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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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June 24, 2008

The Honorable James A. Rispoli
Assistant Secretary for Environmental Management
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Mr. Rispoli:

The staff of the Defense Nuclear Facilities Safety Board (Board) recently reviewed Authorization Basis Amendment Request (ABAR) 24590-WTP-SE-ENS-06-0199, Revision 1, *Tailoring of DOE-STD-1066-97, Fire Protection Design Criteria, Section 14, Nuclear Filter Plenum Protection Based on Hazard Analysis.* The request was submitted by Bechtel National Incorporated (BNI) to modify fire safety design requirements for the Waste Treatment and Immobilization Plant (WTP) for protection of confinement ventilation systems from the effects of a fire. The intent of the request was to provide an alternative means of protecting the final exhaust high efficiency particulate air (HEPA) filters of the confinement ventilation systems in a manner equivalent to that of the features prescribed in Department of Energy (DOE) Standard 1066. The Board notes that DOE-STD-1066 permits the use of equivalent (or superior) methods of fire protection for nuclear final filter plenums. However, the Board's staff identified significant issues pertaining to the proposed tailoring of the standard, adherence to higher-tier policies, and the underlying technical justification for the request, as detailed in the enclosed report. The following issues were of particular concern:

- The ABAR proposed tailoring of DOE-STD-1066 that relied substantially on BNI's Integrated Safety Management (ISM) process for final design decisions regarding fire protection for the final exhaust HEPA filters, instead of providing a clear request for use of alternative design features. This approach could have compromised the effectiveness and timeliness of DOE's oversight of the design.

- The fire protection posture described in the ABAR and supporting documentation may not have provided adequate protection of the safety-class confinement ventilation systems for the High Level Waste and Pretreatment facilities as specified by DOE Order 420.1B, *Facility Safety,* and *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems.*

- The request proposed use of computational technical analyses to justify the elimination of design features prescribed by DOE-STD-1066 (e.g., ember screens and prefilters). Formal validation of the technical adequacy of such analyses would be required. An initial assessment by the Board's staff of the technical analyses in support of the ABAR revealed discrepancies and errors.

- The ABAR addressed gaps identified during the evaluation of the confinement ventilation systems for WTP performed according to *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*. The involvement of the Program Secretarial Office and Central Technical Authority in review and approval of an ABAR involving ventilation system design needs to be clarified to ensure the intent of the *Implementation Plan for the Defense Nuclear Facilities Safety Board's Recommendation 2004-2, Active Confinement Systems,* regarding resolution of any gaps is met.

The Board notes that Department of Energy-Office of River Protection (DOE-ORP) has recently rejected the ABAR due to its weak technical basis, failure to clearly identify equivalent fire protection features, confusing methodology, and prolonged schedule for completion of supporting technical analyses. DOE-ORP, as part of the rejection, provided direction to BNI to resubmit the proposal.

The Board observes that this particular issue may be an example of the concern with the WTP project's Decision to Deviate process noted in the Deputy Assistant Secretary for Safety Management and Operations – Environmental Management memorandum of April 29, 2008 to the Manager, DOE-ORP; specifically, the delay in resolution of safety concerns resulting in cost and schedule risks.

The enclosed report, prepared by the Board's staff, is provided for your information and use as appropriate in resolution of this issue.

Sincerely,

A. J. Eggenberger
Chairman

c: Mr. Glenn S. Podonsky
Mr. Richard H. Lagdon, Jr.
Mr. Mark B. Whitaker, Jr.
Mr. Robert J. McMorland

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

May 6, 2008

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

COPIES: Board Members

FROM: D. Eyler

SUBJECT: Fire Protection for the Final Exhaust High Efficiency Particulate Air Filters of the Waste Treatment and Immobilization Plant Confinement Ventilation Systems

This report summarizes a review performed by the staff of the Defense Nuclear Facilities Safety Board (Board) of an authorization basis amendment request (ABAR), submitted by Bechtel National Incorporated (BNI), to modify existing fire safety design requirements for protection of the confinement ventilation systems of the Waste Treatment and Immobilization Plant (WTP) from the effects of fire. The staff's review addressed potential design changes to the Pretreatment (PT), High Level Waste (HLW), Low Activity Waste (LAW), and Analytical Laboratory (LAB) facilities. The on-site portion of the review was conducted March 11–13, 2008, by staff members D. Eyler, S. Stokes, C. March, W. Linzau, and R. Quirk.

