Department of Energy
Washington, DC 20585
May 21, 2004

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, DC 20004-2901

Dear Mr. Chairman:

The purpose of this letter is to provide a response to concerns identified by your letter of March 23, 2004. The Defense Nuclear Facilities Safety Board (DNFSB) asked how the Department of Energy (DOE) will ensure the Bechtel National, Inc. (BNI) proposed methodology for developing requirements for fire resistance for structural steel used in Waste Treatment and Immobilization Plant (WTP) facilities receives adequate review and comment through a peer review process, consistent with the process that would be expected of any consensus code requirement. The DNFSB further requested DOE to discuss why the proposed methodology should be used in lieu of recognized methods already in use in the fire protection and structural engineering communities, and address any potential structural or safety impacts on the WTP facilities.

This letter and the enclosed response address the DNFSB questions. As noted in the DNFSB's letter, the BNI methodology for justifying a reduction in fire resistance ratings of structural steel was still evolving when the DNFSB letter was issued. As discussed in the enclosed response, a revised methodology has been proposed that is significantly different than the methodology previously discussed with DNFSB staff. Specifically, BNI does not intend to use the performance-based approach of performing heat transfer analyses coupled with limiting temperature criteria from British Standard BS 5950-8:2003, *Structural use of steelwork in building*, to determine the response of structural columns to fire effects. Instead, BNI will use qualitative analyses to determine the adequate protection requirements set and controls. BNI believes that the structural steel elements in the WTP process buildings may be adequately protected from postulated fire events by the existing automatic fire suppression system (wet pipe sprinkler system) and the installation of additional sprinkler heads located to protect the lower portions of structural steel columns from the effects of postulated worst-case fires. However, the potential need for fire-resistance coating will be evaluated as part of the equivalency approach. The qualitative analyses will include consideration of room heights, sprinkler actuation set points,

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and multiple fire magnitudes. The project Preliminary Fire Hazard Analysis reports will be revised accordingly. This approach for protecting WTP structural steel does not involve the development of an ad hoc fire protection code or standard. Rather, the equivalency provisions of the International Building Code, 2000 Edition, and DOE Standard DOE-STD-1066-97 will be used.

DOE will retain the services of an independent technical expert knowledgeable of the building code, National Fire Protection Association standards, and DOE requirements to perform an independent technical review of the BNI analyses and conclusions. The independent technical review will assess the use of active systems and passive systems. From this information and the revised BNI equivalency methodology, DOE will determine the structural steel fireproofing requirements for the WTP. The results of this review will be provided to the DNFSB.

Thank you for meeting with us on May 18. I realize that the Board has continuing concerns regarding the WTP and we have scheduled a follow-on meeting on June 2. As a result, we may need to provide refinements to this response.

If you have further questions, please call me at (202) 586-7709 or Ms. Patrice Bubar, Deputy Assistant Secretary for Integrated Safety Management and Operations Oversight, at (202) 586-5151.

Sincerely,

Jessie Hill Roberson
Assistant Secretary for
Environmental Management

Enclosure:
Response to DNFSB Letter

cc:
M. Whitaker, DR/DOE
P. Bubar, EM/DOE
I. Triay, EM/DOE
C. O'Dell, EM/DOE
C. Fetto, ORP/DOE
R. Schepens, ORP/DOE
S. Hahn, RL/DOE
M. Sautman, DNFSB

Response to Defense Nuclear Facilities Safety Board (DNFSB)
Letter dated March 23, 2004

References

1. Defense Nuclear Facilities Safety Board letter from J. T. Conway to J. H. Roberson, DOE, dated March 23, 2004.

2. DOE letter from R. J. Schepens to J. P. Henschel, BNI, "Submittal of Fire Protection Equivalency Request – (Structural Steel Fireproofing)," 03-OSR-0436, dated December 4, 2003.

3. BNI letter from J. P. Henschel to R. J. Schepens, ORP, "Request for Acceptance of Analysis Approach for Unprotected Structural Steel," CCN: 077695, dated December 23, 2003.

