised typo-nustart-reformat-date.doc; RAI-TR44-25 R2A-NRC DRAFT-nustart-reformat-date.doc; RAI-TR54-15 R3A-NRC DRAFT-reformat-date.doc

Perry,

Here are the final redraft RAIs with the date details as requested during weekly call:

RAI-912-02

RAI-TR44-008, 009, 016, 017, 025

RAI-TR54-015, 026

(Note: RAI-TR54-01 was submitted yesterday by letter with dates and additional wording from OI-914-03 as discussed at the telecom last week).

The updated RAI-TR44-01 on new fuel drop height control is coming next.

--SCOTT ALTMAYER--
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Hearing Identifier: AP1000_DCD_Review
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Files	**Size**	**Date & Time**
MESSAGE	546	7/14/2010 2:06:37 PM
RAI-TR54-26 R2B-NRC DRAFT-reformat-date.doc	227904	
RAI-SRP9.1.2-SEB1-02 R2B-NRC DRAFT-reformat-date.doc	67136	
RAI-TR44-08 R2B NRC final draft-reformat-date.doc	270400	
RAI-TR44-09 R2A-NRC DRAFTeng-nustart-reformat-date.doc	1996352	
RAI-TR44-16 R3B-NRC DRAFT-reformat-date.doc	61504	
RAI-TR44-17 R3C NRC final-revised typo-nustart-reformat-date.doc	493120	
RAI-TR44-25 R2A-NRC DRAFT-nustart-reformat-date.doc	107072	
RAI-TR54-15 R3A-NRC DRAFT-reformat-date.doc	1823296	

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AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR54-026
Revision: 2B-date

Question:

(Revision 0) What are the gaps and tolerances for each of the gaps between the fuel to cell wall, rack to rack, and rack to wall? What are the assumed initial locations of the various components (fuel assemblies and each rack) and what is the technical basis for this assumption. Were any studies done for different initial conditions (considering tolerances); if not, explain why. What requirements are in the DCD to ensure that the assumed gaps (considering tolerances) will always be maintained throughout the licensing period?

(Revision 1 – noted from Revision 1 response below) *During the August 6-7, 2009 meeting with the NRC a new question was raised about the tool storage area*

New Question: (Revision 2B)

During the June 2010 audit, the NRC requested that dimension and gap information for the spent fuel racks be clarified between the two similar RAIs (RAI-TR54-15, RAI-TR54-026) to show consistency and alignment to the current design basis shown in DCD Figure 9.1-2, 9.1-3, and 9.1-4.

Westinghouse Response:

(Revision 0) **(Superseded by Revision 2B)**

~~All gaps between fuel assemblies and cell walls, between racks, and between racks and pool walls are set to match the nominal gaps provided on the Westinghouse Drawing APP-FS02-V2-002 Revision 0 "Discrete Zone Two Region Spent Fuel Rack Pool Layout. The following table summarizes the gap information used in the dynamic analyses.~~

	~~Fuel-to-Cell Wall~~	~~Rack-to-Rack~~	~~Rack-to-Wall~~
~~Nominal Gap (inch)~~	~~(8.8" 8.1")/2 = 0.35"~~	~~1" or 1.25"~~	~~North – 3.2"~~ ~~East – 2.75"~~ ~~South – 2.7"~~ ~~West – 3.2"~~

~~Fuel is assumed centrally located in cell. This is conservative since minimizing gap on one or two walls will generally produce a larger hydrodynamic coupling effect.~~

~~Numerical studies were done on other Holtec rack projects; the results generally showed a small influence on results. A larger influence occurs if the gaps are assumed to be displacement dependent, rather than always being held constant at their initial value. The neglect of this effect is conservative.~~

~~Once racks are installed, the "as-built" gaps are reconciled with the gaps initially used for analysis by evaluation of the numerical results and the predicted motions. Once the "as-builts" are accepted by evaluation of the current results, the only way the gaps would change over time would be by the action of a seismic event. Combined License applicants will have a procedure in place to address measurement of the post design basis seismic event gaps, and to evaluate the acceptability of the configuration showing it is acceptable, or to take appropriate corrective actions. A statement will be added to both the Technical Report and DCD addressing the design basis seismic event potential change in gaps between the spent fuel racks.~~

Response: (Revision 1) ***(Superseded by Revision 2B)***

~~During the August 6-7, 2009 meeting with the NRC it was identified that spent fuel rack A1 is shown to slide into the area of the spent fuel pool designated as the "Tool Storage Area". To eliminate this from happening, the Tool Storage Area has been resized from 34 inches wide with a 3.2 inch gap from the tool storage area to rack A1, to 33 inches wide with a 4.2 inch gap. This increase in gap size precludes rack A1 from entering the tool storage area as the result of a seismic event.~~

~~The DCD and TR Revision sections below have been updated accordingly to reflect this change.~~

Response: (Revision 2B)

The figures and related discussion included in the previous revisions of this RAI response are out dated and superseded (due to design changes that strengthened the racks) as follows:

- The current versions of DCD Figures 9.1-2 (both sheets) and 9.1-3 (both sheets) were included in the response to RAI-SRP9.1.2-SEB1-06 (Letter DCP_NRC_002690, issued 11/11/09).
- The current version of DCD Figure 9.1-4 is included as part of design change proposal (DCP 1185 dated 12/18/09).

The basis of the latest versions of DCD Figures 9.1-2 (both sheets), 9.1-3 (both sheets), and Figure 9.1-4 were included in APP-GW-GLR-033 (Revision 3, November 2009) and are retained in TR54 (Reference 1).

~~The figures and related discussion included in all of the previous revisions of this RAI response are out dated and are superseded as follows:~~

- ~~The latest versions of DCD Figures 9.1-2 (both sheets), 9.1-3 (both sheets), and 9.1-4 are included in the response to RAI-SRP9.1.2-SEB1-06 (Letter DCP/NRC 2690).~~
- ~~The correct figures are incorporated into the latest revision of TR54 (Reference 1).~~

Additionally, the fuel-to-cell wall gap has been recalculated ~~is corrected~~ as follows:

- Maximum (nominal) fuel-to-cell wall gap: (8.8"-8.404")/2 = 0.198".
- Minimum (nominal) fuel-to-cell wall gap: (8.8"-8.426)/2 = 0.187".

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Reference:

1. APP-GW-GLR-033, Revision 4, May 2010, "Spent Fuel Storage Rack Structural/Seismic Analysis," (Technical Report Number 54, TR54)

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:

DCD Changes: (Revision 0 and 1) ***(Superseded by Revision 2B)***

~~(The Revision 0 response was incorporated into DCD R17.)~~

~~DCD Changes: The markup of DCD Rev. 17 Figure 9.1-4 below shows the modification in the tool storage area size.~~

DCD Changes: (Revision 2B)

None.

PRA Revision:
None.

Technical Report (TR) Revision:

TR Changes: (Revision 0, 1) ***(Superseded by Revision 2B)***

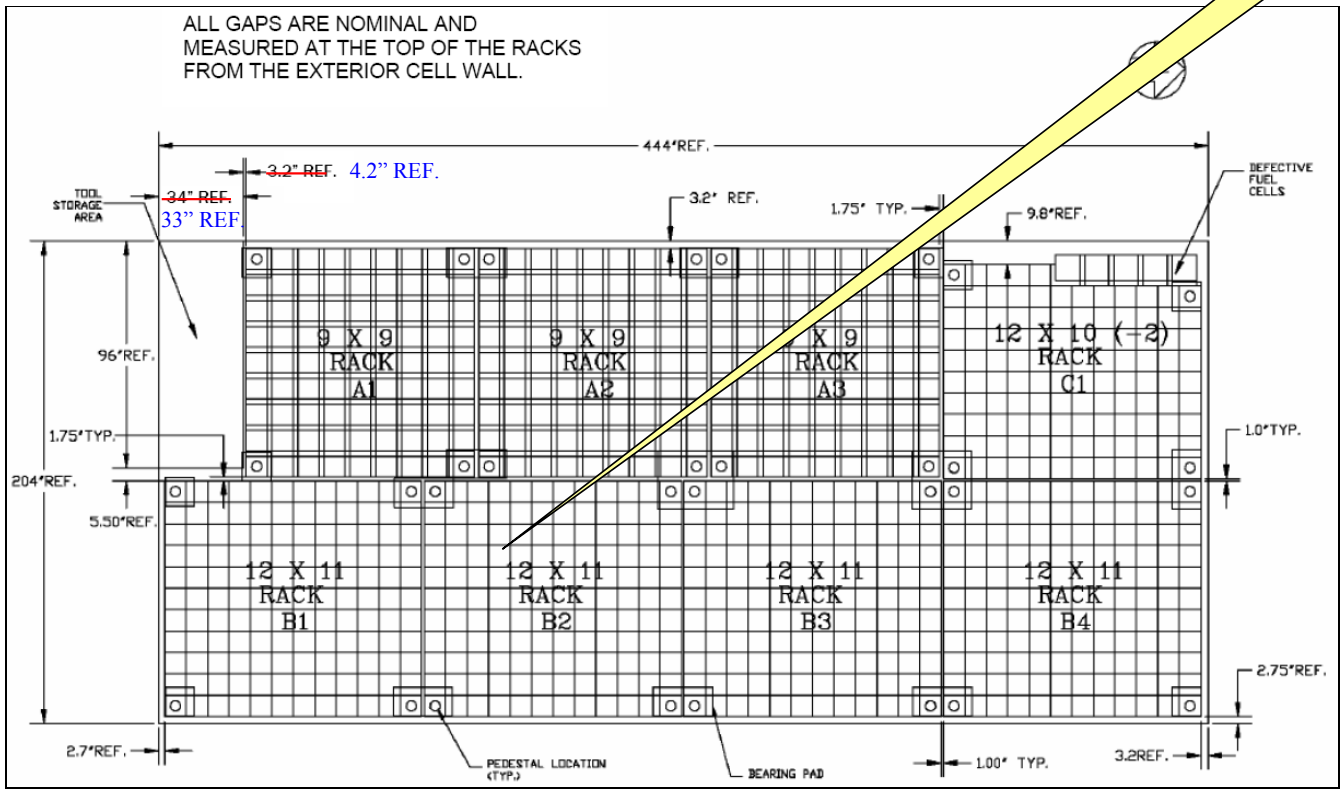
~~(The Revision 0 response was incorporated into APP-GW-GLR-033 R1)~~
~~The markup of TR 54 Rev. 2 and Figure 2-1 below shows the modification in the tool storage area size.~~

TR Changes: (Revision 2B)

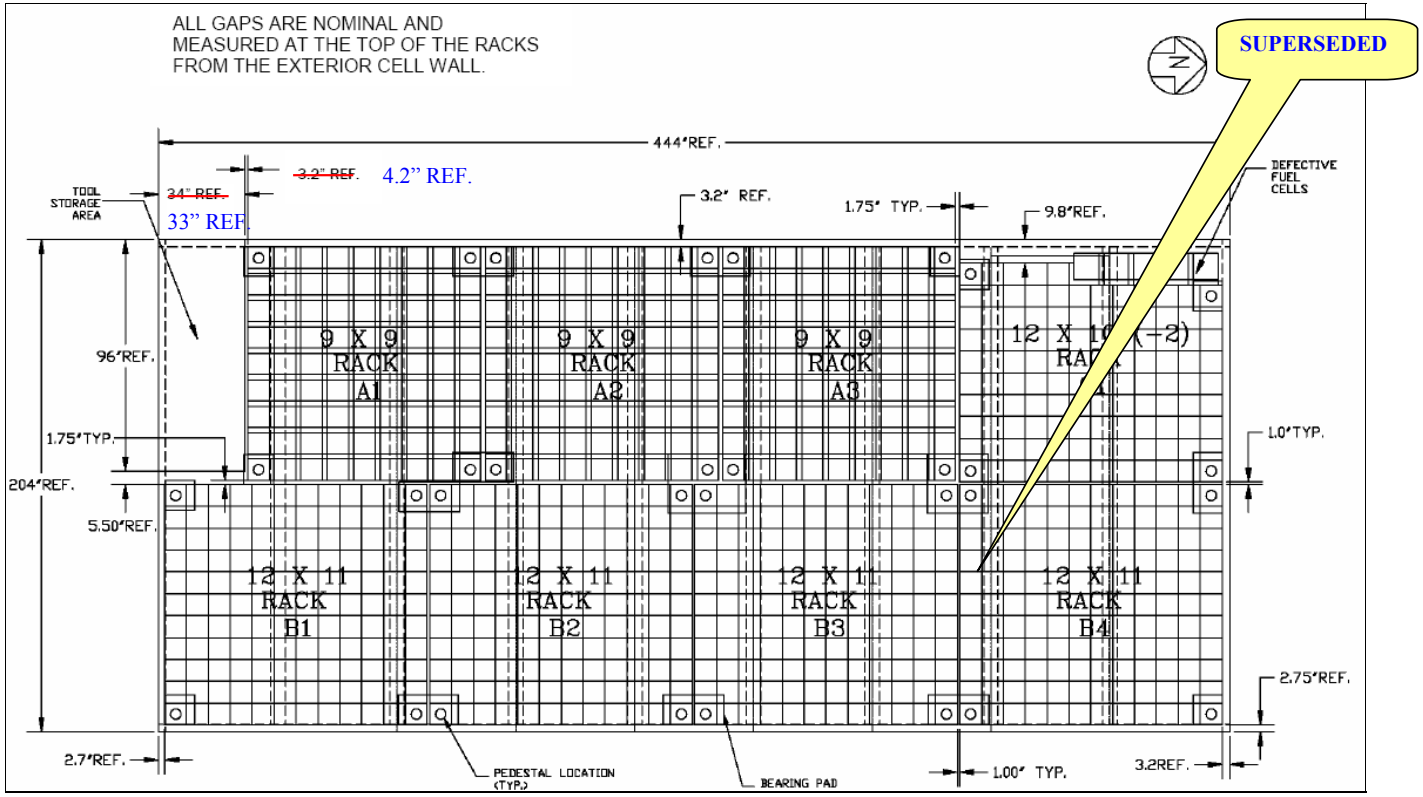
None.

~~Markup of DCD Rev. 17 Figure 9.1-4:~~

SUPERSEDED



~~Markup of TR-54 Rev. 2 Figure 2-1:~~



AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP9.1.2-SEB1-02
Revision: 2B-date~~A~~

Question: ***(Revision 0, 1)***

Section 2.8.1.4 "Impact Loads" was not revised in TR-44 Rev. 1, even though shims between the new fuel rack and the fuel pit wall apparently are no longer used. Shims are still mentioned in Rev. 1. Quoting from Section 2.8.1.4, "The maximum impact load from the set of shims that close the north-south gaps at the top of the rack is summarized in Table 2-8." The staff requests Westinghouse to clarify this, and revise Section 2.8.1.4 accordingly.

The staff also notes that the maximum rack-to-wall impact load in Table 2-8 increased from 112,000# in Rev. 0 to 154,000# in Rev. 1. The staff requests Westinghouse to explain why the impact load increased, and describe how the design of the new fuel rack and the new fuel pit wall were evaluated for the significant increase (35%) in the impact load, in addition to other concurrent loadings. Also identify where this is/will be described in the AP1000 DCD.

New Question: (Revision 2B~~A~~)

Following the Revision 1 response to this RAI and during the June 2010 audit; the NRC sought clarification about the basis (i.e. COF values) and location of wall impacts (if any). They requested that the RAI and TR44 technical reports be reflected to clearly show this information.