Background. The safety-related design requirements for WTP are contained in 24590-WTP-SRD-ESH-01-001-02, Revision 5, *Safety Requirements Document (SRD), Volume II.* This document serves as the project's "List B." As such, the SRD is considered part of the project's authorization basis. BNI's proposed changes to the SRD are governed by RL/REG-97-13, Revision 11, *Office of River Protection Position on Contractor-Initiated Changes to the Authorization Basis.* RL/REG-97-13 requires that SRD change proposals be submitted in an ABAR that contains a "Safety Evaluation for Design," which describes the change, its justification, and a formal evaluation of any safety impacts.[1] The Department of Energy-Office of River Protection (DOE-ORP), in turn, reviews each proposed ABAR and approves or disapproves the recommended change(s) with or without conditions in a Safety Evaluation Report (SER).

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[1] RL/REG-97-13, pp. 6–7. RL/REG-97-13 specifies that proposed revisions involving modification of a standard previously identified in the SRD "identify a set of standards that will continue to provide adequate safety, comply with all applicable laws and regulations, and conform to top-level safety standards." For changes to the SRD, the proposed revision must demonstrate conformance to the top-level safety standards contained in DOE/RL-96-0006, *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for the RPP Waste Treatment Plant Contractor.*

On January 31, 2008, BNI submitted ABAR 24590-WTP-SE-ENS-06-0199, Revision 1, *Tailoring of DOE-STD-1066-97, Fire Protection Design Criteria, Section 14, Nuclear Filter Plenum Protection Based on Hazard Analysis*, to DOE-ORP for approval. BNI proposed tailoring of the fire protection design standards for the final exhaust high efficiency particulate air (HEPA) filters of the confinement ventilation systems contained in Chapter 14 of DOE Standard 1066. This proposed change represents a significant departure from DOE-STD-1066. Instead of the specific design requirements identified in DOE-STD-1066, a substantial portion of BNI's proposal involves a process-orientated approach that combines fire hazards analysis with BNI's Integrated Safety Management (ISM) process for the selection of fire protection controls for these HEPA filters. BNI performed several technical analyses (e.g., heated air, ember transport, and soot loading calculations) in support of the proposal. Attachment 1 to this report provides a summary of the tailoring of DOE-STD-1066 proposed by BNI and the staff's analysis of this approach.

Department of Energy-Office of River Protection Approval. DOE-ORP intends to conduct an expert-based review of the ABAR to ensure that the proposed approach provides protection equivalent to that of the controls prescribed by DOE-STD-1066. This review will be performed by personnel with experience in nuclear safety, fire protection, and heating and ventilation system design. This multidisciplinary group will evaluate the effectiveness of the system functional requirements described in the ABAR and determine whether the controls provide a level of safety comparable to that specified in DOE-STD-1066.[2] If DOE-ORP decides to approve the ABAR, its SER will be forwarded to DOE's Office of Environmental Management (DOE-EM) as input for addressing the design's noncompliance with DOE-STD-1066.[3]

Given the process-oriented approach proposed by BNI, the Board's staff questioned how design decisions made using the ISM process would be reviewed by DOE-ORP. DOE-ORP personnel stated that the design changes would be reviewed as part of final WTP design reviews or during the required biennial updates of the Preliminary Safety Analysis Report. The staff notes that this approach could result in DOE-ORP's not concurring with some relevant BNI design decisions in a timely manner. This issue is particularly significant if DOE-ORP determines that BNI's decision(s) lack technical merit and design changes or additional technical evaluations are needed, posing the risk of cost increases and/or schedule delays. For example, as part of its justification, the ABAR cites fire suppression systems being on certain cranes. However, the ISM meeting minutes referenced in the ABAR regarding these systems mention

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[2] DOE-STD-1066, section 14.10 states "It is not the intent of this Standard to prevent the application of alternative methods that provide equivalent or superior fire protection for nuclear final filter plenums. Therefore, equivalencies from fire protection guidelines provided in this section are permitted."