Introduction

In their March 23, 2004, letter (Reference 1), the DNFSB requested DOE identify its process for conducting a peer review of the methodology used to implement a performance-based approach for developing requirements for the fire resistance of structural steel used in Waste Treatment and Immobilization Plant (WTP) process buildings. As is discussed further below, the WTP Contractor (Bechtel National, Inc., BNI) is no longer pursuing the use of a performance-based approach to determine the structural steel fire resistance requirements, but instead intends to seek approval of an equivalency permitted (in principle) by the International Building Code (IBC, Section 104.11, Alternative materials, design, and methods of construction and equipment) and DOE Standard DOE-STD-1066-97 (Section 1.0, Scope).

Background

The fire protection design and construction for the Waste Treatment and Immobilization Plant (WTP) process buildings [Pretreatment, High Level Waste (HLW), Low Activity Waste (LAW), and the Analytical Laboratory (AL)] are required to meet the requirements of the International Building Code (IBC), 2000 Edition, Chapters 1-15 and 24-35, and U.S. Department of Energy (DOE) Standard DOE-STD-1066-1997. For the majority of the primary, load-bearing structural steel elements in these WTP buildings, the IBC and DOE-STD-1066-97 require protection of the steel against fires for a duration of 2 hours. Depending on the IBC Construction Type determined for the building (Type I-B for Pretreatment and Type II-B for HLW, LAW, and AL), the building code specifies the fire-resistance rating requirements for building structural elements. For Construction Type I-B, the building structural elements are required to have a fire-resistance rating of 2 hours, except for the roof structure, which only requires a fire-resistance rating of 1 hour. For Construction Type II-B, the building elements are not required to have a fire-resistance rating. However, the fire-resistance ratings of the building structural elements must also meet other building code requirements for fire-resistive construction, including those for occupancy separation, fire barrier assemblies in Group H (hazardous) occupancies, vertical exit enclosures, exit passageways, horizontal exits, incidental use areas, and

shaft enclosures. For the protection of electronic computer and data processing equipment, the fire resistance requirements from National Fire Protection Association (NFPA) Standard 75 must also be met, as this standard is specifically referenced by NFPA 801, a WTP project Safety Requirements Document implementing standard. Finally, DOE-STD-1066 requires fire barrier walls, floors, and ceilings in these WTP process buildings, including penetrations through these structures, to be constructed to achieve a minimum fire-resistance rating of 2 hours under conditions of failure of any fire suppression system not designed as a safety class item.

Original Alternative, Performance-Based Approach

In 2003, the WTP design authority, BNI, became concerned that compliance with the structural steel fireproofing requirements of the IBC, NFPA standards, and DOE-STD-1066-97 described above would require the expenditure of significant project resources and result in a level of fire protection for structural steel elements in WTP process buildings not necessary for the fire hazards present. Accordingly, BNI submitted a request for development of an alternative, performance-based approach for determining requirements for the fire resistance of structural steel used in WTP process buildings, as allowed by the IBC (Section 104.11, Alternative materials, design, and methods of construction and equipment) and DOE-STD-1066-97 (Section 1.0, Scope). Reference 2 provided DOE approval for use of the performance-based approach predicated on BNI revising the Preliminary Fire Hazards Analyses (PFHAs) to substantiate that credible fire events within areas of the WTP process buildings with unprotected structural steel were adequately analyzed to ensure the building structural integrity and fire safety remained acceptable. Reference 3 provided an overview of BNI's performance-based approach for analyzing areas of WTP process buildings with unprotected structural steel; ORP concurred with this approach (with the intent to review and approve its specific application when it was identified by BNI).

The performance-based approach included the use of qualitative analysis to show that horizontal structural steel beams and the upper portions of the structural steel columns are adequately protected from fires by the existing automatic fire suppression system (water based sprinkler system). For the lower portions of the structural columns, the performance-based approach included the performance of realistic, but conservative, heat transfer calculations to determine column heat-up during fire events coupled with limiting temperature criteria from British Standard BS 5950-8:2003, *Structural use of steelwork in building*. During the development of the performance-based approach, BNI concluded the required calculations were complex, required many assumptions, and could result in uncertain and/or exceedingly conservative results. Accordingly, BNI abandoned this performance-based approach and, instead, is developing an equivalency approach to compliance with the structural steel fire protection requirements. DOE agreed with BNI's change in plans for resolution. **As such, DOE is no longer pursuing a performance-based approach for the protection of structural steel from the effects of fires.** BNI is developing an equivalency, discussed further below, that DOE expects will provide documented justification for concluding that WTP process building structural steel is adequately protected from credible fire events. DOE expects to receive the formal equivalency request from BNI by June 30, 2004.