Westinghouse Response:

(Revision 0) ***(Superseded by Revision 2B)***

~~The shims have been eliminated from the new fuel rack design and analysis. All mentions of the rack-to-wall shims should be disregarded. TR-44 Rev 1, Section 2.8.1.4 should be read, "The maximum impact load from the pit walls at the top of the rack is summarized in Table 2-8." Also note that page 5 of 46 unintentionally continues to indicate that the shims are still included in the design and analysis, which they are not. The following sentence on page 5 (half way through first paragraph) should be deleted, "The rack to wall (north and south side) impact spring gaps at the top are reduced to zero to reflect the shims that are in place, which absorb the impact load and transmit them to the pool wall."~~

~~There are 2 reasons why the load increased. The first is that the floor response spectra for the new fuel vault floor were revised in TR-44 Rev. 1. The second reason for the change in impact load is the elimination of the shims from the design and analysis. In TR-44 Rev. 0, the new fuel rack was shimmed against the corbels on the North and South walls of the new fuel vault. This configuration produced a maximum impact load of 112,000 lb between the top of the new fuel~~

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~~rack and the corbel at the location of the shims. The new design eliminates the shims at the top of the new fuel rack, as well as the corbels on the North and South walls of the new fuel vault. As a result, the minimum clearance between new fuel rack and the walls of the new fuel vault is almost 6 inches. Per the latest analysis, when the coefficient of friction between the rack pedestals and the floor is assumed to be 0.2 (which is an extreme lower bound value for a clean and dry steel on steel interface), the rack slides along the floor and impacts the North and South walls at the rack baseplate elevation with a maximum impact force of 154,600 lbf. The cell region of the new fuel rack does not impact the vault walls under any of the analyzed conditions.~~

~~Although the seismic analysis of the new fuel rack considers three different coefficients of friction (0.2, 0.5, and 0.8 - the same conditions considered under wet conditions in the analysis of the spent fuel racks) between the support pedestals and the floor liner, the reality is that the coefficient of friction will be greater than 0.5 since the new fuel pit, unlike the spent fuel pool, is not flooded with water. Per Marks' Standard Handbook for Mechanical Engineers (Tenth Edition), the static coefficient of friction for steel on steel (dry) is between 0.74 and 0.78. Therefore, since the seismic analysis shows no rack-to-wall impacts when the coefficient of friction is equal to or greater than 0.5, the new fuel pit walls are not analyzed for any rack-to-wall impacts.~~

~~The new fuel rack base plate, which is machined from a ¾" thick stainless steel plate (SA240-304), is intentionally designed to resist high impact loads in the in-plane direction. For example, assuming that the impact spreads over a 10" horizontal baseplate width, the impacted area of the baseplate is 10" x ¾" = 7.5 sq. in. Using the Level A bearing stress limit of 0.9 Sy per ASME Subsection NF, the impact capacity of the baseplate is 7.5 sq. in x (0.9 x 25,000 psi) = 168,750 lbf. The baseplate of the rack is conservatively designed considering the statements above which indicate that in reality the new fuel rack will not impact the new fuel pit walls.~~

Westinghouse Response (Revision 1) ***(Superseded by Revision 2B)***

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~~Westinghouse is revising this response to include justification in TR-44 to explain why the 0.2 coefficient of friction case is not credible. The 0.2 COF results are being retained in the report for information and continuity; however, only the results of the 0.5 and 0.8 COF runs should be considered to be plausible. See the "Revision 1 Update" section of the Technical Report Revision section for details.~~

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New Response: (Revision 2B~~A~~)

This response is provided to update information to be consistent with the current design and analysis. It supersedes RAI Revision 0 and 1 responses and TR changes with clarifications overviewed below.

Westinghouse has reevaluated the range of appropriate friction values. To ensure that the interface between the New Fuel Storage Rack and the New Fuel Pit floor is accurately and conservatively represented; Westinghouse has concluded that that the appropriate credible lower-bound COF is presented in Run Number 5 (case for COF=0.24). This will eliminate confusion regarding what is included in the design basis. Details are included in Reference 2.

Additionally, ~~for clarity, the~~ Run Number 1 evaluation (case for COF = 0.2) has been demonstrated to be non-credible as noted above. It will be maintained in the supporting calculations; but for clarity ~~will be~~ will be eliminated from the tables in the next revision of APP-GW-GLR-026~~TR44~~. ~~(but maintained in supporting calculations) because this case has been demonstrated to not be credible.~~

Reference(s):

1) Marks' Standard Handbook for Mechanical Engineers, 10th Edition, Theodore Baumeister, 1996.
2) APP-GW-GLR-026, Revision 3, May 2010, "New Fuel Storage Rack Structural/Seismic Analysis," (Technical Report Number 44, TR44).

Design Control Document (DCD) Revision:
None

PRA Revision:
None

Technical Report (TR) Revision~~:~~:

TR Changes: (Revision 0) ***(Superseded by Revision 2B)***

~~The following changes should be made to TR-44; however, these changes do not necessitate a subsequent submittal of TR-44 to the NRC for review.~~

~~Section 2.8.1.4 is revised to read:~~

~~"The maximum impact load from the set of shims that close the north-south gaps at the top of the rack is summarized in Table 2-8."~~

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~~The following sentence on page 5 of 46 (half way through first paragraph) should be deleted, "The rack-to-wall (north and south side) impact spring gaps at the top are reduced to zero to reflect the shims that are in place, which absorb the impact load and transmit them to the pool wall."~~

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TR Changes: ~~Revision~~ (Revision 1) ~~(formerly "…Revision 1 Update…")~~ ***(Superseded by Revision 2B)***

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~~The "Interface Coefficient of Friction" section under Section 2.2.2.1 of Rev. 1 of TR-44 is modified as follows:~~

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~~Coefficient of friction (COF) values are assigned at each interface, which reflect the realities of stainless steel-to-stainless steel contact. The mean value of coefficient of friction considered throughout the analysis is 0.5, and the limiting values are based on experimental data related to spent fuel racks, which are bounded by the values 0.2 and 0.8 (Reference 20).~~

~~Although the seismic analysis of the new fuel rack has been completed considering the COF cases of 0.2, 0.5, and 0.8, the results of the 0.2 COF case are not considered credible and are included for information only. The coefficient of friction will be 0.5 or greater since the new fuel pit, unlike the spent fuel pool, is not flooded with water. Per Reference 28 the static coefficient of friction for dry steel on steel is between 0.74 and 0.78; therefore only the results from the 0.5 and 0.8 runs are considered plausible.~~

~~Reference 28 is added to the end of Section 4 of Rev. 1 of TR-44 as follows:~~

~~28. Marks' Standard Handbook for Mechanical Engineers, 10th Edition, Theodore Baumeister, 1996.~~

TR Changes: ~~TR Revision~~ (Revision 2B~~A~~)

The next revision of TR44 will be updated to ~~modified for~~ clarify ~~ication to show~~ what run numbers apply to the design basis and the details about credible ~~decisions about~~ lower-bound coefficient of friction effects. The report will eliminate the non-credible case for Run Number 1 (~~case for~~ coefficient of friction COF=0.2). ~~from the report.~~

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR44-008
Revision: 2B-date

***Question:* (Revision 0)**

As indicated in Table 2-3 of the report and the markup for DCD Table 9.1-1, one of the fuel handling accident loads that need to be considered is uplift force on the rack caused by a postulated stuck fuel assembly. Section 2.8.3 of the report states: "An evaluation of a stuck fuel assembly, leading to an upward load of 2,000 lb has been performed. The results from the evaluation show that this is not a bounding condition because the local stresses do not exceed 2,500 psi." The information provided is not sufficient for the staff to reach a conclusion that this load has been adequately considered. Please provide a detailed description of the assumptions, the analyses conducted, the results obtained, and the basis for the conclusion that this is not a bounding condition.

Staff Assessment (Revision 1): Response similar to response for spent fuel racks. See RAI-TR54-14.

Following the submittal of the Westinghouse Revision 1 response to RAI-TR54-14, the NRC staff requested additional information:

The following information is needed to ensure that the calculation in Westinghouse's response is adequate:

(1) Explain how the effective b_e and t_e are determined.

(2) Provide a calculation on the adequacy of the vertical welds along the height between adjoining cells and the horizontal welds at the base (cell walls to baseplate). If the stress levels are higher than those currently presented in the response, then revise the Technical Report accordingly.

(3) The two sentence description of the stuck fuel assembly is presented in Section 2.8.3- "Dead Load Evaluation" of the Technical Report. A more detailed description comparable to the information given in the RAI response should be included in a more appropriate section of the Technical Report since this loading is a fuel handling accident condition not a dead load evaluation.

(4) Explain why the Technical Report and the response describes the uplift force equal to 2,000 pounds is used, while DCD Section 9.1.2.2.1 indicates that an uplift force of 5,000 pounds is used in the analysis.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Additional Question: (Revision 2B)

Clarify why the proposed DCD change quoted below from RAI Revision 1 was never implemented:

"Item Q, 'New Fuel Handling Crane', of Section 9.1.4.2.4, 'Component Description', is revised as follows:

> *'The new fuel handling crane is located in the fuel handling area. It is a standard commercial crane with an "L" shaped frame and an electric operated hoist. It is used to move the new fuel from the new fuel storage position to the new fuel elevator. The crane is positioned so that it cannot reach the spent fuel storage positions. The crane capacity is limited to a 4000 pound load.' "*

Westinghouse Response:

Westinghouse Response: (Revision 0) ***(Superseded by Revision 2B)***

~~A nearly empty rack with one corner cell occupied is subject to an upward load of 2000 lbf, which is assumed to be caused by the fuel sticking while being removed. The ramification of the loading is two-fold:~~

> ~~1) The upward load creates a force and a moment at the base of the rack;~~
>
> ~~2) The loading induces a local tension in the cell wall.~~

~~The following calculation determines the maximum stress in the rack cell structure due to a postulated stuck fuel assembly. The terms p, Nx, Ny, Ixx2, and Iyy2 are defined as the cell pitch, the number of storage cells in the horizontal x-direction, the number of storage cells in the horizontal y-direction, the moment of inertia of the rack cell structure about the x-axis, and the moment of inertia of the rack cell structure about the y-axis, respectively.~~

SUPERSEDED

Calculation of the Effect of a Stuck Fuel Assembly

$P_{stuck} := 2000 \cdot lbf$ Per Westinghouse design input

Compute maximum stress at base of rack cell structure assuming rack behaves as a cantilever beam

$X := N_x \cdot \frac{p}{2}$ $X = 4.087\ ft$ $I_{xx2} = 6.653 \times 10^4\ in^4$

$Y := N_y \cdot \frac{p}{2}$ $Y = 3.633\ ft$

$\sigma_{grid} := P_{stuck} \cdot \frac{X^2}{I_{xx2}} + P_{stuck} \cdot \frac{Y^2}{I_{yy2}}$ $\sigma_{grid} = 118.032\ psi$

It is clear that the global stress due to a stuck fuel assembly is insignificant. Now, check local stress in cell in tension. Conservatively using the effective width

$A_{celllocal} := 4 \cdot b_e \cdot t_e$ $A_{celllocal} = 0.991\ in^2$

$\sigma_{local} := \frac{P_{stuck}}{A_{celllocal}}$ $\sigma_{local} = 2.018 \times 10^3\ psi$

~~This local stress is well below the yield stress of the cell wall material (i.e., 30,000 psi per Table 2-5.)~~

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Westinghouse Supplemental Response from May 21 and 22, 2008 Technical Review: (Revision 1) ***(Superseded by Revision 2B)***

~~Item 1: During the October 8-12, 2007 audit, Westinghouse showed the NRC staff Appendix D (pg. D-13) of the equivalent structural/seismic calculation for the spent fuel racks, APP-FS02-S3C-002, Rev. 0, where the calculation of b_e and t_e was performed. The equations for the calculation of the effective width were taken from the ASME Code, Section III, Subsection NF, NF-3222.2, and the methodology used in the new fuel rack structural/seismic analysis is the same.~~

~~The effective thickness for a spent fuel rack cell uses one-half the actual thickness because each cell wall is shared by the adjacent two cells. During the May 21 and 22, 2008 technical review the NRC staff reviewed Revision 1 of APP-FS02-S3C-002, and determined that the calculation for the effective width is based on the provisions in the ASME Code, Section III, Subsection NF, and the effective wall thickness corresponds to one-half of the true wall thickness. Therefore, item 1 of RAI-TR54-14 for the spent fuel racks was found to be technically acceptable by the NRC staff.~~

~~The same approach was used in the new fuel rack structural/seismic analysis, APP-FS01-S3C-001, Revision 1; therefore, Westinghouse considers this item to be technically acceptable for the new fuel rack as well.~~

~~Item 2: The following calculations demonstrate the adequacy of the vertical welds along the height between adjoining cells and the horizontal welds at the base (cell walls to baseplate) to resist the stuck fuel assembly load.~~

SUPERSEDED

Cell to cell welds

Each storage cell in the new fuel rack is welded vertically along its height to the adjoining cells by a combination of 3" and 6" long intermittent fillet welds. The minimum length of weld over the height of a storage cell, along one corner of the cell, is 6". Therefore, for conservatism, the entire stuck fuel assembly load is assumed to be resisted by only two 3" long fillet welds at the very top of the rack. Based on this approach, the stress in the cell to cell welds is calculated as follows:

Stuck fuel assembly load $P_{stuck} := 4000 \cdot lbf$

Length of intermittent fillet weld $L_{weld} := 3 \cdot in$

Size of intermittent fillet weld $t_{weld} := \frac{1}{16} \cdot in$

Number of fillet welds that resist load $N := 2$

Effective throat area of fillet welds $A_{weld} := N \cdot L_{weld} \cdot \frac{t_{weld}}{\sqrt{2}}$

$A_{weld} = 0.265\ in^2$

Shear stress in fillet welds $\tau := \frac{P_{stuck}}{A_{weld}}$

$\tau = 15085\ psi$

Per Section 2.3.4.1 of TR-44, the allowable weld stress under normal conditions is 0.3 times the material ultimate strength. From Table 2-5 of TR-44, the ultimate strength of SA240-304 material at 100F is 75,000 psi. Therefore, the allowable weld stress under normal conditions is 0.3 x 75,000 psi = 22,500 psi, which is greater than the weld stress calculated above.

SUPERSEDED

Cell to baseplate welds

Each storage cell in the new fuel rack is welded to the base plate by four 7" (min.) long fillet welds. Since the total length of weld associated with cell to baseplate connection (28") is greater than the length considered in the above cell to cell weld evaluation (6"), and the weld size is the same (1/16"), the stress in the cell to baseplate welds is bounded by the preceding stress calculation for the cell to cell welds.

~~Item 3: The description of the stuck fuel assembly evaluation will be deleted from Section 2.8.3 of the Technical Report and will be replaced by a more detailed description in the newly added Section 2.8.6 (Stuck Fuel Assembly Evaluation). See the Technical Report Revision section below.~~

~~Item 4: This item is not directly applicable to the new fuel racks as it is currently worded; however, in the TR an uplift force of 2,000 pounds was stated, but in Section 9.1.1.2.1 of the DCD it is stated that an uplift force of 2,027 will be evaluated. The uplift force was reevaluated in Revision 1 of the new fuel rack structural/seismic analysis, APP-FS01-S3C-001, for 4,000 pound because the hoist on the fuel handling machine is rated at 4,000 pounds. The resultant stress on the rack is within the allowable; the max stress is 4,046 psi (see below calculation) compared to an allowable stress of 30,000 psi. The consideration of a 4,000 lbf uplift force will be reflected revised in TR44 and the DCD; see the Technical Report and DCD Revision sections below.~~

SUPERSEDED

Calculation of the Effect of a Stuck Fuel Assembly

$P_{stuck} := 4000 \cdot lbf$ Per Westinghouse design input

Compute maximum stress at base of rack cell structure assuming rack behaves as a cantilever beam

$X := N_x \cdot \frac{p}{2}$ $X = 4.087\ ft$ $I_{xx2} = 6.644 \times 10^4\ in^4$

$Y := N_y \cdot \frac{p}{2}$ $Y = 3.633\ ft$ $I_{yy2} = 8.306 \times 10^4\ in^4$

$\sigma_{grid} := P_{stuck} \cdot \frac{X^2}{I_{xx2}} + P_{stuck} \cdot \frac{Y^2}{I_{yy2}}$ $\sigma_{grid} = 236.391\ psi$

It is clear that the global stress due to a stuck fuel assembly is insignificant. Now, check local stress in cell in tension. Conservatively using the effective width

$A_{celllocal} := 4 \cdot b_e \cdot t_e$ $A_{celllocal} = 0.989\ in^2$

$\sigma_{local} := \frac{P_{stuck}}{A_{celllocal}}$ $\sigma_{local} = 4045.588\ psi$

~~This local stress is well below the yield stress of the cell wall material (i.e., 30,000 psi per Table 2-5 of TR44.)~~

New Response: (Revision 2B)

The piece of equipment ~~above~~ called the New Fuel Handling Crane has been superseded by design and operations changes, limitations, and commensurate DCD changes as discussed in OI-SRP9.1.1-SBPA-03 R3. As noted in revisions to DCD Rev. 17 Section 9.1.4.2.4 Item B, the Fuel Handling Machine now performs fuel handling operations in the new and spent fuel handling area. The FHM is equipped with two 2-ton hoists, one of which is single failure proof.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

The technical questions, DCD changes, and TR changes raised in previous revisions of this RAI remain bounded and answered in the current version of the structural analyses (Reference 2), applicable technical report (APP-GW-GLR-026 R3 (TR44)), and DCD Rev. 17.

For example, stresses from the maximum uplift force of 4,000 lbs are confirmed to be acceptable.

The DCD Rev. 17 Section 9.1.1.2.1.B on fuel handling clarifies that an analysis is performed to demonstrate that the rack can withstand a maximum uplift load of 4000 pounds. This load is applied to a postulated stuck fuel assembly. Resultant rack stresses are evaluated against the stress limits and are demonstrated to be acceptable. It is demonstrated that there is no change in rack geometry of a magnitude which causes the criticality criterion to be violated.

The DCD Rev. 17 Section 9.1.1.3, "Safety Evaluation", discusses that the rack is also designed with adequate energy absorption capabilities to withstand the impact of a dropped fuel assembly from the maximum lift height of the new fuel handling crane. Handling equipment (cask handling crane) capable of carrying loads heavier than fuel components is prevented from traveling over the fuel storage area. The fuel storage rack can withstand an uplift force of 4000 pounds.

