Department of Energy
Washington, DC 20585

JUN 30 2010

The Honorable Peter S. Winokur
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, DC 20004-2901

Dear Mr. Chairman:

On March 29, 2010, the Office of Environmental Management (EM) transmitted an initial response to the Defense Nuclear Facilities Safety Board (Board) regarding issues that the Board identified with existing designs at the Waste Treatment Plant at Hanford. In that response EM acknowledged that further analysis was necessary to address additional comments we received from your staff. The analysis was completed on May 31, 2010. Your staff and the Office of River Protection staff agreed that additional review, by the project Structural Peer Review Team (PRT), of these analyses should be done prior to finalizing the analysis. This information has been openly shared at the staff level, during four meetings (on January 21, February 3, March 26 and May 20, 2010). This review was completed on June 25, 2010, and the final report, along with input from the PRT, was provided to your staff (see enclosed).

Results of these analyses confirm that the existing methodologies used for the structural steel design of the Pretreatment, High-Level Waste, and Low-Activity Waste facilities provide a conservative basis to assure that these structures will perform their intended safety function. The design methodology (e.g. enveloping load and redundant strength capacity) is within the standard industry practices, and provides structures with allowable strength margins that are within the applicable design codes.

If you have any questions, please contact me or Dr. Steven L. Krahn, Deputy Assistant Secretary for Safety and Security Program at (202) 586-5151.

Sincerely,

Inés R. Triay
Assistant Secretary for
Environmental Management

Enclosure

Enclosure 1

List of DNFSB issues and the resolution Documents

(Documents transmitted separately in DVDs)

Document	Description	Issue
WTP-ATS-10-0383(HLW) WTP-ATS-10-0389 (PTF)	These ATS's contain response to the DNFSB questions relating to the effect to intermediate mass nodes in the comparison of the SAP and SASSI axial force results.	Modeling of intermediate mass points in the SAP to SASSI comparison. *Comparison of the SASSI2000 an SAP2000 member forces is intended to show adequacy of SAP2000 results for design in spite of the fact that the out of phase motion considered in SASSI solution is not included in SAP2000 response spectrum analysis. The SAP refinement includes additional mass points in the superstructure model. The additional refinement may mask the comparison of the results between two solutions which was intended to evaluate the effect of the out of phase motion of support points. A one to one assessment of the effect of out of phase motion of support points is requested.*
24590-LAW-S0C-S15T-00027	24590-LAW-S0C-S15T-00027: LAW Facility Hybrid Composite Verification FEM	Modeling Issues: *Framing members between adjacent columns in HLW, PT, and Low-Activity Waste (LAW) are not modeled in the analysis, as attached to or supporting the concrete floor slab. The resulting analysis is inconsistent with actual behavior. In addition, the stiffness of the supporting member (secondary framing), as well as members acting compositely with the concrete floor slab, affects load distribution in the building. These factors need to be considered in the analysis and compared with the previous results to determine the potential impact on the existing design.* *The supporting girders or beams are not modeled as attached to or supporting the concrete floor slab, but as independent members framing between adjacent columns.* *A 1-inch-wide elastomeric joint exists around the perimeter of the steel column, preventing load transfer between the concrete floor slab and supporting members in (PT and HLW) invalidating the assumption concerning floor slab-column connectivity. In LAW, the concrete floor slab is cast directly against the face of the steel columns. The Board's staff determined that the concrete at this interface would crush well before the predicted loads are reached. Because of the modeling approach used, load transfer from the concrete floor slab to the columns was not properly considered. Further, the stiffness of the supporting members acting compositely with the floor slab affects load distribution.* *While a composite cross-section exhibits greater load-carrying capacity than a comparable non-composite cross-section, the design adequacy of the composite cross-section must be validated*
24590-HLW-S0C-S15T-00143	SAP 2000 hybrid verification model, to validate the current HLW facility equivalent static finite element model	
24590-PTF-S0C-S15T-00065	SAP 2000 hybrid verification model, to validate the current PTF facility equivalent static finite element model	