[3] This previously identified noncompliance was highlighted during the evaluation of the confinement ventilation systems for WTP in accordance with *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*; that evaluation was performed as part of the *Implementation Plan for the Defense Nuclear Facilities Safety Board's Recommendation 2004-2, Active Confinement Systems.*

ongoing evaluations to determine whether the systems are necessary. These evaluations will be based on the final results of key supporting analyses (discussed below). Depending on the conclusions of these evaluations, the ISM process could result in a final decision to remove one or more of these systems. It is not clear if the DOE-ORP review of either the final analyses or the final design decision would occur in a time frame that would be in the best interest of the project's schedule and budget.

The staff also questioned how the Program Secretarial Office (PSO) and Central Technical Authority (CTA) will be involved in the concurrence with the ABAR as discussed in the Implementation Plan for Recommendation 2004-2. DOE-ORP personnel stated that they intended to communicate with DOE headquarters before approving the ABAR to ensure that it satisfies the expectations set forth in the Implementation Plan. This approach does not appear to be fully consistent with the current Implementation Plan (dated July 12, 2006), Deliverable 8.6.5, which states that for evaluations of safety-related ventilation systems, there will be "PSO concurrence and approval on disposition of gaps and upgrades identified in [the] evaluations after coordination with the Central Technical Authority, if necessary." It would be prudent to clarify the involvement of DOE-EM and the CTA in concurring with the ABAR before DOE-ORP initiates its approval process to ensure that the intent of the Implementation Plan is met and that the timely involvement of the CTA is assured. This clarification is particularly important since the scope, process-oriented approach, and alternative controls proposed in the ABAR represent a significant departure from DOE-STD-1066.

Analyses performed in support of the ABAR. The technical analyses supporting the ABAR evaluated the potential for failure of the final exhaust HEPA filters for the C5V systems during various credible fire scenarios.[4] These analyses address (1) the amount of soot generated and loaded onto the C5V final exhaust HEPA filters, (2) the air temperature to which the filters would be exposed, and (3) the potential for transport of burning embers to the filters. Each of these analyses includes assumptions that require verification and validation prior to WTP startup; the assumptions have been assessed by BNI as representing low technical risk. BNI used these analyses to justify elimination of certain design requirements of DOE-STD-1066 (e.g., deluge spray suppression systems, ember screens and heat detectors upstream of the filters), offering the rationale that the proposed design provides an equivalent level of protection through the use of select facility design features and administrative controls. For example, based on these analyses, BNI rerouted one ventilation duct and specified the installation of a local ember screen in the HLW facility to prevent failure of the C5V final exhaust HEPA filters due to heat and embers, concluding that with these design changes, the features prescribed in DOE-STD-1066 to protect the filters from these failures were not necessary. Considering the substantial reliance of BNI on these analyses to justify the proposal, the discrepancies noted in some calculations, and the new methodology contained in the ember transport analysis, the staff believes formal peer review of the calculations (and possibly additional research) is warranted. Attachment 2 to this report

[4] WTP facilities are divided into radiological areas according to the level of contamination; C5 designates areas with the highest contamination levels (e.g., black cells, hot cells).

provides a summary and the staff's assessment of the technical analyses done in support of the ABAR.

Potential Failure of the Final Exhaust HEPA Filters of the C5 Area Ventilation (C5V) Systems. The analyses performed in support of the ABAR show that for the HLW and PT facilities (which both have safety-class confinement ventilation systems), there are fire scenarios that will compromise the final exhaust HEPA filters as a result of soot loading to the point of filter rupture. These scenarios include (1) fire in the electrical cables for various cranes (e.g., filter cave and melter cave cranes for the HLW facility, filter cave and hot cell cranes for the PT facility), and (2) fire in the export or import truck bays (HLW facility only).