References:

1. APP-GW-GLR-026, Revision 3, May 2010, "New Fuel Storage Rack Structural/Seismic Analysis," (Technical Report Number 44, TR44)
~~1.~~2. ~~APP-FS02-S3C-002, Revision 13, May 2010,May 2008, "Spent Fuel Storage Rack Structural/Seismic Analysis"~~ ***(Superseded by Revision 2B)***
~~2.~~3. APP-FS01-S3C-001, Revision 3, May 2010, "New Fuel Storage Rack Structural/Seismic Analysis"

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Design Control Document (DCD) Revision:

DCD Changes: (Revision 0)
None.

DCD Changes: (Revision 1) ***(Superseded by Revision 2B)***
~~Item B, "New Fuel Handling Crane Uplift Analysis", of Section 9.1.1.2.1, "New Fuel Rack Design", is revised as follows:~~

~~An analysis is performed to demonstrate that the rack can withstand a maximum uplift load of 4000 pounds. This load is applied to a postulated stuck fuel assembly. Resultant rack stresses are evaluated against the stress limits and are demonstrated to be acceptable. It is demonstrated that there is no change in rack geometry of a magnitude which causes the criticality criterion to be violated.~~

~~Section 9.1.1.3, "Safety Evaluation", is revised as follows:~~

~~The rack is also designed with adequate energy absorption capabilities to withstand the impact of a dropped fuel assembly from the maximum lift height of the new fuel handling crane. Handling equipment (cask handling crane) capable of carrying loads heavier than fuel components is prevented from traveling over the fuel storage area. The fuel storage rack can withstand an uplift force greater than or equal to the uplift capability of the new fuel handling crane (4000 pounds).~~

~~Item Q, "New Fuel Handling Crane", of Section 9.1.4.2.4, "Component Description", is revised as follows:~~

~~The new fuel handling crane is located in the fuel handling area. It is a standard commercial crane with an "L" shaped frame and an electric operated hoist. It is used to move the new fuel from the new fuel storage position to the new fuel elevator. The crane is positioned so that it cannot reach the spent fuel storage positions. The crane capacity is limited to a 4000 pound load.~~

DCD Changes: (Revision 2B)
None.

PRA Revision:
None

Technical Report (TR) Revision:

TR Changes: (Revision 0)
None.

TR Changes: (Revision 1) ***(Superseded by Revision 2B)***
~~The two sentence description of the stuck fuel assembly evaluation in Section 2.8.3 of the Technical Report was replaced by the following newly added section:~~

~~2.8.6 Stuck Fuel Assembly Evaluation~~

~~A nearly empty rack with one corner cell occupied is subject to an upward load of 4,000 lbf, which is assumed to be caused by the fuel sticking while being removed. The ramification of the loading is two-fold:~~

~~1. The upward load creates a force and a moment at the base of the rack;~~
~~2. The loading induces a local tension in the cell wall and shear stresses in the adjacent welds.~~

~~Strength of materials calculations have been performed to determine the maximum stress in the rack cell structure due to a postulated stuck fuel assembly. The results are summarized in Table 2-16.~~

~~Table 2-16 was added to the Technical Report:~~

~~Table 2-16 Results from Stuck Fuel Assembly Evaluation~~			
~~Item~~	~~Calculated Stress (psi)~~	~~Allowable Stress (psi)~~	~~Safety Factor~~
~~Tensile Stress in Cell Wall~~	~~4,046~~	~~30,000~~	~~7.41~~
~~Shear Stress in Cell-to-Cell Weld~~	~~15,085~~	~~22,500~~	~~1.49~~

TR Changes: (Revision 2B)
None.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR44-009
Revision: 2A-date

Question: ***(Revision 0)***

Insufficient descriptive information has been included in the new fuel report to permit an adequate review of the structural/seismic analysis of the new fuel rack. Please provide descriptive information including plans and sections showing the new fuel rack and vault walls. All of the major features of the rack including the cell walls, baseplate, pedestals, bearing pads, neutron absorber sheathing, any impact bars, welds connecting these parts, and any other elements in the load path of the rack should be shown on one or several sketches. These sketches should also indicate related information which includes key: cutouts, dimensions, material thicknesses, and gaps (fuel to cell, rack to walls). In addition to the above, for review of postulated fuel handling drop accident and quantification of the drop parameters, sketches with sufficient details for the fuel handling system should be provided.

(Revision 1) **Staff Assessment**: Response similar to response for spent fuel racks. See RAI - TR54-15.

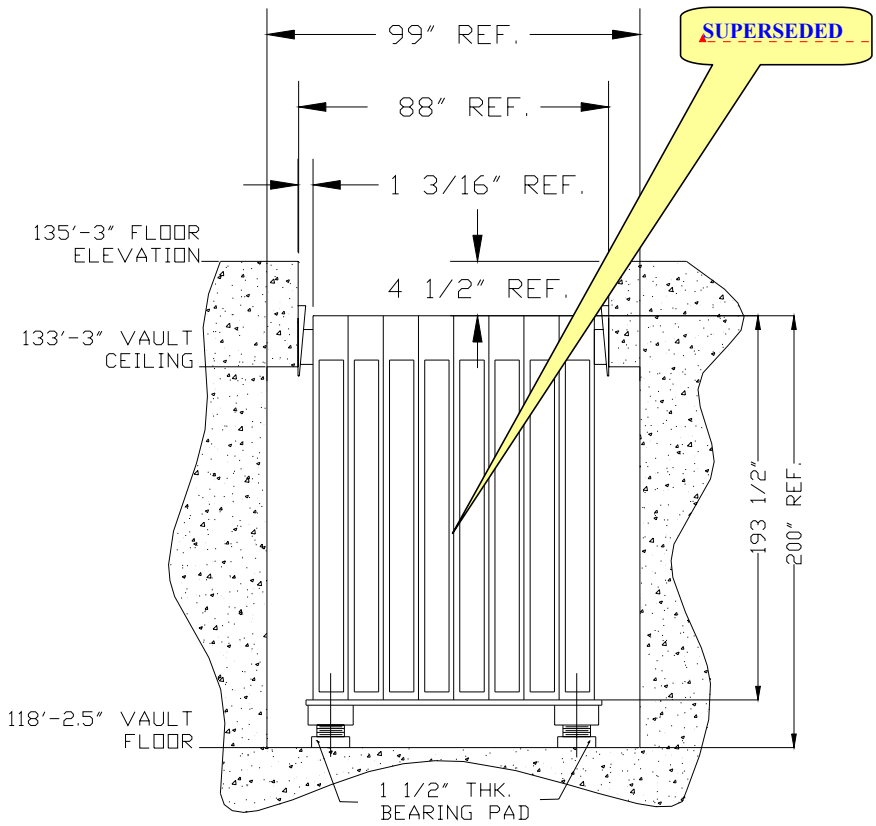
New Question: (Revision 2A)

During the June 2010 audit, the NRC requested that dimension and gap information for the new fuel racks be clarified between the three similar RAIs (RAI-TR44-09, RAI-TR44-017, RAI-TR44-25) to show consistency and alignment to the current design basis shown in DCD Figure 9.1-1.

Westinghouse Response:

(Revision 0) ***(Superseded by Revision 2A)***

~~Figures TR44-9.1 through TR-44-9.5 provide additional descriptive information on the new fuel rack and New Fuel Storage Pit floor and walls. The new fuel handling system is still in final design and no sketches are available. The quantification of the drop parameters has been established and analyzed in Technical Report Number 44. A conservative drop height of 36 inches has been assumed even though the most likely drop height will not exceed 18 inch above the new fuel rack. The total drop weight is 2,027 pounds, which consist of a new fuel assembly, control assembly and new fuel handling tool.~~



ELEVATION VIEW OF NEW FUEL STORAGE RACK
(EAST WALL VIEW LOOKING WEST)

FIGURE TR44-9.1

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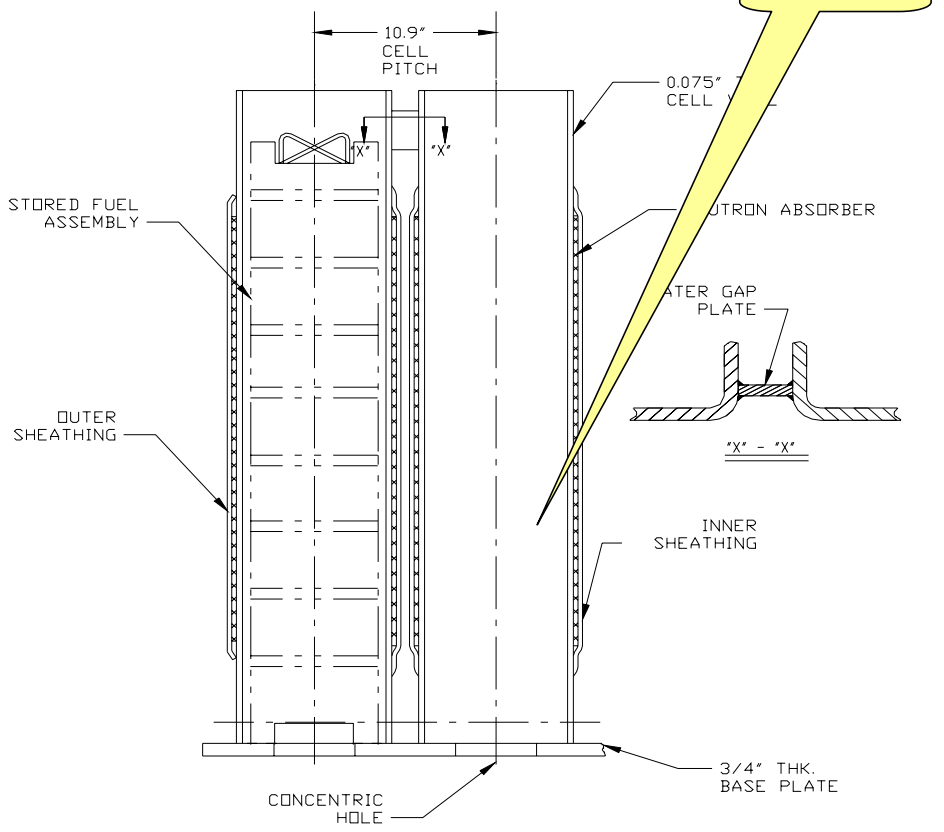

FIGURE TR44-9.2; ELEVATION VIEW OF NEW STORAGE RACK CELLS

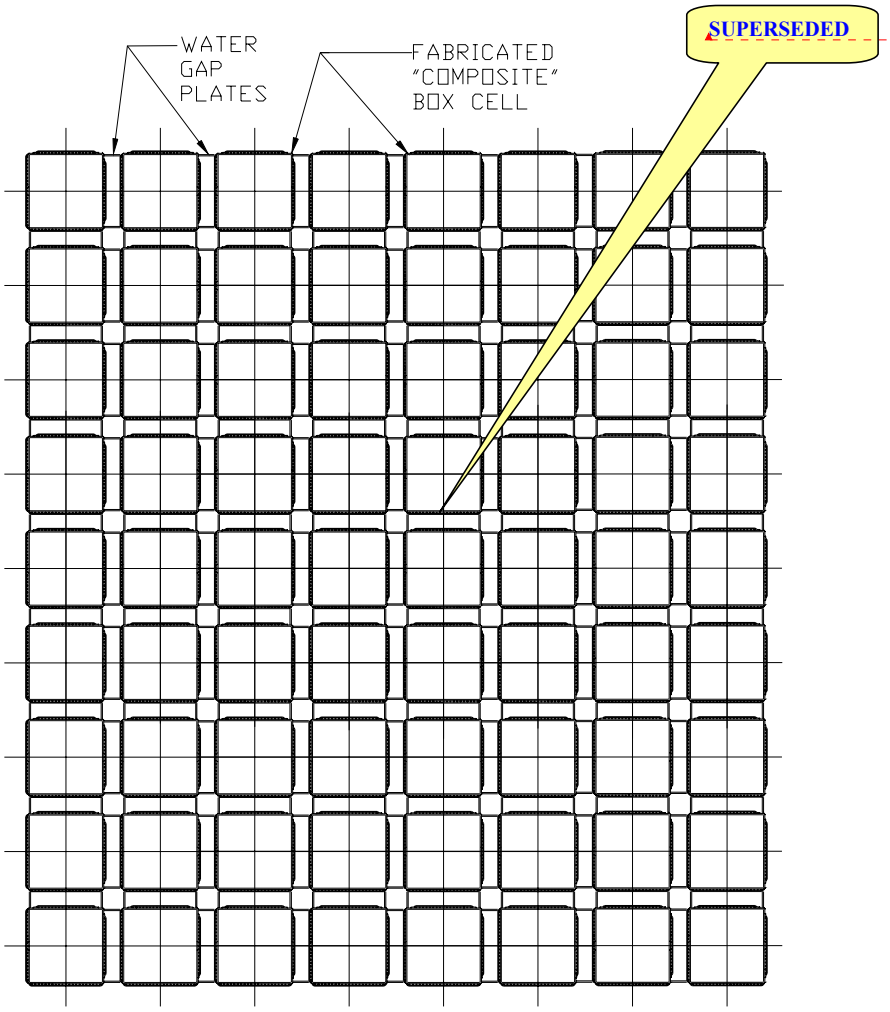

FIGURE TR44-9.3; STORAGE CELL ARRAY
FOR NEW FUEL STORAGE RACK

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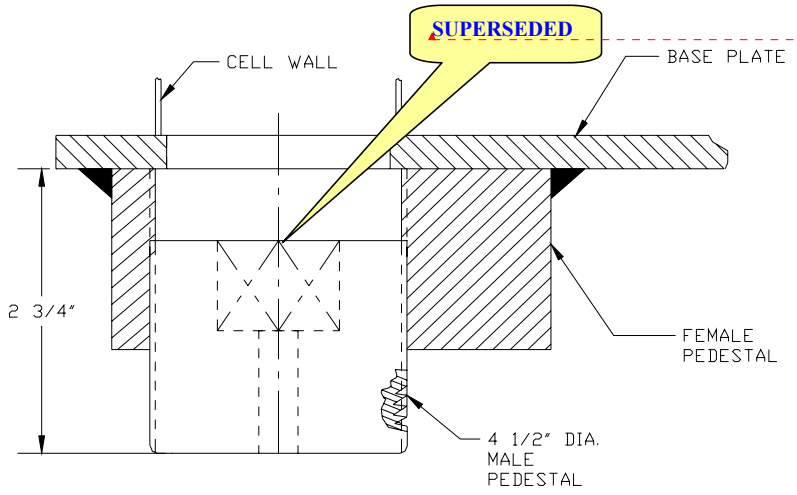

FIGURE TR44-9.4; CROSS SECTION OF ADJUSTABLE SUPPORT

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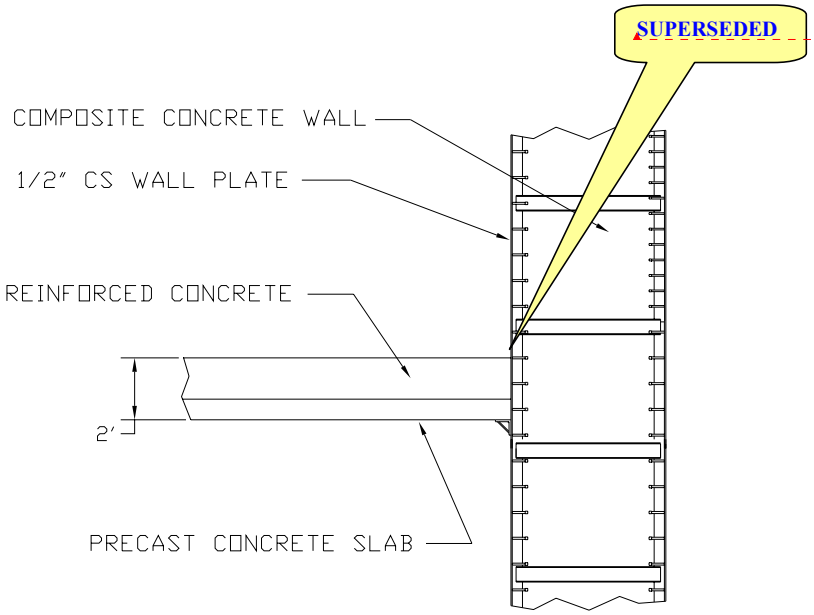

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~~Figure TR44-9.5 New Fuel Pit Floor and Wall Detail~~

Westinghouse Response (Revision 1): ***(Superseded by Revision 2A)***

~~**Westinghouse Supplemental Response following May 21 and 22, 2008 Technical Review:**~~

~~The two figures shown in the DCD and TR markup sections provide updates of the layout and cross section of the new fuel storage rack. The figures replaced Figure 2-1 of TR44 and DCD Figure 9.1-1, Sheets 1 and 2; see the DCD and TR markup sections for details.~~

New Response: (Revision 2A)

This response is provided to update information to be consistent with the current design and analysis. It supersedes RAI Revision 0 and Revision 1 responses, DCD changes, and TR changes with clarifications overviewed below.