		by comparison with code acceptance requirements, even if the girders or beams are capable of carrying their share of the total load separately. *These (composite) effects need to be considered in the analysis to enable comparison of the originally modeled behavior and a mode more representative of actual behavior. If the difference is significant, the analysis and design of record should be revised to reflect actual behavior.* *(In terms of hand calculations of beams for composite design), It would be prudent, in highly loaded areas of each building, to compare design results based on the approximate method (in hand calculations for seismic loads) with results obtained from Finite Element Model (FEM) analyses to confirm the adequacy of the design.*
24590-HLW-S0C-S15T-00143	SAP 2000 hybrid verification model, to validate the current HLW facility equivalent static finite element model (Includes section &.? on stud check)	Steel Stud Adequacy: *The project team did not develop calculations to validate the adequacy of the steel stud patterns or evaluate the effect of the actual stress distribution of composite members for the HLW, PT, and LAW building designs. These issues need to be thoroughly evaluated so their impact on the existing designs can be determined.* *No calculations exist to validate code allowable lood transfer for the various stud spacing patterns used.*
24590-PTF-S0C-S15T-00065	SAP 2000 hybrid verification model, to validate the current PTF facility equivalent static finite element model (Includes Section 7.? on Stud Check)	
24590-HLW-SSE-S15T-00030	Evaluate stress distribution between concrete and steel in the composite beams	Secondary Beams: *The simplified approach used to evaluate the design adequacy of members involves approximating seismic loads and neglecting the action of secondary beams and may not always be conservative. These assumptions need to be thoroughly evaluated so their impact on the existing designs can be determined.* *It is non-conservative to neglect secondary beams when calculation midspan (maximum) moment. Concentrated loads at the one-third or one-quarter points equal to the total uniform load previously determined result in midspan moments greater than those calculated based on uniform loading.*
24590-HLW-SSE-S15T-00175	Evaluate stress distribution between concrete and steel in the composite beams	
24590-PTF-SSE-S15T-00149	Evaluate stress distribution between concrete and steel in the composite beams	
24590-PTF-SSE-S15T-00144	Add column loads & evaluate the stress distribution between concrete and steel in the composite beams	

Enclosure 2

ORP Structural Peer Review Report

June 2010

ORP Structural Peer Review Team

Loring Wyllie,

Degenkolb Engineers

Greg Mertz,

Los Alamos National Laboratory

Frederick Loceff,

Frederick Loceff Technical Services

Revision 0

ORP Structural Peer Review Report

June 2010

Introduction

This report covers ORP Structural Peer Review Team (PRT) reviews from October, 2009 until the present. During this period the main areas of focus were on the HLW and PTF structural Steel Design and the composite beam modeling refinements for LAW, HLW and PTF. Several related issues were contained in the December 2nd DNFSB letter [1] and the PRT provided active review of all of the ORP responses to all of the issues contained in the DNFSB letter.

The PRT reviewed and commented on the Structural Steel Design calculations for the PTF and HLW buildings. Responses to the comments were acceptable to the PRT and are being tracked in the BNI Action Tracking System (ATS). A summary and details of this review can be found in the December 2009 ORP Structural Peer Review Report [2]. The revised PTF and HLW calculations that incorporate the responses are scheduled to be issued in October 2010 and February 2011.

Composite Construction

One issue in the DNFSB letter [1] questioned effects of differences in analysis results that would exist if the finite element analysis models were modified 1) to more accurately represent the as constructed condition of composite beam construction and 2) to more accurately represent the connection designs at the intersection of columns, beams, bracing and slabs. To respond to these issues it was agreed between the ORP and the DNFSB that three calculations; one for each of the main building structures, LAW, PTF and HLW, be prepared to identify if any differences between results from a more accurate modeling of as constructed conditions compared to results from the calculations of record exist that would result in design changes. It is noted that the more accurate modeling was not considered necessary by the PRT based on previous reviews and understanding of the WTP structural designs and conservatism in the design process. However, this issue was not susceptible to resolution without implementing refined modeling of the building structures.

The PRT participated in discussions with ORP, BNI and the DNFSB that settled on the methodologies for the modeling refinements to be implemented in these new calculations and also to concur on the areas to be refined in each of the three building models. Because of the planned release of the calculations to the DNFSB by the end of June, reviews by the PRT took place while the calculations were being prepared. This included reviews of the computer models, spreadsheets containing the computer analysis results that correlated and summarized these results and Mathcad calculation sheets that evaluate the structure for the loads from the

analyses. Calculation reports that provided discussion on how the analyses were implemented, that summarized results of the analyses and that provided comparisons between the refined analyses results and the calculations of record were reviewed. Because of the active nature of the review, comments were provided in several formats; formal comment sheets, emails of comments that required immediate attention, mark-up of draft calculation reports and teleconferences. In many instances the comments were incorporated into revisions to the draft calculations rather than inserted into the BNI ATS tracking system. The refined modeling calculations are in References 5, 6 and 7.

Refined Modeling

The PRT's review of the refined finite element models, associated calculations and the contractor's responses to comments for LAW, PTF and HLW support the contention of the ORP contractor and the PRT that the buildings as re-analyzed and originally designed are adequate for the postulated design loads based on the existing calculations of record and no changes to the design are necessary due to the results from the refined finite element models. The PRT bases its conclusion on the following observations.