Revised Approach (Equivalency)

Consistent with the use of alternate approaches allowed by the IBC and DOE-STD-1066-97, BNI is developing an equivalent approach to the protection of WTP process building structural steel from the effects of credible fire events. The equivalency is expected to show that horizontal structural steel elements (beams) and the upper portions of structural steel columns do not require fireproofing based on protection provided by installed automatic fire suppression systems (water based sprinkler systems). The lower portions of the structural steel columns, which are expected to be more substantially affected by a fire, will require additional protection. This protection will be achieved by installing additional sprinkler heads, beyond those required by the IBC or DOE-STD-1066-97, along the structural columns. The additional sprinkler heads will be installed in close proximity to the lower portions of structural columns and designed to actuate at temperatures well below the temperature at which the structural steel column or the structure would be significantly impacted by a fire event. This approach to the protection of the structural steel beams and columns relies upon "recognized methods already in use in the fire protection and structural engineering communities" and is consistent with approved project standards. The details of the installation of additional sprinkler heads will be part of the formal equivalency request to be submitted by BNI by June 30, 2004.

The adequacy of the protection provided to the structural steel beams and columns will be determined through qualitative analyses based on the room height, sprinkler actuation set point, and multiple fire magnitudes.

DOE and Peer Reviews

The Office of River Protection (ORP), as the Authority Having Jurisdiction, will review and approve the results of the qualitative analyses demonstrating the adequacy of the protection provided to structural steel elements in the WTP process buildings. In addition, the results of the qualitative analyses will be incorporated into the Preliminary Fire Hazards Analyses (PFHAs) for the WTP process buildings during the next scheduled update of these documents. Facility design, fire protection systems, and combustible loading assumptions will be verified and documented in the final facility Fire Hazards Analysis (FHA) prior to facility operation. As required by DOE Order 420.1A, the conclusions of the FHA will be incorporated into the Safety Analysis Report (SAR) accident analyses and integrated into design basis and beyond design basis accident conditions. The PFHAs, final facility FHA, and the SAR are project deliverables that will be formally reviewed and approved by ORP.

ORP will also have an independent technical review performed of the BNI equivalency request and qualitative analyses discussed above. Arrangements are being made for this review to be performed by Mr. James Begley of Schimer Engineering, Inc., who performed a similar peer review at the Y-12 facility in Oak Ridge, Tennessee.

Path Forward

In the revised equivalency approach, BNI will consider the individual and integrated effects of the following functions:

- The structures, systems, and components in these buildings are constructed of noncombustible materials,
- Specific Administrative Control(s) to ensure the buildings contain quantities of fixed and transient combustibles are kept substantially below the Design Basis Fire/Preliminary Fire Hazard Analysis assumptions,
- Increased sprinkler water spray density: the sprinkler systems are being designed and installed in accordance with Ordinary Hazard (Group 2) requirements per NFPA Standard 13, resulting in a water spray density of 0.17 gpm/ft^2 over 3,000 ft^2; while design and installation in accordance with Ordinary Hazard (Group 1) (0.15 gpm/ ft^2 over 1,500 ft^2) would be allowed,
- Additional automated sprinklers along the structural columns: a sufficient number of properly located additional sprinkler heads will be installed along the structural columns to protect the lower portions of the columns from the affects of postulated fires,
- Passive 2-hour fire-resistance to protect the lower portions of the columns, and
- Appropriate functional classification and performance requirements for both passive and active controls, including performance requirements under seismic events.

DOE will thoroughly evaluate the revised equivalency information prepared by BNI and the independent technical review completed by Mr. Begley. DOE will ensure that the fire protective approach selected is adequate and does not result in significant structural or safety impacts to WTP facilities.