~~The figures (and related discussion) included in the previous revisions of this RAI response are out dated and are superseded as follows:~~
The most recent change to DCD Figure 9.1-1 (Sheet 1 of 2) is included in the response to RAI-TR44-17 Revision 3C.

- ~~The latest version of DCD Figure 9.1-1 Sheet 1 is included in the response to RAI-TR44-17, Revision 3C.~~
- ~~The correct TR44 figures and sheets are incorporated into the latest revision of TR44 (Reference 1).~~

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The DCD Figure 9.1-1 (Sheet 2 of 2) is not modified by any revision of comments in this RAI response. This figure and page were included into DCD Revision 17 (Letter DCP/NRC 2202) and remain applicable to the new fuel rack design.

Reference:

1. APP-GW-GLR-026, Revision 3, May 2010, "New Fuel Storage Rack Structural/Seismic Analysis," (Technical Report Number 44, TR44)

Design Control Document (DCD) Revision:

DCD Changes: (Revision 0 and Revision 1) ***(Superseded by Revision 2A)***

~~Revise Figure 9.1-1, Sheets 1 and 2, as follows:~~

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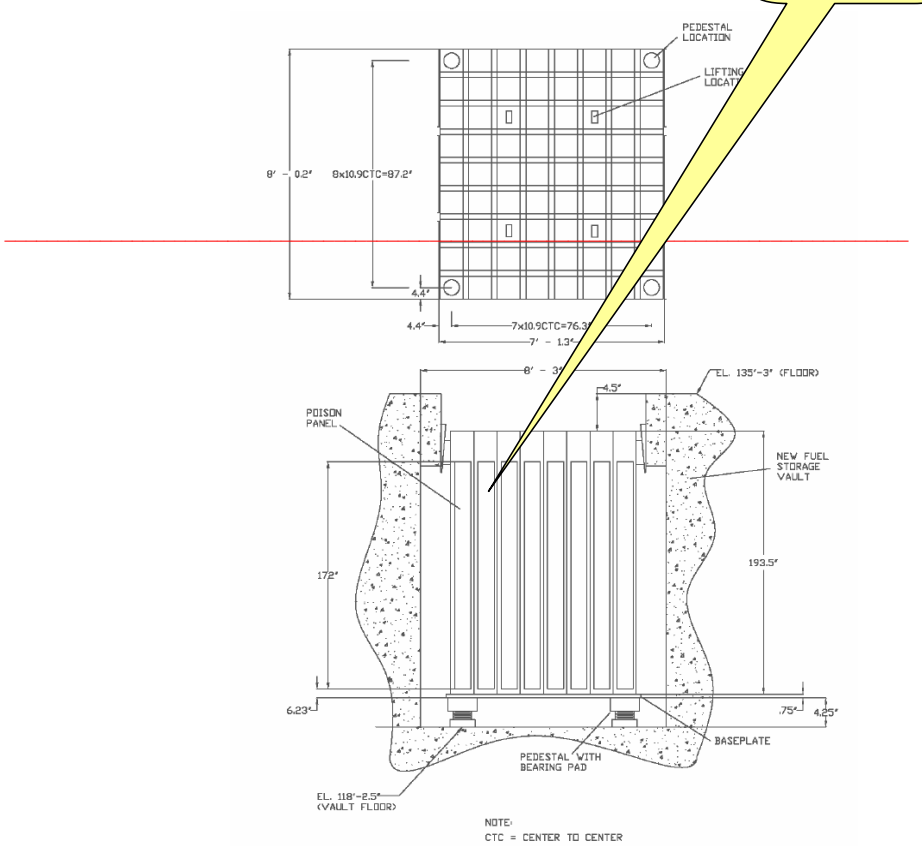

~~Figure 9.1-1 (Sheet 1 of 2)~~
~~**New Fuel Storage Rack Layout (72 Storage Location)**~~

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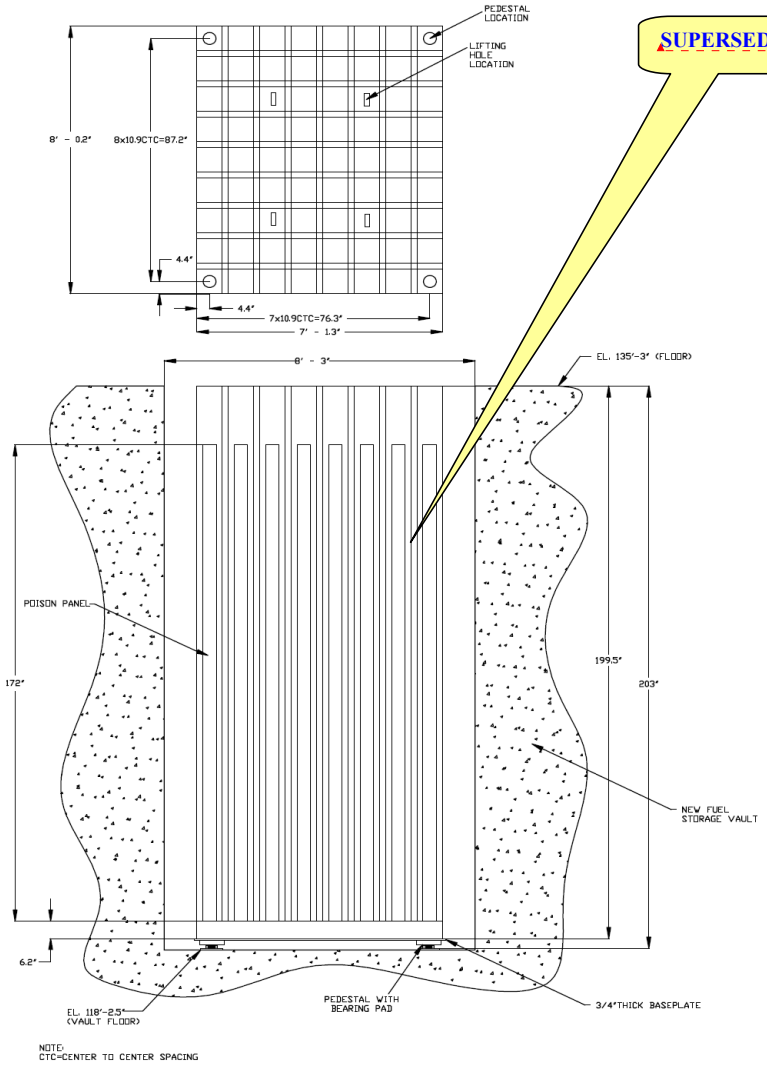

~~Figure 9.1-1 (Sheet 1 of 2)~~
~~**New Fuel Storage Rack Layout (72 Storage Location)**~~

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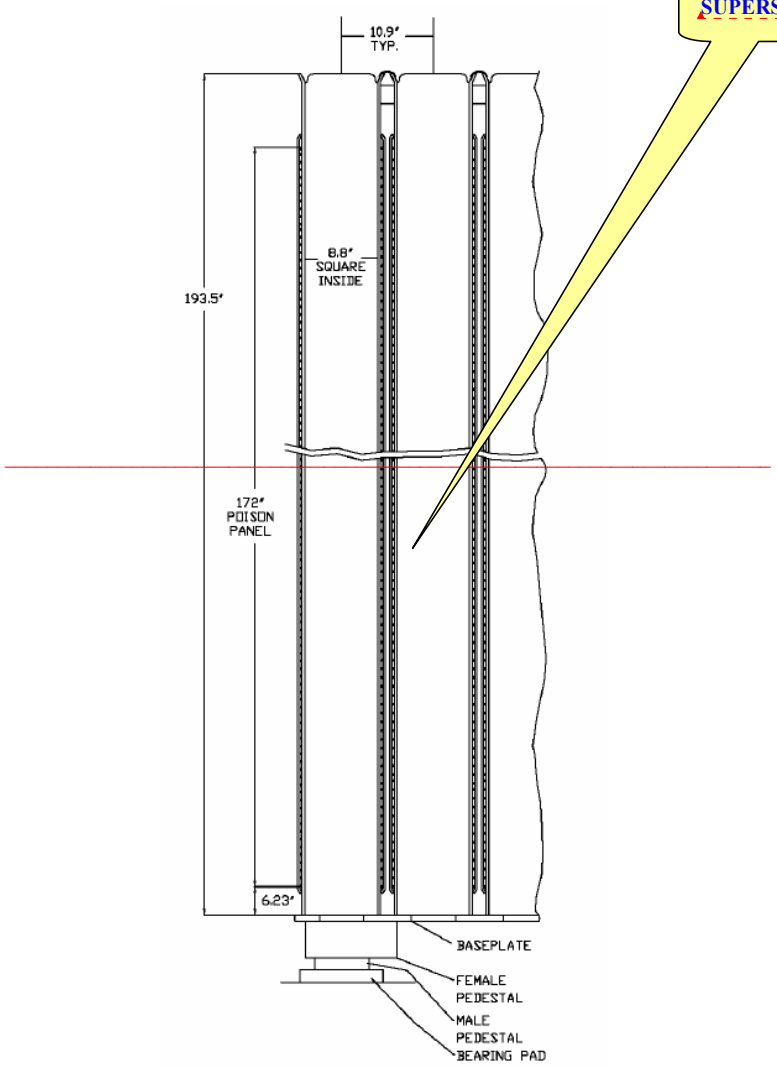

~~Figure 9.1-1 (Sheet 2 of 2)~~
~~**New Fuel Storage Rack Cross Section**~~

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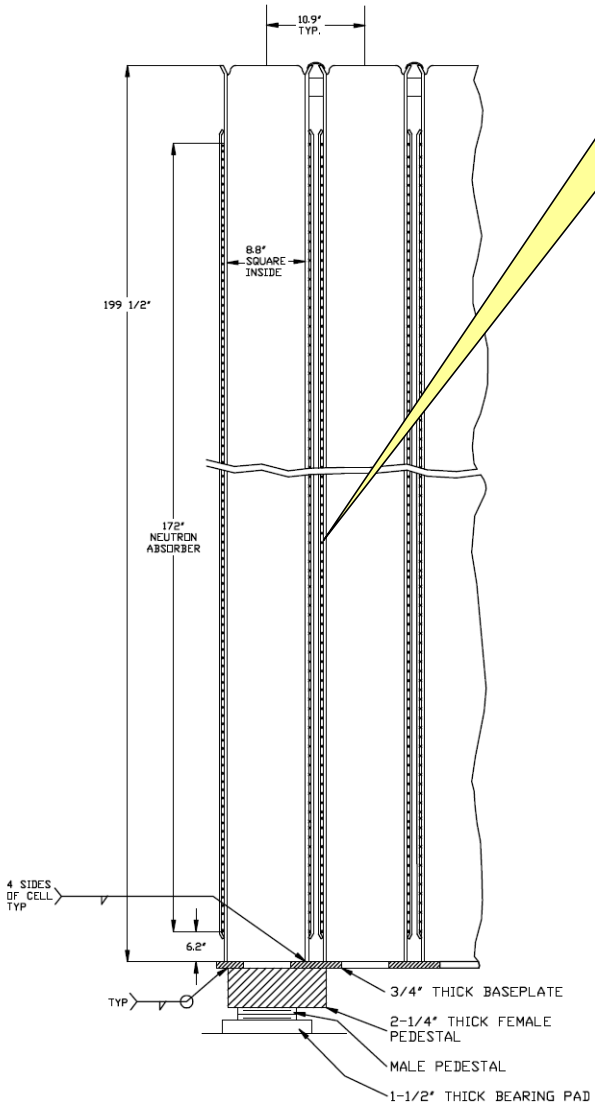

~~Figure 9.1-1 (Sheet 2 of 2)~~
~~**New Fuel Storage Rack Cross Section**~~

DCD Changes: (Revision 2A)
None.

PRA Revision:
None

Technical Report (TR) Revision:

~~**TR Changes: (Revision 0 and 1)**~~ ***(Superseded by Revision 2A)***
~~Figure 2-1 was renamed and replaced by the following 2-sheet figure:~~

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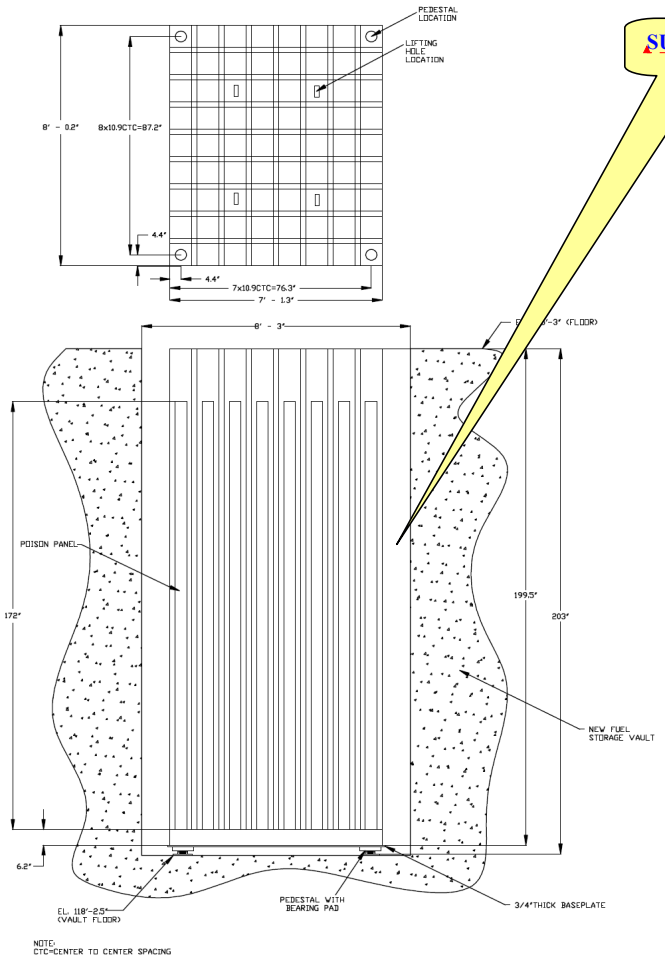

~~**Figure 2-1 New Fuel Storage Rack Layout (72 Storage Location) (Sheet 1 of 2)**~~

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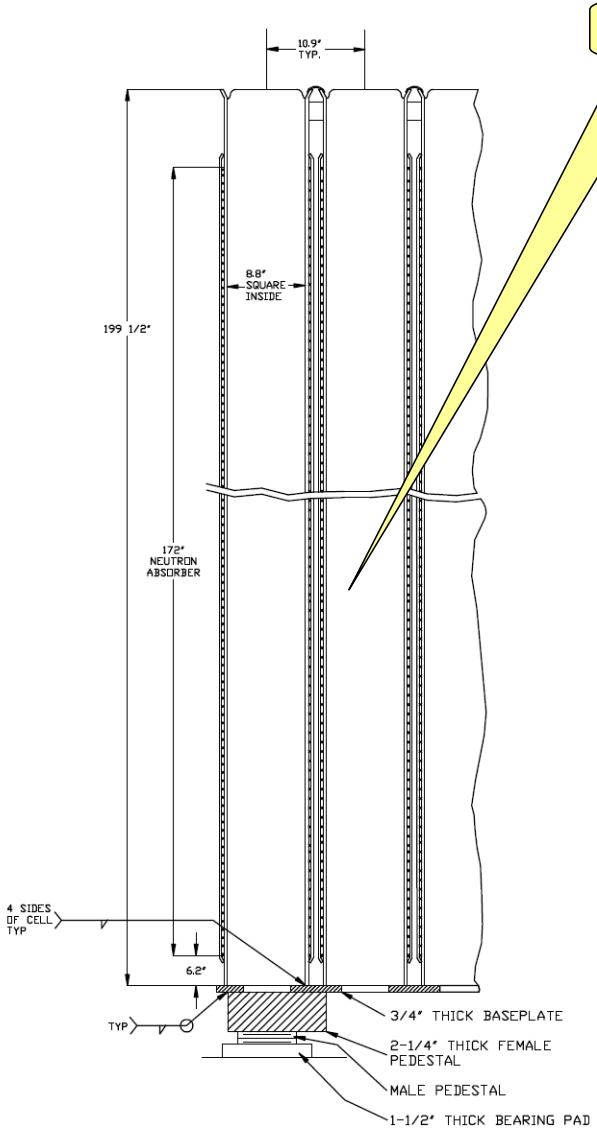


~~**Figure 2-1 New Fuel Storage Rack Cross Section (Sheet 2 of 2)**~~

TR Changes: (Revision 2A)

~~The correct TR44 figures and sheets are incorporated into the latest revision of TR44 (Reference 1).~~ none

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR44-016
Revision: 3B-date

Question: ***(Revision 0, 1, 2)***

Explain whether only a full fuel rack is considered in the simulation, or if several scenarios are considered; i. e., different fill ratios, from empty to full. Provide the technical justification if only a full rack is considered.