A fire involving the power cable reel for the filter cave crane for the HLW facility (located in the maintenance area for the HLW filter cave crane) is of particular concern. This crane is required to replace both the primary and secondary C5V final exhaust HEPA filters in the HLW facility. A fire in this crane's power cable would result in the crane's loss for up to 5000 hours, compromising the HLW facility's confinement ventilation system for an extended period following a fire. A significant radioactive release would be likely during that period as the result of an upset condition such as a leak or spill.[5]

To prevent or mitigate the impacts of the scenarios that introduce high levels of soot to the HLW and PT C5V systems, BNI has proposed several design features in lieu of the controls specified in DOE-STD-1066 (i.e., high efficiency prefilters) to protect the final exhaust HEPA filters from failure due to soot loading. For crane cable fires, the proposed features are (1) fast-acting over-current protection devices for the crane's electrical cabling, (2) quick-response sprinklers and smoke detection in the maintenance areas for the HLW and PT filter cave cranes, (3) fire suppression systems on the power cable reel enclosure for the HLW filter cave crane, on the HLW melter cave cranes, and on the PT hot cell crane, (4) high-differential pressure alarm for PT C5V primary final exhaust HEPA filters, and (5) limitations on the combustibility of HLW crane cabling and the overall combustible loading of the PT and HLW crane fire areas. For HLW truck bay fires, BNI has proposed using an administrative control: one of the exterior truck bay doors would remain open and the interior cask transfer door would remain closed when a truck tractor (which represents a substantial combustible load) is in the truck bay. The intent of this control is for the soot generated in a truck fire to migrate outside the facility instead of into the ventilation system.

Of the design and administrative controls identified in these scenarios, the only items designated as safety-class (SC) or safety-significant (SS) are the high-differential pressure alarm for the PT C5V primary final exhaust HEPA filters (designated SC based on other scenarios) and the fire suppression system on the power cable reel enclosure for the HLW filter cave crane

[5] 24590-HLW-RPT-ENS-08-001, Revision 0, *HLW Filter Cave Crane Fire Subsequent Release Frequency Evaluation*, p. 11. Additionally, in the event this postulated fire were to occur while the crane was extended into the filter bay, BNI has assumed that the crane could be retrieved mechanically from the filter bay into the crane maintenance area using the crane's power cable assembly, even though the cable would be damaged in the fire.

(designated SS). The SS designation of the latter control results from the potential to compromise the C5V ventilation system for an extended period (with subsequent release likely to result from another accident), as discussed above. The lack of other SC or SS design features or administrative controls is based on the minimal consequences of the full release of the assumed radiological inventory of the HEPA filters due to fire scenarios. BNI's analysis assumes that the full radiological inventory of the HEPA filters at the time of a fire would be limited to contamination resulting from normal plant operations, and not the much greater inventory following plant upset conditions. This assumption is consistent with the analysis performed for other accidents involving the C5V HEPA filters (e.g., drop of a filter) and with DOE Handbook 3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities.*

Additional Issues. DOE Order 420.1B, *Facility Safety*, requires redundant fire protection systems in areas where "safety class systems are vulnerable to fire damage, and no redundant safety capability exists outside of the fire area of interest...." Additionally, *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems* states that confinement ventilation systems for new facilities should be able to withstand credible fires.[6] Based on the justification provided in the ABAR, it is not clear that this guidance is met, particularly for scenarios in which the technical analyses conclude that the C5V final exhaust HEPA filters would fail as a result of soot loading. Furthermore, assessment of the proposal with respect to both of these documents and determination of whether the proposed design offers a level of protection equivalent to that specified in DOE-STD-1066 is difficult because of discrepancies between the ABAR and supporting documentation regarding the fire protection posture provided by the design (Attachment 3 provides examples of these discrepancies). At a minimum, the staff believes these discrepancies need to be resolved before the ABAR is approved. Clarification of how the proposed design meets the above guidance would provide additional assurance of the adequacy of the proposed design with respect to the facility's fire safety posture.

Dependence on fire department response as a means of protection also requires assessment, because for some scenarios, detection and fire department response is relied upon to provide one means of redundant fire protection of safety class confinement ventilation systems. For fire department response to be considered a redundant fire protection system, DOE-STD-1066 requires timely and effective response by the fire department; this criterion may not be met in all cases.[7]

Should the proposed design be determined to meet the above guidance, it may be appropriate to require that the non-SC/SS fire protection features that are relied upon to protect

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[6] *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems,* p. 21.