- The modeling refinements used provide a reasonable and accurate representation of the as built conditions that consider composite behavior and design details that reflect the connections between slabs, beams columns and braces.
- The refined models include the secondary beams, which were evaluated in the calculation of record using conservative loading independent from the analysis models. The results from the refined analysis demonstrated the conservative approach used for the design of the secondary beams.
- The number of elements per beam and the number of ties that represent the connectivity of the shear studs between the steel beam and the concrete slab is adequate to represent the shear loading distributed to the studs.
- The SAP and GT STRUDL finite element models are appropriately constructed and include the applicable load cases.
- The post processing, particularly for the GT STRUDL analysis, while complicated, provides the forces and moments for evaluation of the structural members. The description of the post processing in the calculation has been expanded from the initial drafts to enable a better understanding of how the forces and moments are combined and enveloped during post processing.
- The forces and moments used for design of the structural members are generally enveloping for given member types (beam, column, brace) and sizes.
- The results show that all demand to capacity ratios (DCR) remain within code allowable limits and with one exception the DCRs generated from the refined models are generally less than those in the unrefined models and less than the DCRs contained in the design

calculations of record, which include in many cases combined computer along with traditional calculation techniques. The one exception is the HLW W12W35 beam where the DCR for the refined model is 0.86 and for the calculation of record is 0.84, a difference of less than 2.5%

- The bearing stresses between the concrete slab and the steel columns in the LAW building structure have been shown to be sufficiently low to avoid the possibility of loss of contact due to bearing failure.
- The response of the building structures, as reflected by the force distributions in the steel bracing and beams, is consistent between the refined models and the models without the refinement.

Shear Studs

The calculations of record for shear stud capacities are contained in References 8 and 9 for the PTF and HLW structures. These calculations consider only the capability of the shear studs to carry load transferred to the steel beams from its vertical bracing. Additional evaluations of shear studs for combined loading based on the force distribution in the PTF and HLW refined models have been included in PT and HLW refined modeling calculations [6, 7] and shows that the shear studs are capable of carrying the combined loads. Evaluation of the shear studs for the LAW calculation [10] demonstrate that the combined effects of vertical and lateral loading are such that the shear studs are capable of resisting the combined design loads.

PTF and HLW Response Spectra Analysis

The response spectra analyses of the PTF [3] and HLW [4] were reviewed and comments provided in Reference 2. The responses to these comments are in the BNI ATS and were judged acceptable to the PRT and will be incorporated into the calculations at a later date.

Out of phase motion

The confirmation that the out-of-phase concrete anchorage motion of the steel structure has been shown to be of little consequence by comparing the axial forces in the steel members from the SAP RSA model (in-phase anchorage) used for the response spectra analysis with the axial forces in the steel members from the SASSI analyses, which captures the out-of-phase effects. An appendix to each of these calculations was prepared that compares the differences between the SAP analysis results with the SASSI analysis results for axial loads in members in order to evaluate the effect of not including intermediate node masses between the ends of the beam members, as used in the SAP RSA analyses and to assure that the initial comparison between the SAP and SASSI results was reasonable. In general the results are comparable; however there are a few notable differences in the PTF structure for both the initial and the revised evaluations. These are ascribed to modifications to the steel structure after the final

SASSI analyses were completed. These modifications are local design changes to accommodate a pipe rack. For the NS seismic event there were 18 members in the revised evaluation that had axial stress greater than 5 ksi where the SASSI analysis results exceeded the SAP stresses by more than 10%. In the HLW comparison there are no members with axial stresses of 5 ksi where SASSI stresses are greater than axial stresses in the SAP analysis by more than 10%. Comparing structural members with axial stresses greater than 5 ksi is judged reasonable for the typical member sizes and lengths used for the structural steel in these two building.

Summary

The responses to the DNFSB issues confirm that the existing design of the LAW, PTF and HLW buildings based on the calculations of record are safe with respect to the prescribed design loads, are within code allowable criteria and that no modifications are required to the LAW, PTF and HLW building structures because of these issues raised by the DNFSB Staff.

The ORP contractor's original modeling logic was generally consistent with the intent of using the FEM model to design the lateral load path and using simple hand analysis to design for the vertical load path. This confirms the DOE and PRT contention that the forces and moments used for design, because of conservative assumptions and design methodology, are greater than forces and moments developed using the refined model and in particular because of the thick slabs that are supported on substantial shear walls, the use of refined modeling was not necessary for the HLW and PTF structures.

References

1. Mansfield to Triay, DNFSB Letter, December 2, 2009.
2. Wyllie, Loring, Frederick Loceff, ORP Structural Peer Review Report of the October 2009 Peer Review, Revision 1, December 2009
3. 24590-PTF-SOC-S15T-00062, PTF Roof Steel Structure Response Spectrum Analysis
4. 2459024590-HLW-S0C-S15T-00229 HLW Steel Finite Element Model for Response Spectrum and Static Analyses
5. 24590-LAW-S0C-S15T-00027, LAW Facility Hybrid Composite Verification FEM
6. 24590-PTF-S0C-S15T-00065, PT Facility Hybrid Composite Verification FEM
7. 24590-HLW-SOC-S15T- 00143, HLW Facility Hybrid Composite Verification FEM
8. 24590-PTF-SSC-S15T-00353, Seismic Qualification of Beam Shear Studs for Transfer Bracing into 1'0" Thick Slabs
9. 24590-HLW -SSC-S15T-00313, Qualification of Beam Shear Studs for Transfer Bracing Force into Concrete slabs at Elevation 58'-0".
10. 24590-LAW-SSC-S15T-00156, LAW Design Behavior Considerations for Composite Action