Staff Assessment: Response similar to response for spent fuel racks. See RAI-TR54-025.

New Question: (Revision 3B)

After NRC reviewed the supplemental RAI response from the August 2009 audit, they requested that the RAI response be revised to delete the argument that the partial loading case is not controlling.

Westinghouse Response:

(Revision 0) ***(Superseded by Revision 3B)***

~~The new fuel rack is assumed to be fully loaded with maximum weight fuel assemblies in all three simulations. This scenario bounds any partially loaded configuration since it (1) maximizes the vertical compression and lateral friction loads on the support pedestals and (2) produces the maximum rack displacements and fuel-to-cell wall impacts. The displacements are larger for a fully loaded rack, as opposed to a partially filled rack, because the dynamic model conservatively assumes that all stored fuel assemblies rattle in unison. Hence, the momentum transferred between the rattling fuel mass and the spent fuel rack is maximum for a fully loaded rack. For a partially filled rack, the decrease in rattling fuel mass outstrips the destabilizing effect of an eccentric fuel loading pattern.~~

Westinghouse Supplemental Response following May 21 and 22, 2008 Technical Review: (Revision 1) ***(Superseded by Revision 3B)***

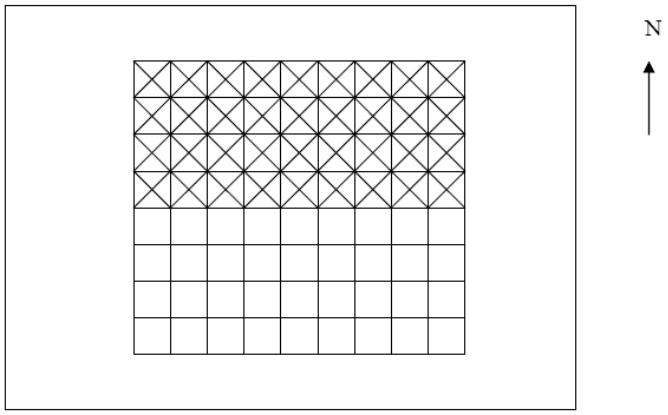
~~For the similar spent fuel racks RAI-TR54-025, the NRC found that the Westinghouse response "does appear to support the conclusion that generally the fully loaded racks would be expected to maximize impact forces and displacements." The NRC reviewer also concluded that "the use of the maximum weight for the fuel assemblies, the analysis assumption that all stored fuel assemblies rattle in unison, and consideration of the upper and lower bound coefficient of friction at all support legs provide added conservatism to bound the results from the other~~

~~possible variations." Therefore, Westinghouse considers the above response to RAI-TR44-016 to be resolved for the new fuel rack.~~

~~Section 9.1.1.2.1 of the DCD will be revised to eliminate the reference to performing seismic and stress analyses that evaluate partially full and empty fuel assembly loadings of the new fuel rack.~~

Additional Response: (Revision 2)

Following the August 2009 audit with the NRC, Westinghouse has completed an additional run (Run Number 4) to examine the effects of the worst possible partial rack loading scenario (half full, all on one side, as depicted in the following figure). The results of this additional run will be included in Revision 2 of TR-44. Also, DCD Section 9.1.1.2.1, Item A, is modified to indicate that a partially filled loading case was evaluated.



New Response: (Revision 3B)

This response is provided to update information to be consistent with the current design and analysis in Reference 1. It supersedes responses in RAI Revision 0 and 1 with clarifications overviewed below.

Earlier discussions indicated that analysis of partial rack loading would be eliminated from the RAI discussions and DCD since they were not limiting. However, the partial rack loading scenario described in the Revision 2 response confirmed that partial loading does generate

limiting results for certain loading cases. Therefore, the current version of TR44 (Reference 1) includes these limitations; and the ~~a~~ commensurate change to the DCD from Revision 2 is shown below.

Reference:

1. APP-GW-GLR-026, Revision 3, May 2010, "New Fuel Storage Rack Structural/Seismic Analysis," (Technical Report Number 44, TR44)

Design Control Document (DCD) Revision:

DCD Changes: (Revision 0, 1) ***(Superseded by Revision 3B)***
~~Changes have been included in DCD R17.~~

DCD Changes: Additional Response (Revision 2):

The first paragraph under Item A of Section 9.1.1.2.1 of Rev. 17 of the DCD is revised as follows:

The new fuel storage rack array center-to-center spacing of nominally 10.9 inches provides a minimum separation between adjacent fuel assemblies sufficient with neutron absorbing material to maintain a subcritical array. The seismic and stress analyses of the new fuel rack consider the conditions of full and partially filled fuel assembly loadings. The rack is evaluated for the safe shutdown earthquake condition against the seismic Category I requirements. A stress analysis is performed to verify the acceptability of the critical load components and paths under normal and faulted conditions. The rack rests on the pit floor.

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DCD Changes ~~-~~: (Revision 3B)

None

PRA Revision:
None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Technical Report (TR) Revision:

TR Changes: (Revision 1)~~:~~ ***(Superseded by Revision 3B)***

~~The results of the ANSYS analysis of cell wall buckling at the base of the rack will be included in the next revision of TR-44. This revision is expected to be available in November, 2009.~~

TR Changes: Additional Response (Revision 2)~~:~~

The results of the partial rack loading analysis will be included in the next revision of TR-44. This revision is expected to be available in November, 2009.

TR Changes: (Revision 3B)

The results of the partial rack loading analysis were included in TR44 Revision 2 (November 2009) and have been carried forward into TR44 Revision 3 (Reference 1). ~~None.~~

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AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR44-017
Revision: 3C-date

***Question:* (Revision 0, 1, 2)**

What are the gaps and tolerances for each of the gaps between the fuel assembly and cell wall, and between the rack and vault wall? What are the assumed initial locations of the various components (fuel assemblies and rack) and what is the technical basis for this assumption. Were any studies done for different initial conditions (considering tolerances); if not, explain why it was not necessary. Are there requirements in the DCD to ensure that the assumed gaps (considering tolerances) are maintained throughout the operating license period?

Staff Assessment: Response similar to response for spent fuel racks. See RAI-TR54-026.

New Question: (Revision 3C)

During the June 2010 audit, the NRC requested that dimension and gap information for the new fuel racks be clarified between the three similar RAIs (RAI-TR44-09, RAI-TR44-017, RAI-TR44-25) to show consistency and alignment to the current design basis shown in DCD Figure 9.1-1.

Westinghouse Response:

Westinghouse Response: (Revision 0) ***(Superseded by Revision 3C)***

~~All gaps between fuel assemblies and cell walls and between the rack and vault walls are set to match the nominal gaps provided on the layout drawing. Table TR44-017.1 summarizes the gap information used in the dynamic analyses.~~

	~~Fuel to Cell Wall~~	~~Rack to Wall~~
~~Nominal Gap (inch)~~	~~(8.8" 8.404")/2 = 0.198"~~	~~North – 0" (see note 1)~~ ~~East – 28.7"~~ ~~South – 0" (see note 1)~~ ~~West – 28.7"~~

~~Table TR44-017.1 Gap Information used in the Dynamic Analysis of the New Fuel Rack~~

~~Note:~~

1. ~~The new fuel storage rack is braced against the north and south walls of the New Fuel Storage Pit by inserting stainless steel wedges in the interstitial space between the top of the new fuel storage rack and the New Fuel Storage Pit opening (see TR44-009 RAI Response Figure TR44-9.1).~~

~~Fuel is assumed centrally located in cell. This is conservative since minimizing gap on one or two walls will generally produce a larger hydrodynamic coupling effect.~~

~~Some numerical studies were done on other rack projects; the results generally showed a small influence on results. A larger influence occurs if the gaps are assumed to be displacement dependent, rather than always being held constant at their initial value. The neglect of this effect is conservative.~~

~~Once the new fuel rack is installed, the "as-built" gaps are reconciled with the gaps initially used for analysis by evaluation of the numerical results and the predicted motions. The new fuel rack will be positioned in the New Fuel Storage Pit per the gap information provided in Table TR44-017.1. The only way the gaps would change over time would be by the action of a seismic event. Combined License applicants will have a procedure in place to address measurement of the post design basis seismic event gaps, and to evaluate the acceptability of the configuration showing it is acceptable, or to take appropriate corrective actions. A statement will be added to the Technical Report addressing the design-basis seismic event potential change in gaps between the new fuel rack and New Fuel Storage Pit walls.~~

Westinghouse Supplemental Response following May 21 and 22, 2008 Technical Review: (Revision 1) (Superseded by Revision 3C)

~~Since the Westinghouse submittal of the Revision 0 response to this RAI, the design of the new fuel storage pit was changed to remove the concrete corbels at the top of the pit and the stainless steel wedges that were to be welded in the interstitial space between the top of the new fuel storage rack and the pit opening following installation of the rack. As a result of the changes to the new fuel storage pit, the updated gap information is provided in the table below and was used in the dynamic analyses. Note that a conservative gap size was used for the fuel to cell wall gap in the dynamic analysis based on the smallest fuel assembly cross section of 8.404 inches. The largest fuel assembly cross section is 8.426 inches which equates to a 0.187 inch fuel to cell wall gap.~~

	~~Fuel to Cell Wall~~	~~Rack to Wall~~
~~Nominal Gap (inch)~~	~~(8.8" 8.404")/2 = 0.198"~~	~~North – 6.88"~~ ~~East – 28.93"~~ ~~South – 6.88"~~ ~~West – 28.93"~~

~~Per the structural/seismic calculation for the new fuel rack, APP-FS01-S3C-001, Revision 1, the maximum displacement at the top of the new fuel rack is 6.35". Therefore, the minimum gap between the new fuel rack and the pit walls (at the top of rack elevation) will be specified on Rev. 1 of Drawing APP-FS01-V2-002 as 6-3/8".~~

Additional Response: (Revision 2) **(Superseded by Revision 3C)**

~~Following the August 2009 audit, Westinghouse is updating DCD Figure 9.1-1 to include additional details related to the placement of the New Fuel Storage Rack within the New Fuel Pit. Figure 9.1-1 will be updated as shown in the DCD Revision section below to show the general position of the rack within the pit, including a definition of the minimum gaps. The only changes to the figure are that the rack is now shown within the vault and the 4 inch minimum typical gap dimension along with the clarifying note about where the gaps are measured from have been added. The 4 inch minimum gap is conservative based on the maximum rack displacement of 3.2 inches (which occurs at the top of the rack; the maximum displacement at~~

~~the baseplate elevation is only 0.5 inches) when the 0.2 COF is ignored (justification for ignoring the 0.2 COF case is discussed in the response to RAI-SRP9.1.2-SEB1-02, Revision 1).~~

Westinghouse Response: (Revision 3C)

This response is provided to update information to be consistent with the current design and analysis. It supersedes RAI Revision 0, Revision 1, and Revision 2 responses, DCD changes, and TR changes with clarifications overviewed below.

The discussion about a statement being added to the Technical Report (TR44) to address the design-basis seismic event potential change in gaps between the new fuel rack and New Fuel Storage Pit walls was completed in the response to RAI-SRP9.1.2-SEB1-01 which noted that the appropriate place for such a statement is in the DCD. This statement was added to the DCD via RAI-SRP9.1.2-SEB1-01 and is no longer in the TR44 (Reference 1).

The current nominal placement of the New Fuel Storage Rack within the New Fuel Storage Pit based on current seismic analysis and drawings (References 2 and 3) is described below:

- The nominal rack-to-wall gap in the East direction is 6.88".
- The nominal rack-to-wall gap in the West direction is 61.97".

Additionally, the maximum displacement that results from the design-basis seismic event and the corresponding minimum rack-to-wall gap limitation was revised to be consistent with the current results of the seismic analysis and changes to the friction assumptions that affect rack movement. The current analysis now uses a credible lower-bound coefficient of friction (COF) of 0.24. Justification of this lower-bound COF is included in the latest revision of TR44 (Reference 1).

The updated analysis shows maximum rack-to-wall displacement is 5.54" at the top-of-rack location (note that this is equal to 4.92" at the baseplate location since the new fuel rack baseplate extends nominally 1" beyond the cell envelope in each horizontal direction.) Based on accessibility considerations, the rack-to-wall gaps are measured at the top-of-rack. To minimize/avoid the rack impacting the new fuel pool wall, the minimum rack-to-wall gap has been set to $\geq$6" which is slightly more than the maximum displacement.

To ensure that criticality safety assumptions are met, a maximum rack-to-wall gap of < 8" has been added to the North and South walls, where there are no neutron absorber panels. The 8" maximum gap precludes the possibility of a fuel assembly (with minimum nominal fuel assembly dimensions greater than 8.4" square) being inadvertently placed into the space next to the exterior of the New Fuel Storage Rack on the North and South faces where no neutron absorber panels exist. There are neutron absorber panels provided on the East and West faces; so there is no need to limit the maximum gap in these directions.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

The attached DCD changes to Figure 9.1-1 (Sheet 1 of 2) reflects the current nominal placement of the New Fuel Storage Rack within the New Fuel Storage Pit ~~based o~~per the ~~n current~~ seismic report, analysis, and drawings listed below (References 1, 2, and 3).

References:

1. APP-GW-GLR-026, Revision 3, May 2010, "New Fuel Storage Rack Structural/Seismic Analysis," (Technical Report Number 44, TR44)

2. APP-FS01-S3C-001, Revision 3, May 2010, "New Fuel Storage Rack Structural/Seismic Analysis"

3. Westinghouse Drawing APP-FS01-V2-002, Revision 3, May 2010, "New Fuel Storage Rack Outline Drawing~~Layout~~"

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Design Control Document (DCD) Revision:

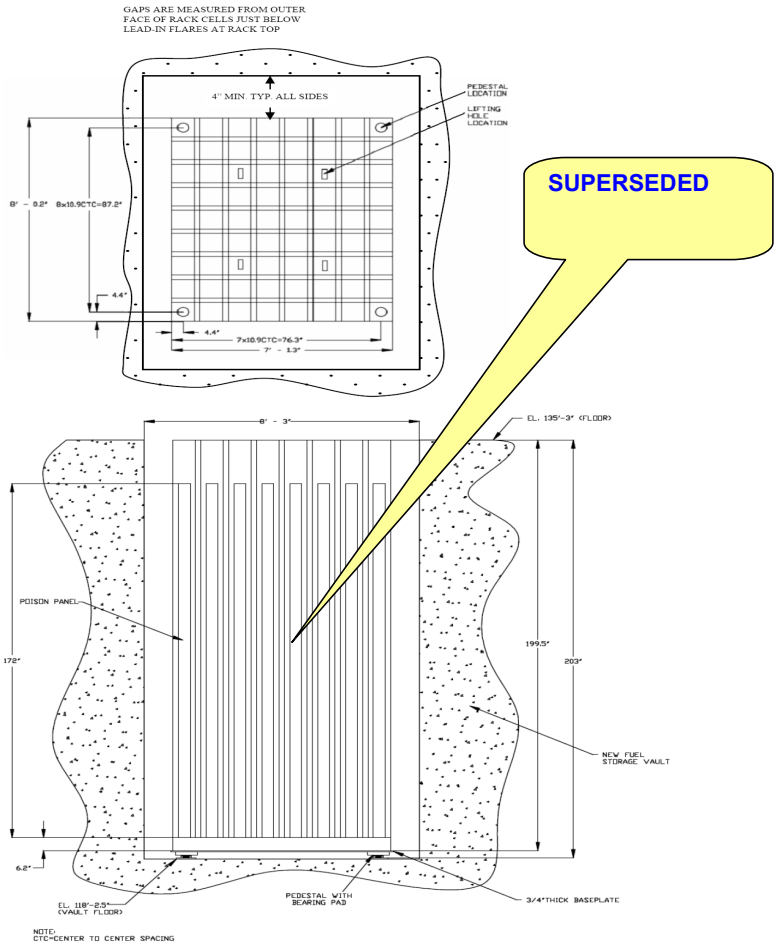
DCD Changes: (Revision 0, 1)
none

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

DCD Changes: (Revision 2) ***(Superseded by Revision 3C)***

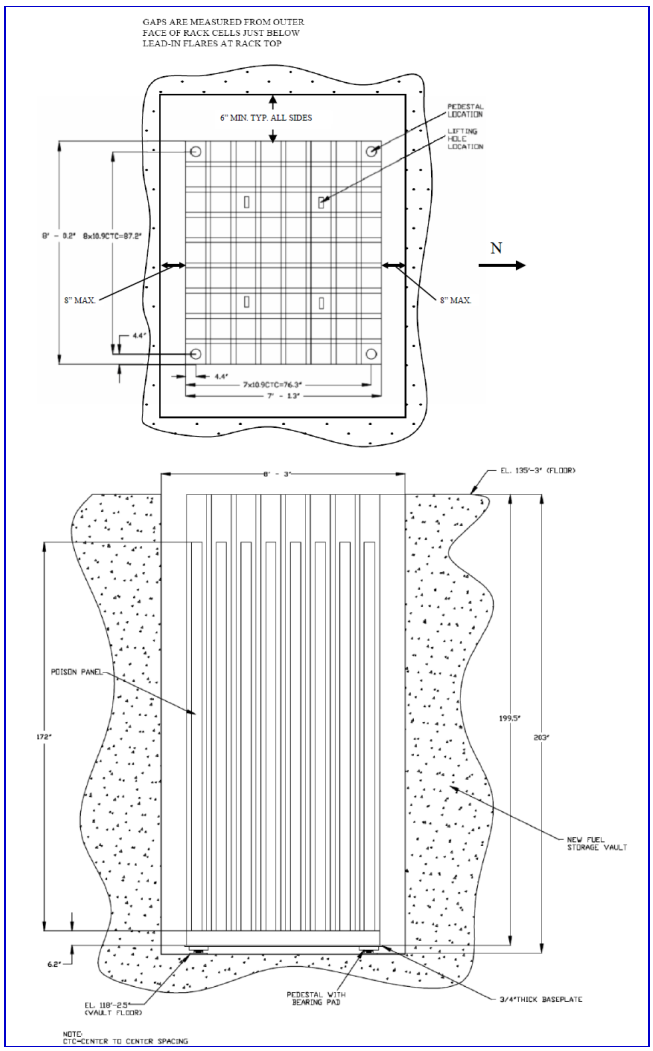
~~Replace DCD Figure 9.1-1 with the following figure:~~



DCD Changes: (Revision 3C)

The following change to DCD Figure 9.1-1 (Sheet 1 of 2) represents the current design basis shown in TR44 (Reference 1).