[7] DOE-STD-1066, section 4. For example, 24590-HLW-RPT-ENS-07-002, Revision 1, *HEPA Filter Hazard Analysis of High-Level Waste Facility (HLW) Filter Cave H-0104*, p. 35, credits fire department response with providing redundant protection in the event of a fire in the maintenance room for the filter cave crane; timely access to this area in the event of a fire in the crane power cable reel is questionable.

the SC C5V final exhaust HEPA filters be subject to Technical Safety Requirements (TSRs), as discussed in DOE Guide 423.1-1, *Implementation Guide for Use in Developing Technical Safety Requirements,* Section 4.10.5. Otherwise, the filters will be at increased risk of failure since Limiting Conditions for Operation will not be required; for example, operation of cranes with inoperable fire protection systems could occur.

Finally, the assumed effect of the administrative control for the HLW truck bay doors and the ability to retrieve the HLW filter cave crane mechanically following a fire in the power supply cable need to be verified by testing or modeling as appropriate.

Conclusion. The proposal contained in this ABAR represents a substantial departure from the requirements set forth in DOE-STD-1066 and advocates a process-oriented approach that relies on fire hazards analysis and the ISM process to determine the fire protection design features that will be used to protect the WTP confinement ventilation systems. This approach could result in a fire protection posture that will not provide protection to the C5V final exhaust HEPA filters equivalent to that prescribed by DOE-STD-1066. It is the staff's opinion that a more effective and straightforward approach would be to identify the specific set of design features that will be used, and to provide technical justification of their equivalency. Should DOE approve the ABAR as submitted, conditions will need to be specified to ensure adequate and timely review of the fire protection methods selected by BNI based on fire hazards analysis and the ISM process.

Attachment 1

Summary and Analysis of 24590-WTP-SE-ENS-06-0199, Revision 1, *Tailoring of DOE-STD-1066-97, Fire Protection Design Criteria, Section 14, Nuclear Filter Plenum Protection Based on Hazard Analysis*

1. Section 14.2.1, *HEPA Filters*. Adds Section FK of American Society of Mechanical Engineers (ASME) AG-1, *Code on Nuclear Air and Gas Treatment*, reflecting the use of radial flow cylindrical HEPA filters at WTP. **This change appears warranted.**

2. Section 14.2.3, *Filter Framing*. This section is being removed so as not to allow combustible construction of filter framing. The proposed filter housing design does not include combustible construction. **Tailoring of this section does not appear to be necessary.**

3. Section 14.2.4, *Number of Final HEPA Filters*. DOE-STD-1066 requires two stages of final filtration to be arranged in series. According to the proposed change, the final number of HEPA filters will be determined by the ISM process.[8] The proposed WTP design contains two stages of HEPA filters in the C5V and vessel/equipment filtering systems. **Tailoring of this section does not appear to be necessary.**

4. Section 14.3.1, *Final Filter Plenums Located inside Process Buildings*. DOE-STD-1066 requires that filter plenums located inside process buildings be separated from all parts of the building and enclosed by 2–hour fire rated construction. BNI's proposed design does not meet this requirement in some cases. According to the proposed change, the filter plenums will be spatially separated, enclosed with noncombustible material, and separated from adjacent process areas by 2–hour fire rated construction where practical. **This change appears to be warranted in that it provides a level of protection equivalent to that of DOE-STD-1066.**

5. Section 14.3.2, *Final Filter Plenums Located in Separate Buildings*. According to the proposal, this section would apply if it were determined through the ISM process that final filter plenums need to be housed in separate buildings. The proposed WTP design does not have the final filter plenums in separate buildings. **Tailoring of this section does not appear to be necessary.**

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[8] The justification for this change includes the following citation: "The DOE Nuclear Air Cleaning Handbook (DOE-HDBK-1169-2003) states, 'the exact number of testable stages is determined by safety analysis.' " However, the complete citation from DOE-HDBK-1169-2003 reads: "High-efficiency filters, preferably HEPA type, are typically required in air inlets, and two independently testable stages of HEPA filters are required in the exhaust. The exact number of testable stages is determined by safety analysis." BNI's incomplete citation does not accurately reflect the handbook's intent to have a minimum of two stages of HEPA filtration of the exhaust.