Replace DCD Figure 9.1-1 (Sheet 1 of 2) entitled “New Fuel Storage Rack Layout (72 Storage Locations” with the following figure.


GAPS ARE MEASURED FROM OUTER
FACE OF RACK CELLS JUST BELOW
LEAD-IN FLARES AT RACK TOP
6" MIN. TYP. ALL SIDES
PEDESTAL LOCATION
LIFTING HOLE LOCATION
8' - 9.2" 8x10.9CTC=87.2"
N
8" MAX.
8" MAX.
4.4"
4.4"
7x10.9CTC=76.3"
7' - 1.3"
8' - 3"
EL. 135'-3" (FLOOR)
POISON PANEL
172"
199.5"
203"
NEW FUEL STORAGE VAULT
6.2"
EL. 110'-2.5" (VAULT FLOOR)
PEDESTAL WITH BEARING PAD
3/4"THICK BASEPLATE
NOTE:
CTC=CENTER TO CENTER SPACING

PRA Revision:
None

Technical Report (TR) Revision:

TR Changes: (Revision 0, 1)
none

TR Changes: (Revision 2) ***(Superseded by Revision 3C)***

~~The following statement will be added to Technical Report 44 addressing the design-basis seismic event potential changes in gaps between the new fuel rack and walls of the new fuel storage pit:~~

~~"Per DCD subsection 3.7.5.2, Combined License applicants will prepare site-specific procedures for activities following an earthquake. These procedures will be used to accurately determine both the response spectrum and cumulative absolute velocity of the recorded earthquake ground motion from the seismic instrumentation system. An activity will be to address measurement of the post-seismic event gaps between the new fuel rack and walls of the new fuel storage pit and to take appropriate corrective actions."~~

TR Changes: (Revision 3C)

None.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR44-025
Revision: 2A-date ___

Question:

(Revision 0)
In the markup of the DCD, provided in Section 5 of the topical report, Figure 9.1-1, New Fuel Storage Rack, is identified for deletion. Please explain why you are deleting this figure. This figure should be retained in the DCD.

(Revision 1) Supplemental Questions from May 2008 Meetings: general

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New Question: (Revision 2A)

During the June 2010 audit, the NRC requested that dimension and gap information for the new fuel racks be clarified between the three similar RAIs (RAI-TR44-09, RAI-TR44-017, RAI-TR44-25) to show consistency and alignment to the current design basis shown in DCD Figure 9.1-1.

Westinghouse Response:

Westinghouse Response: (Revision 0) ***(Superseded by Revision 2A)***

~~We are in agreement. Revision 16 of the DCD will have a revised Figure 9.1-1 New Fuel Rack Layout. This figure will show the new fuel rack configuration in plan and elevation views identifying significant features and dimensions.~~

Westinghouse supplemental response from NRC Technical Meetings May 21 & 22, 2008 (Revision 1) ***(Superseded by Revision 2A)***

~~The new fuel rack has been changed to have additional storage cell height to protect control elements that are stored in the new fuel assemblies. Also the rack is not wedged in place in the North - South directions and is free to move within the new fuel storage vault. Revision 17 of the DCD and TR-44 revision 1 will have figures showing significant features and dimensions of the new fuel rack. The format for the new fuel rack significant features and dimensions is the same format reviewed and accepted by the NRC for the spent fuel racks. See changes in DCD revision and TR revision.~~

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

New Response: (Revision 2A)

This response is provided to update information to be consistent with the current design and analysis. It supersedes RAI Revision 0 and Revision 1 responses, DCD changes, and TR changes with clarifications overviewed below.

The most recent change to DCD Figure 9.1-1 (Sheet 1 of 2) is included in the response to RAI-TR44-17 Revision 3C.

The DCD Figure 9.1-1 (Sheet 2 of 2) is not modified by any revision of comments in this RAI response. This figure and page were included into DCD Revision 17 (Letter DCP/NRC 2202) and remain applicable to the new fuel rack design.

~~The most recent change to DCD Figure 9.1-1 (Sheet 1 of 2) is included in response to RAI-TR44-17 Revision 3C.~~

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References:

1. APP-GW-GLR-026, Revision 3, May 2010, "New Fuel Storage Rack Structural/Seismic Analysis," (Technical Report Number 44, TR44)

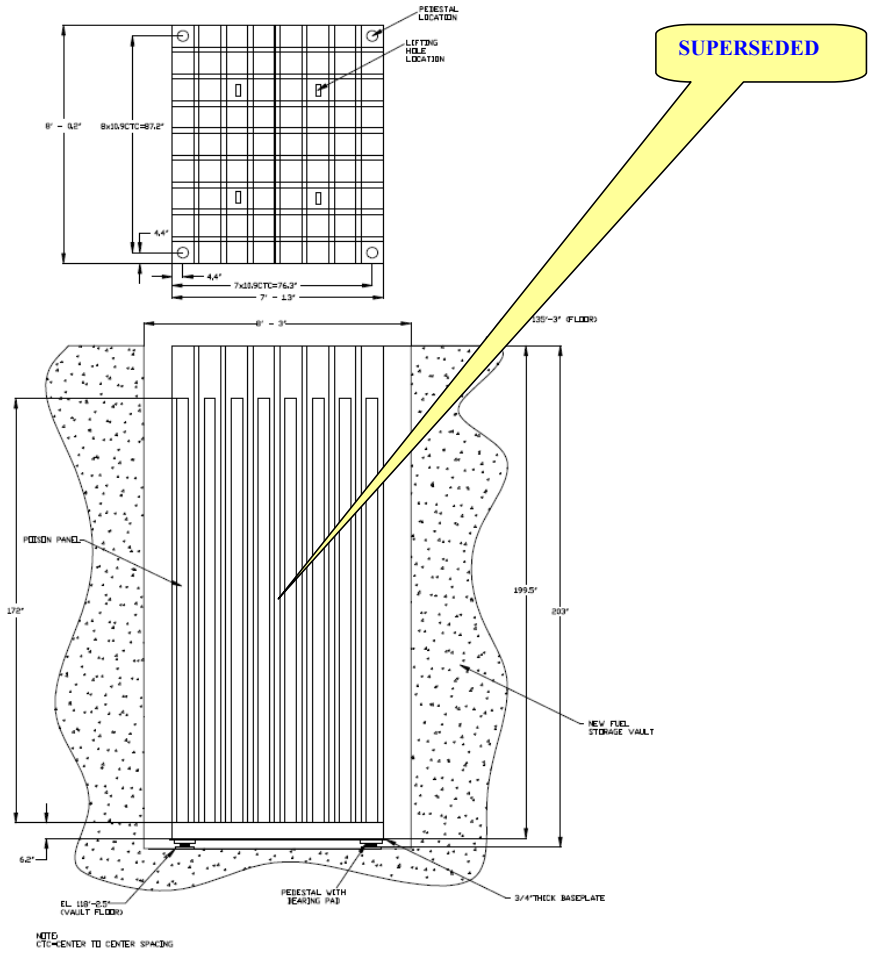
Design Control Document (DCD) Revision:

DCD Changes: (Revision 0) ***(Superseded by Revision 2A)***

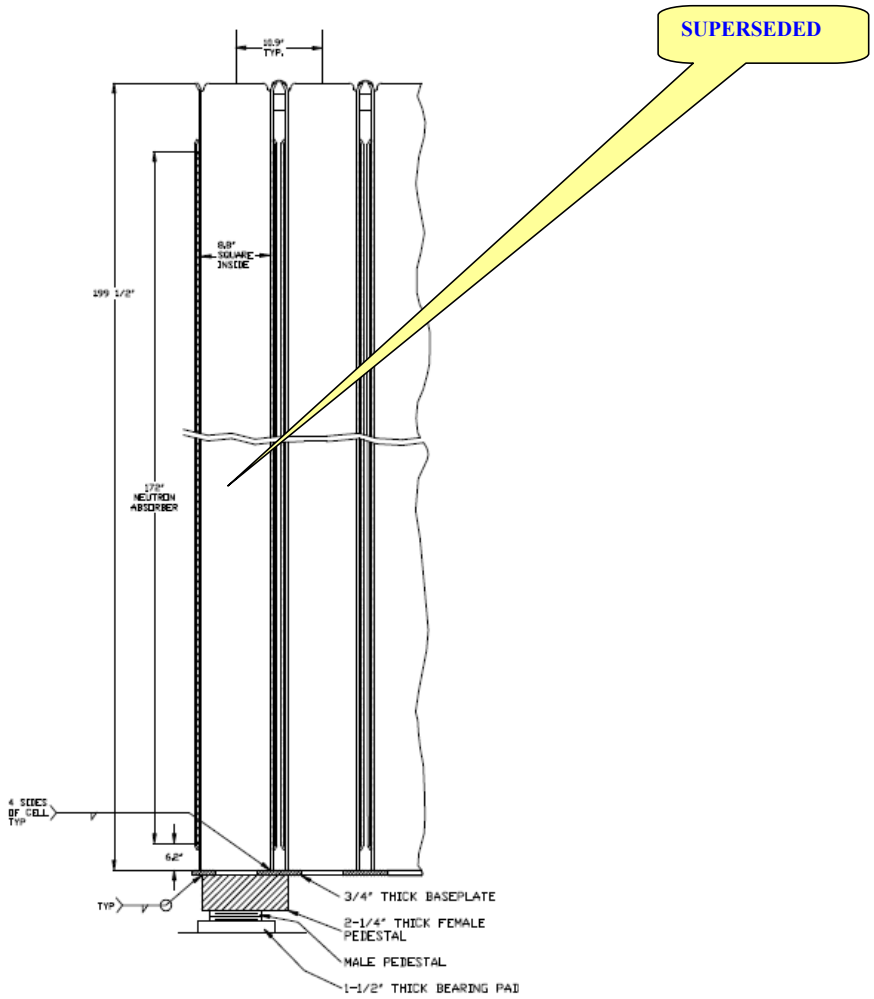
~~Yes. Figure 9.1-1 New Fuel Rack Layout will be revised in DCD Revision 16 to show the new fuel rack configuration in plan and elevation views identifying significant features and dimensions.~~

DCD Changes: Westinghouse supplemental response from NRC Technical Meetings May 21 & 22, 2008 (Revision 1) ***(Superseded by Revision 2A)***

~~Figures 9.1-1 (Sheet 1 of 2) and Figures 9.1-1 (Sheet 2 of 2) are changed as shown below.~~



~~Figure 9.1-1 (Sheet 1 of 2)~~
~~New Fuel Storage Rack Layout (72 Storage Locations)~~



~~Figure 9.1-1 (Sheet 2 of 2)~~
~~New Fuel Storage Rack Cross Section~~

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

DCD Changes: (Revision 2A)

None.

PRA Revision:
None

Technical Report (TR) Revision:

TR Changes (Revision 0): (Superseded by Revision 2A)

~~Yes- Figure 9.1-1 New Fuel Rack Layout will be will be added to the revision of APP-GW-GLR-026, Revision 0, "New Fuel Storage Rack Structural/Seismic Analysis," (Technical Report Number 44).~~

TR Changes: Westinghouse supplemental response from NRC Technical Meetings May 21 & 22, 2008 (Revision 1) (Superseded by Revision 2A)

~~Figures 9.1-1 (Sheet 1 of 2) and 9.1-1 (Sheet 2 of 2) shown in DCD revision are also placed in TR 44 Revision 1 subsection 2.1.1.~~

TR Changes: (Revision 2A)

~~The correct TR44 figures and sheets are incorporated into the latest revision of TR44 (Reference 1).~~
None.

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AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-TR54-015
Revision: 3A-date

***Question:* (Revision 0)**

Insufficient descriptive information has been included in the spent fuel report to permit an adequate review of the structural/seismic analysis of the spent fuel racks. As indicated in SRP 3.8.4, App. D, provide descriptive information including plans and sections showing the spent fuel racks and pool walls, liner, and concrete walls. All of the major features of the racks including the cell walls, baseplate, pedestals, bearing pads, neutron absorber sheathing, any impact bars, welds connecting these parts, and any other elements in the load path of the racks should be shown on one or several sketches. These sketches should also indicate related information which includes key: cutouts, dimensions, material thicknesses, and gaps (fuel to cell, rack to rack, rack to walls, and rack to equipment area). In addition to the above, for review of postulated fuel handling drop accident and quantification of the drop parameters, sketches with sufficient details for the fuel handling system should be provided to facilitate the review as indicated in SRP 3.8.4, App. D.

October 8-12, 2007 Audit: (Revision 1)

Based on the original request made in the RAI, the review of the RAI response and the revised details in Section 9.1 of DCD Rev. 16, the following items still need to be provided or clarified in the TR and DCD:

(1) The key dimensions of the male and female pedestal components and bearing plates should be shown in the figures provided in the RAI response.

(2) The welds connecting the pedestals to the baseplate and the baseplate to the fuel cell walls are not shown. The information for the welds should indicate the type of the weld (e.g., fillet) and whether they are all around or the extent of the welds.

(3) Figure TR54-15.6 (in the RAI response) does not show any leak chase channels in the spent fuel pool floor. W indicated that there are leak chase channels; however they are not shown in rack layout figure. W confirmed that the fuel rack analyses did not consider the possible impact loading of a rack pedestal over the leak chase channel. Therefore, the staff request W to explain why the effects of the leak chase channel were not considered in the fuel rack analyses and the calculation that demonstrates the adequacy of the liner/concrete in the local region around the pedestal which is part of the TR report. Also, Figure TR54-15.6 which will be included in the TR should be revised to show the leak chase channels if they are used.

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

(Revision 2) Supplemental Question from May 2008 Meetings: general

New Question: (Revision 3A)

During the June 2010 audit, the NRC requested that dimension and gap information for the spent fuel racks be clarified between the two similar RAIs (RAI-TR54-15, RAI-TR54-026) to show consistency and alignment to the current design basis shown in DCD Figure 9.1-2, 9.1-3, and 9.1-4.

Westinghouse Response:

(Revision 0) ***(Superseded by Revision 3A)***

~~Westinghouse has provided sketches in the attachment to RAI-TR54-15 response showing the major features of the racks and spent fuel pool. These sketches will be incorporated in Technical Report 54. Westinghouse has not finished the detailed design of fuel handling equipment and detailed sketches are not available at this time. However, the quantification of the drop parameters has been established in the DCD (both maximum drop weights and heights). The DCD drop heights are much greater than what is being designed for the fuel handling equipment. This is stated in the RAI-TR-54-1 response. During the NRC Structural/Seismic audit of April 16th, the complete design drawings of the spent and new fuel racks were available to the NRC for review. Holtec explained how the rack features were incorporated into the seismic/structural models.~~

October 8-12, 2007 Audit: (Revision 1) ***(Superseded by Revision 3A)***

~~Westinghouse has revised the layout figures for Region 1 and Region 2 spent fuel racks as requested. These figures are presented below in the DCD Revision and TR Revision sections below. Leak chases are used in the spent fuel pool. The plates making up the spent fuel pool liner have been designed such that no rack pedestals are over leak chases.~~

Westinghouse supplemental response to NRC Technical Review Meetings May 21 & May 22, 2008: (Revision 2) ***(Superseded by Revision 3A)***

~~Westinghouse agreed to change spent fuel pool rack layout shown in Figure 2-1 of TR-54 Rev 2 and DCD Figure 9.1-4 to change note to "All gaps are nominal and measured at the top of the rack from the exterior cell wall". Also from RAI-TR54-36 Rev 2 response, the tool area is shown to be 34 inches rather than 36 inches. In addition, Figure 2-3 and DCD Figure 9.1-3 (sheet 1 of 2) have been changed to correctly reflect the distance from the TOP of the bearing pad (not the bottom of the bearing pad) to the top of the rack.~~

New Response: (Revision 3A)

The figures and related discussion included in the previous revisions of this RAI response are out dated and superseded (due to design changes that strengthened the racks) as follows:

- The current versions of DCD Figures 9.1-2 (both sheets) and 9.1-3 (both sheets) were included in the response to RAI-SRP9.1.2-SEB1-06 (Letter DCP_NRC_002690, issued 11/11/09).
- The current version of DCD Figure 9.1-4 is included as part of design change proposal (DCP 1185 dated 12/18/09).

The basis of the latest versions of DCD Figures 9.1-2 (both sheets), 9.1-3 (both sheets), and Figure 9.1-4 were included in APP-GW-GLR-033 (Revision 3, November 2009) and are retained in TR54 (Reference 1).

~~The figures and related discussion included in all of the previous revisions of this RAI response are out dated and are superseded as follows:~~

- ~~The latest versions of DCD Figures 9.1-2 (both sheets), 9.1-3 (both sheets), and 9.1-4 are included in the response to RAI-SRP9.1.2-SEB1-06 (Letter DCP/NRC 2690).~~

~~The correct figures are incorporated into the latest revision of TR54 (Reference 1).~~

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Reference:

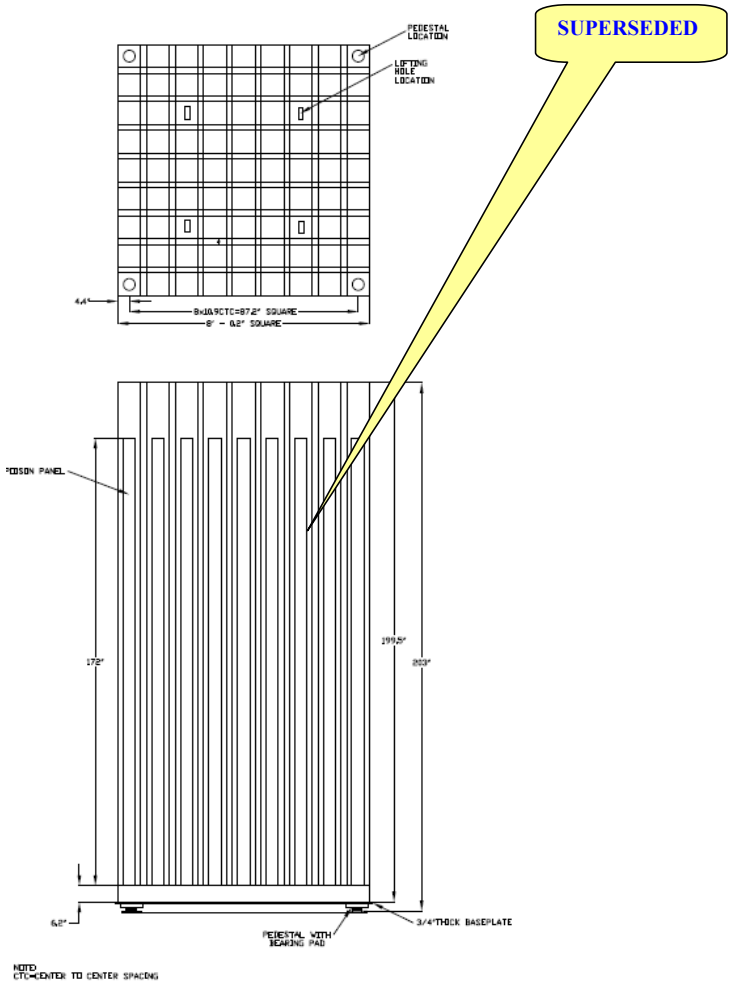
1. APP-GW-GLR-033, Revision 4, May 2010, "Spent Fuel Storage Rack Structural/Seismic Analysis," (Technical Report Number 54, TR54)

Design Control Document (DCD) Revision:

(Revision 0 and 1) ***(Superseded by Revision 3A)***

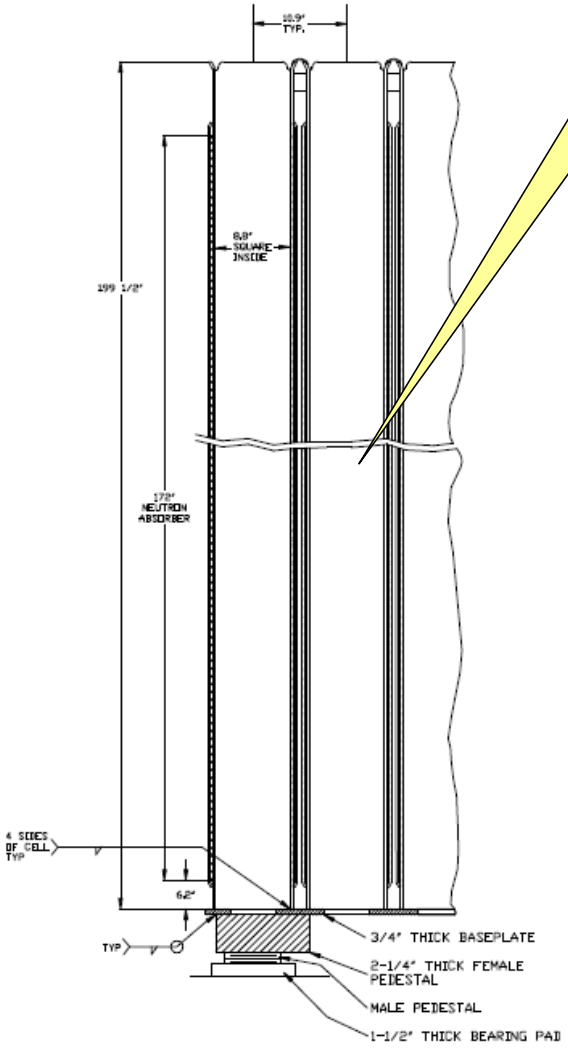
~~The spent fuel rack figures in section 9.1 of DCD revision 16 are replaced with the following figures:~~

~~Figure 9.1-2 (Sheet 1 of 2) Region 1 Spent Fuel Storage Rack Layout~~

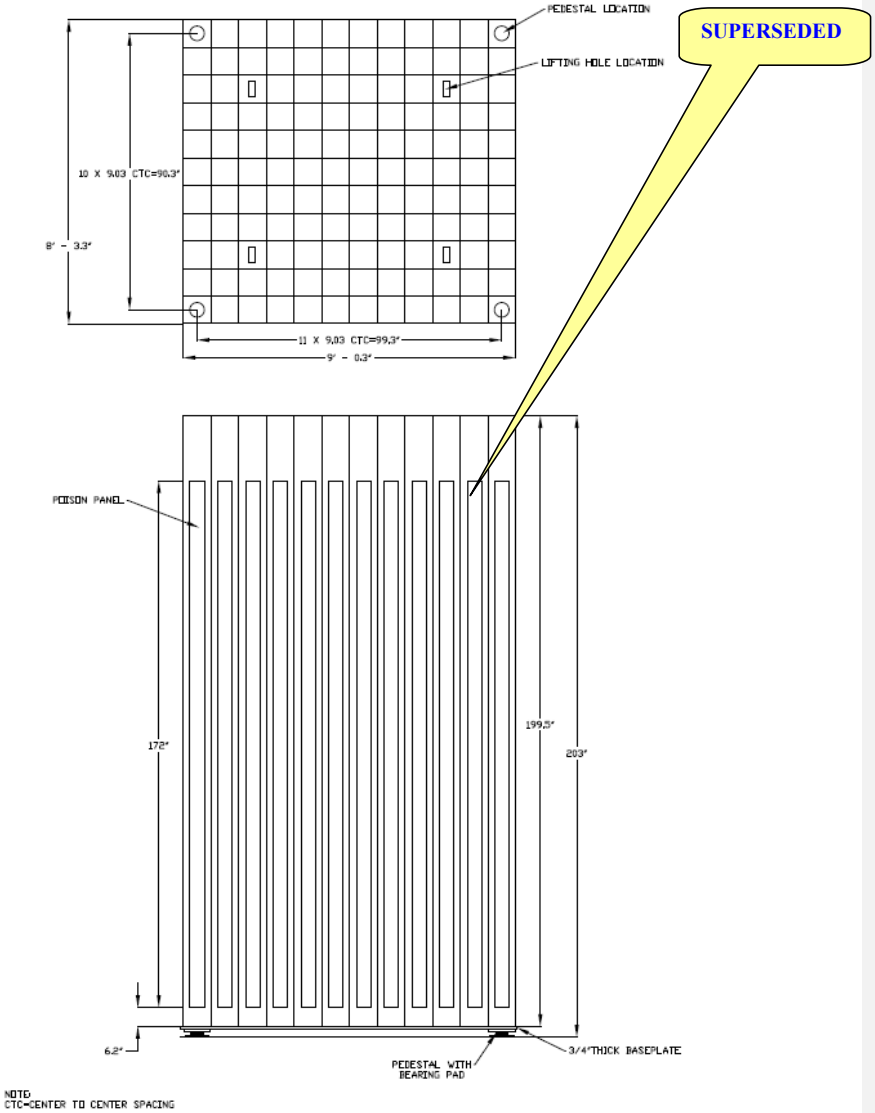


~~Figure 9.1-2 (Sheet 2 of 2) Region 1 Spent Fuel Storage Rack Cross Section~~

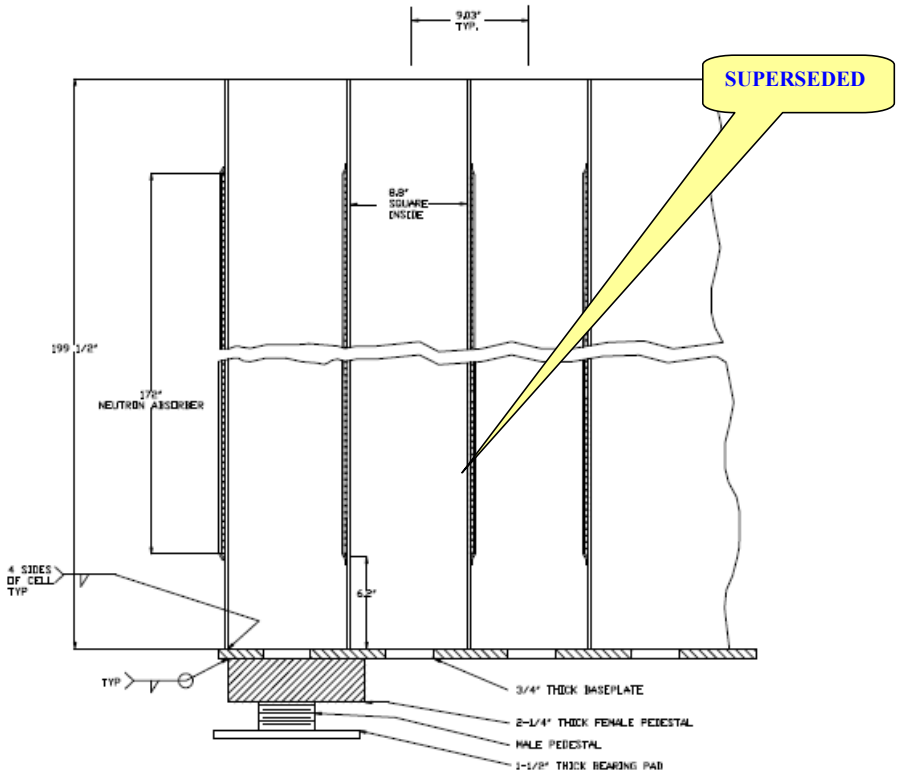
SUPERSEDED



~~Figure 9.1-3 (Sheet 1 of 2) Region 2 Spent Fuel Storage Rack Layout~~



~~Figure 9.1-3 (Sheet 2 of 2) Region 2 Spent Fuel Storage Rack Cross Section~~

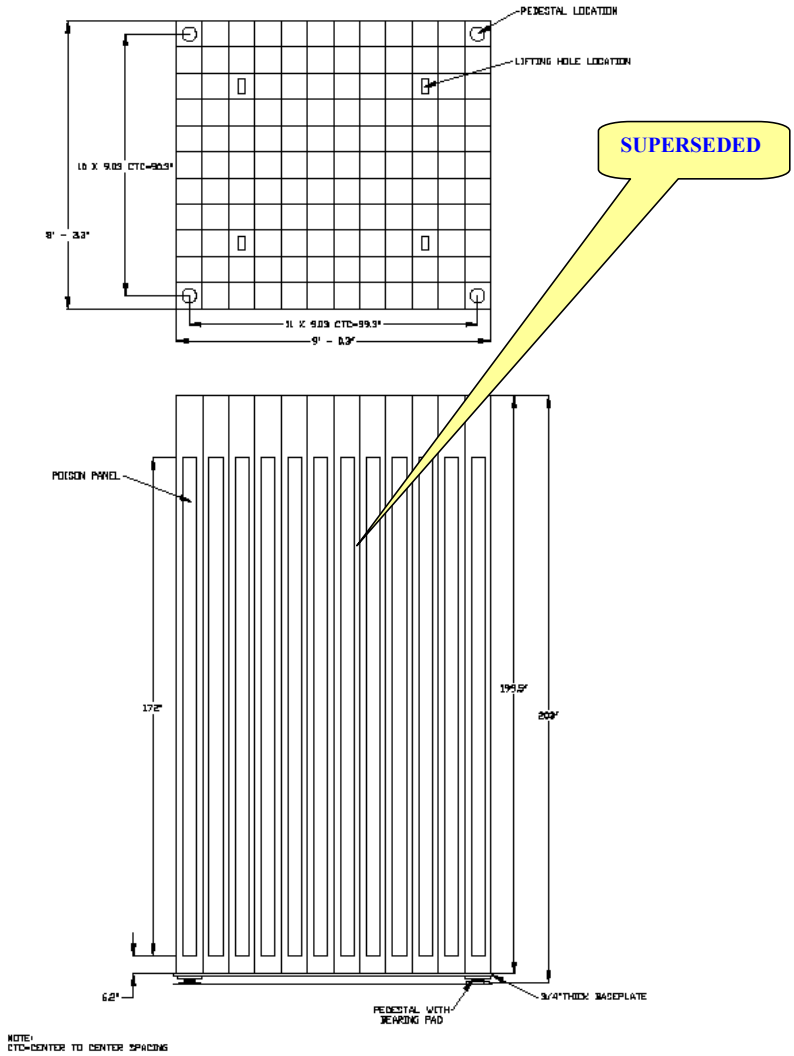


~~Figure 9.1-4 Spent Fuel Storage Pool Layout (889 Storage Locations)~~

SUPERSEDED

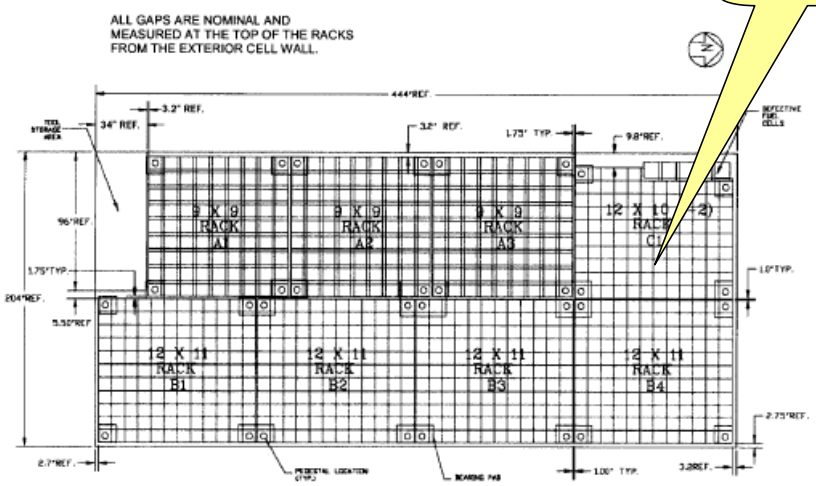
DCD Revision from RAI-TR54-15: (Revision 2) **(Superseded by Revision 3A)**

~~Replace Figures 9.1-3 (Sheet 1 of 2) and 9.1-4 with the following:~~



~~Figure 9.1-3 (Sheet 1 of 2) Region 2 Spent fuel Storage Rack Layout~~

SUPERSEDED



~~Figure 9.1-4 Spent Fuel Storage Pool Layout (889 Storage Locations)~~

DCD Changes: (Revision 3A)

None.