6. Section 14.3.4, *Small Filter Plenums*. According to the proposed change, this section would apply if it were determined through the fire hazards analysis/ISM process that use of small filter plenums is necessary. The proposed WTP design does not have small filter plenums. **Tailoring of this section does not appear to be necessary.**

7. Section 14.3.5, *Existing Plenums*. This section is being removed since the WTP is a new construction. **Tailoring of this section does not appear to be necessary.**

8. Sections 14.4, *Protection of Openings in Fire Rated Construction*, and 14.5, *Materials and Special Hazards Inside Plenums*. The ABAR states that sections 14.4.1, 14.5.1, 14.5.2, 14.5.3.1, 14.5.3.2, and 14.5.4 are being changed to be aligned with the current WTP design. Additionally, it states that section 14.5.3.2, which requires fixed combustible gas analyzers in the final filter enclosures when processes subject final filter plenums to flammable and combustible vapors, is not applicable since the proposed design yields no concentrations of combustible gases in WTP's HEPA filtration system, and that these analyzers would be installed only if determined to be necessary through the fire hazards analysis/ISM process. **With the exception of the change to section 14.5.3.2, these changes appear warranted. Regarding section 14.5.3.2, since WTP's confinement ventilation systems will exhaust hydrogen gas generated in process vessels, this section would appear to require the use of fixed combustible gas analyzers. However, without describing the technical basis for this change, the ABAR defers the decision to install fixed monitors to the fire hazards analysis/ISM process. This change does not appear warranted without further explanation or technical evaluation.**

9. Section 14.6.1, *Prefilters and Duct Entrance Filters*. The ABAR proposes revising this section to align it with the current WTP design, and removes the requirement for high-efficiency prefilters to protect the final exhaust HEPA filters from particles, lint, and dust. The ABAR justifies this change based on the WTP design features of low air flow in rooms, air supply filters, and moderate-efficiency C5V inbleed filters. **These changes appear warranted as long as the controls provided to prevent the failure of the final HEPA filters due to soot and embers are determined to be adequate.**

10. Section 14.6.2, *Fire Screens for Filter Plenums*. This section is being changed to remove the general requirement for fire screens upstream of the final filter plenums, as well as the specification for minimum distance between the filter screens and the final HEPA filters. The proposed change prescribes use of the fire hazards analysis/ISM process to determine when fire screens are required. **Removal of the general requirement is warranted if it can be shown that the analyses performed by BNI are technically adequate, and an equivalent level of protection will be provided. Removal of the specification for minimum separation between the filter screens and final filter plenums represents an**

exemption rather than a clarification of terms as stated in the ABAR summary and does not appear to be justified given the information in the ABAR.

11. Section 14.7, *Detection Systems*. This section is being changed to allow for use of the fire hazards analysis/ISM process to determine when heat detection systems in the ducting prior to final filter enclosures are necessary, as well as the specific design requirements. **This change is warranted if it can be shown that the analyses performed by BNI are technically adequate, and an equivalent level of protection can be provided.**

12. Section 14.8, *Deluge Spray Suppression Systems*, is being changed to eliminate the requirement for a deluge spray suppression system in the ducting prior to final filter plenums. Instead, the ventilation system design would be relied on to ensure that the final exhaust HEPA filters would not be subjected to air temperatures in excess of their design rating during a fire. **This change is warranted if it can be shown that the analyses performed by BNI are technically adequate.**

13. Section 14.9, *Special System Guidelines*. This section is being changed to align with the current WTP design. **This change appears warranted.**

Attachment 2

Summary and Analysis of Supporting Calculations for 24590-WTP-SE-ENS-06-0199, Revision 1, *Tailoring of DOE-STD-1066-97, Fire Protection Design Criteria, Section 14, Nuclear Filter Plenum Protection Based on Hazard Analysis*