PRA Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

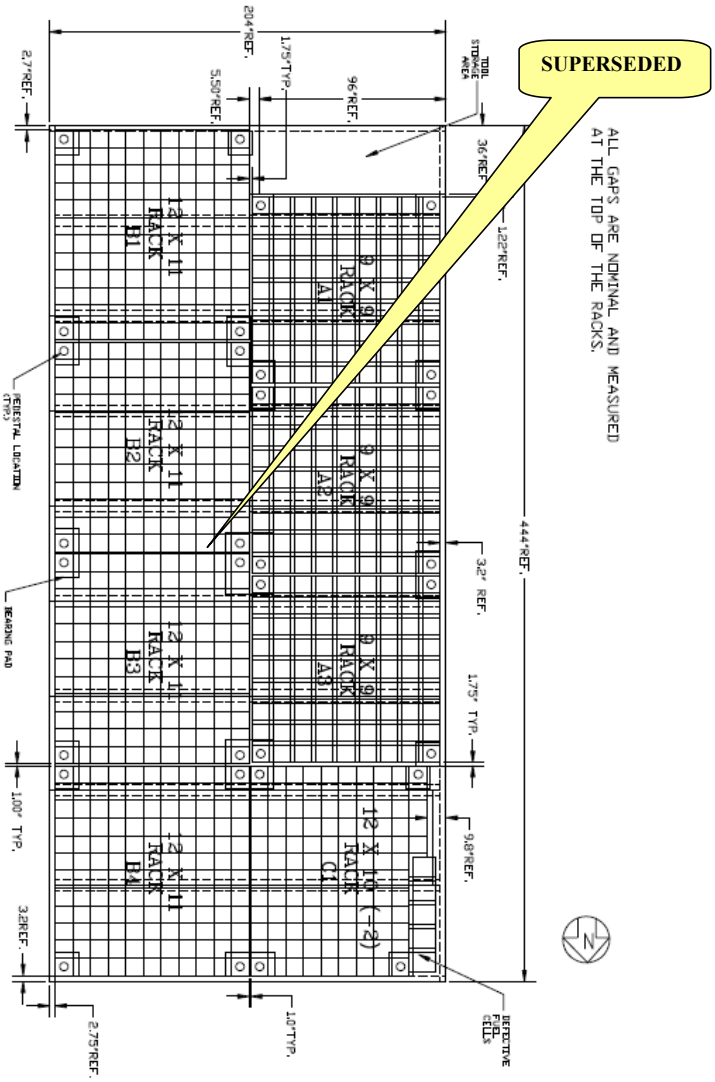
Technical Report (TR) Revision:

(Revision 0 and 1) ***(Superseded by Revision 3A)***

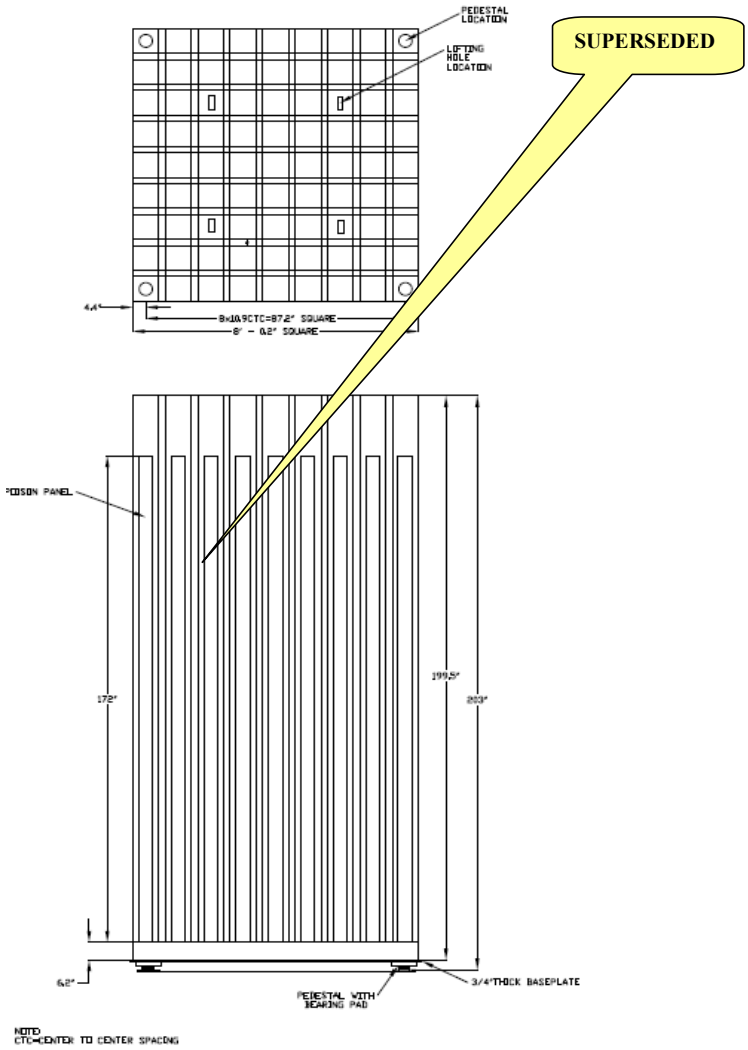
~~The following Figures have been incorporated into Technical Report 54 Revision 1:~~

~~Figure 2-1 Spent Fuel Pool Storage Layout (889 Total Storage Locations)~~
~~Note: leak chases shown in phantom~~

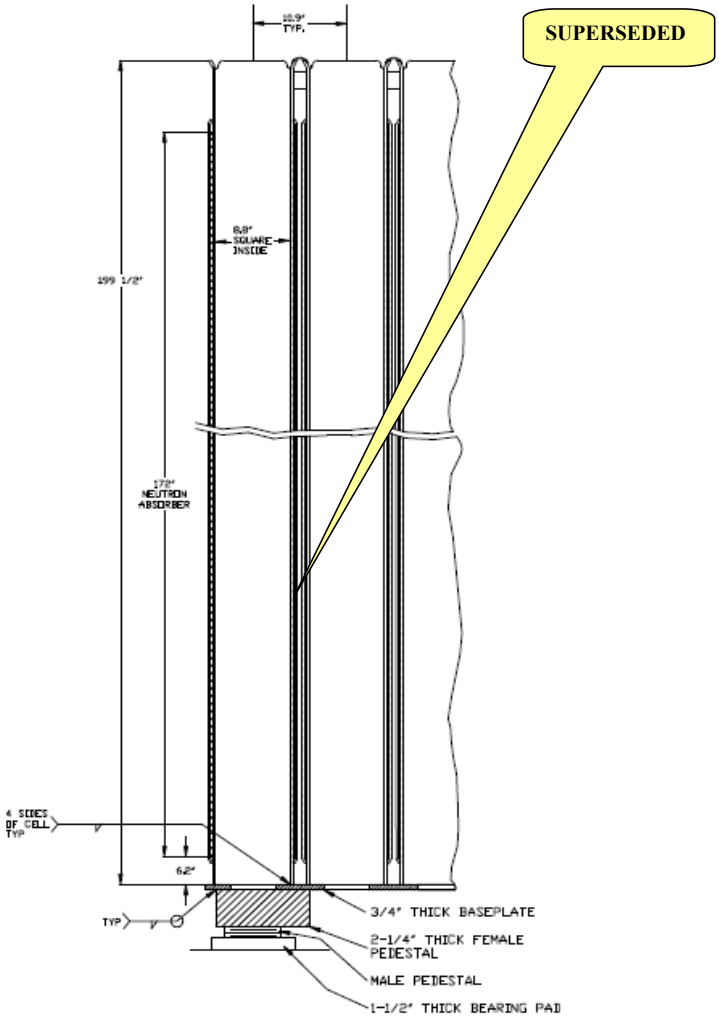
SUPERSEDED



~~Figure 2-2 Configuration of a Region 1 Storage Cell (Sheet 1 of 2)~~

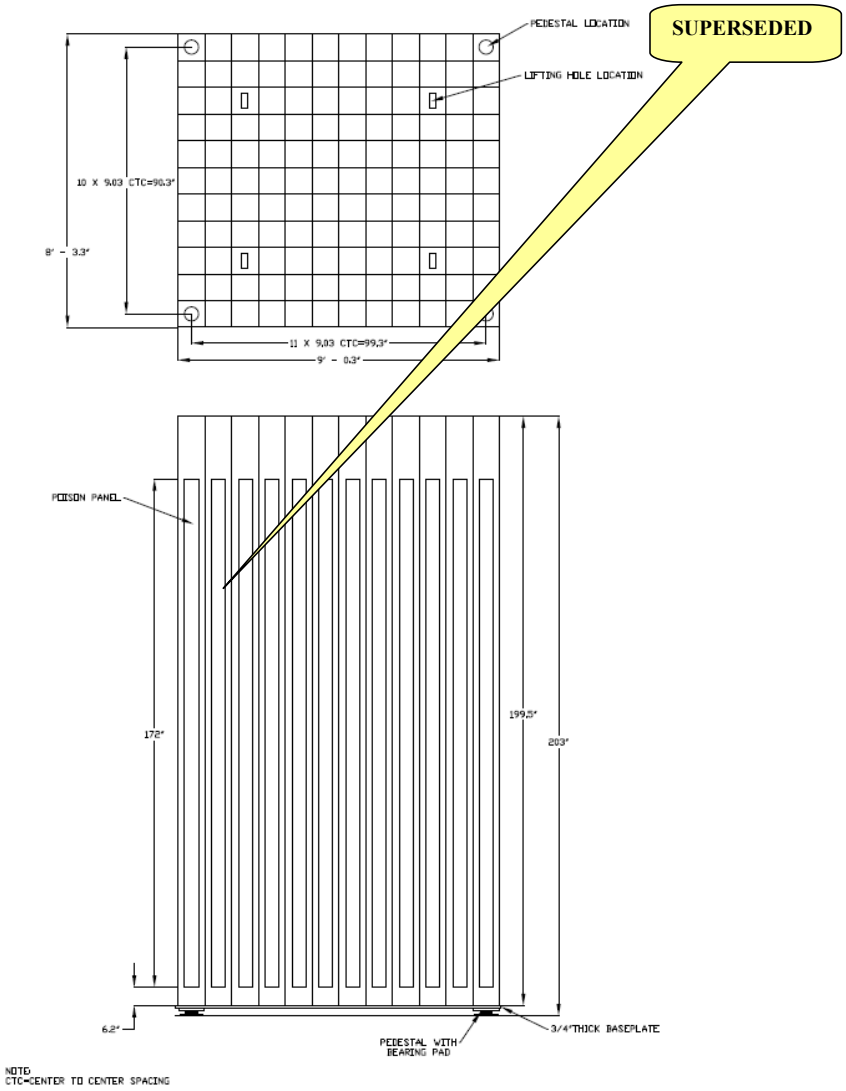


~~Figure 2-2 Configuration of a Region 1 Storage Cell (Sheet 2 of 2)~~



~~Figure 2-3 Configuration of a Region 2 Storage Cell (Sheet 1 of 2)~~

SUPERSEDED



~~Figure 2-3 Configuration of a Region 2 Storage Cell (Sheet 2 of 2)~~

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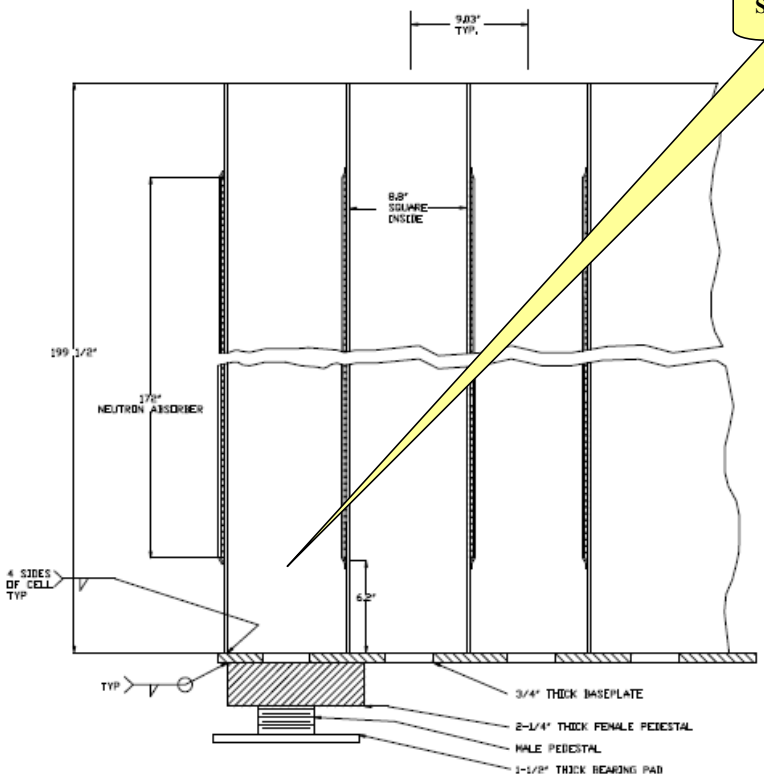


Technical Report Revision from RAI-TR54-15 Rev 2 response:
(Superseded by Revision 3A)

~~Figure 2-1 has been changed to reflect the requested added note All gaps are nominal and measured at the top of the rack from the exterior cell wall and the change in size of the tool storage area to accommodate rack movement during an earthquake.~~

SUPERSEDED

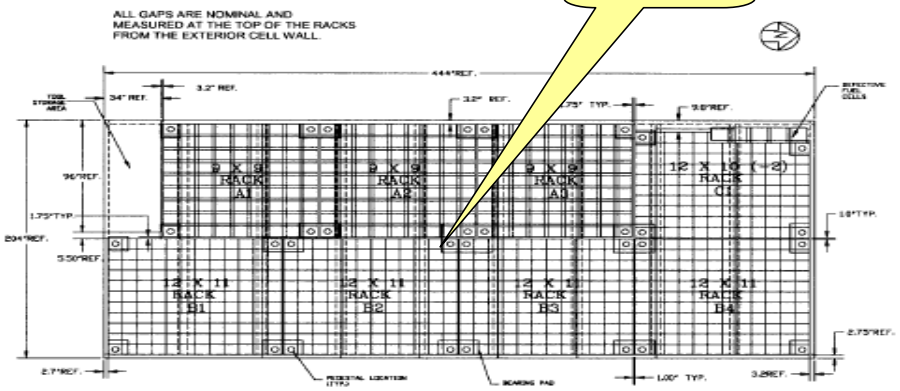
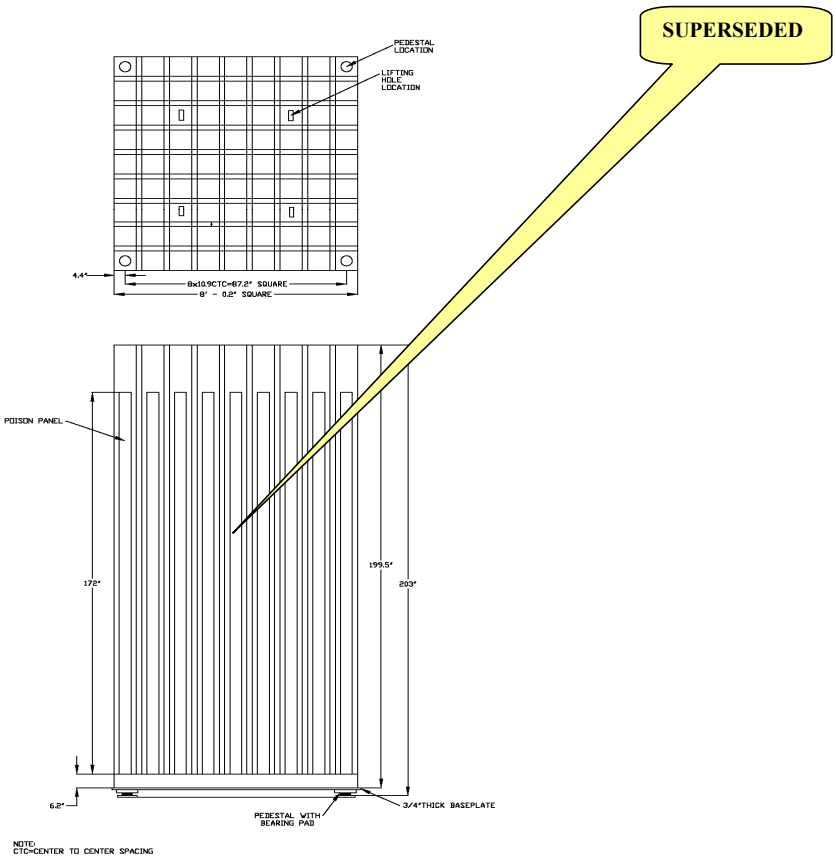


Figure 2-1 Spent Fuel Pool Storage Layout (889 Total Storage Locations) – Leak Chases Show in Phantom

~~Figure 2-3 (Sheet 1 of 2) has been changed to reflect the correct distance from the TOP of the bearing pad to the top of the rack.~~



~~Figure 2-3 Configuration of a Region 2 Storage Cell (Sheet 1 of 2)~~

TR Changes: (Revision 3A)

None.