Soot Loading Analyses. The soot loading analyses calculate the mass of soot generated by the full expenditure of the combustible load in a fire area and the portion of the soot transported to the C5V final exhaust HEPA filters via the ventilation system (based on the relative amount of the air flow out of the affected space). The predicted soot loading is then compared to that loading estimated to cause HEPA filter failure. These analyses are subject to a substantial amount of uncertainty due to (1) the extrapolation of the HEPA loading required to cause failure from available empirical data for the radial flow HEPA filters, and (2) assumptions regarding the composition of the soot, particularly with respect to water content. Uncertainties aside, the Board's staff determined that the assumptions and calculations for several of the scenarios for the HLW facility contained errors. BNI representatives responded that a number of design features and administrative controls are in place to prevent or mitigate the fire scenarios that could cause failure of the C5V final exhaust HEPA filters, and that even if the filters did fail, the radiological consequences do not warrant changes in the design. The staff does not believe this response is satisfactory given the SC function of the HLW and PT filters, and that the fire protection scheme needs to ensure the filters' protection to a level equivalent to the controls prescribed by DOE-STD-1066.

High Temperatures Analyses. Analyses were performed to evaluate the need for design changes to protect the C5V final exhaust HEPA filters from exposure to high temperatures. To determine a temperature value for the air supplied to the filters, the analyses conservatively assumed incipient flashover conditions in the affected space, and calculated heat generation due to fire, changes in ventilation flow rates due to air expansion, heat loss through ducting and room walls, and the cooling effect of mixing the heated air stream with other, low-temperature air sources. According to the analyses, the methodology used is based on the *SFPE Fire Protection Engineering Handbook* and other studies that provide integrated fire and ventilation models. The results of the calculations show that rerouting of the filter cave ventilation ducting for both HLW and PT facilities would be required to avoid exposing the C5V final exhaust HEPA filters to air temperatures beyond their design limits. The staff pointed out discrepancies in these calculations that require clarification, and notes that the project is requiring verification and validation of the methodology prior to facility startup.

Ember Transport Analysis. The calculation of ember transport draws on a number of prior studies that describe the transport and deposition of particles in ventilation ducting, as well as the length of time embers are likely to burn. This calculation compares the ember burn and transport times to determine whether burning embers could be transported to the C5V final exhaust HEPA filters. Critical assumptions used in the calculation include the material composition, density, size, and shape of postulated embers. Where the calculation shows that burning embers could be transported to the filters, either ventilation inlets were relocated or ember screens were installed to prevent introduction of embers into the exhaust system. The

staff raised two issues regarding this calculation. First, the calculation uses nominal ventilation flow rates instead of the higher flow rates resulting from air expansion during a fire. Second, the calculation is based on a new methodology that ought to be subject to a formal peer review; BNI has made arrangements for an informal review only.

Attachment 3

Examples of Discrepancies between 24590-WTP-SE-ENS-06-0199, Revision 1, *Tailoring of DOE-STD-1066-97, Fire Protection Design Criteria, Section 14, Nuclear Filter Plenum Protection Based on Hazard Analysis* and Supporting Documentation

1. In 24590-HLW-RPT-ENS-07-002, Revision 1, *HEPA Filter Fire Hazard Analysis of High-Level Waste Facility (HLW) Filter Cave H-0104*, pages 35, 55, and 62, fire-related design features, such as smoke detection and quick-response sprinklers, moderate-efficiency filters, smoke dampers, and fire suppression systems, that directly affect the scenarios of concern are discussed; these features are not discussed in the ABAR.

2. In 24590-PTF-RPT-ESH-02-001, Revision 3, *Preliminary Fire Hazards Analysis for Pretreatment Facility*, page 4–6, fire suppression for the filter cave crane and possible extension of the fire suppression system for the crane maintenance room into and below the enclosure for the filter cave crane cable reel are discussed; these items are not discussed in the ABAR.

3. In the ABAR, Attachment 5, and 24590-HLW-RPT-ENS-07-002, Revision 1, *HEPA Filter Fire Hazard Analysis of High-Level Waste Facility (HLW) Filter Cave H-0104*, page 43, HLW crane cables are discussed as meeting standards for flame propagation and smoke development, yet the applicable ISM meeting minutes referenced in the ABAR (CCNs 166169, 166162, and 166163) indicate that flame propagation testing will not be done until later this year. Furthermore, 24590-HLW-RPT-ESH-01-001, Revision 3, *Preliminary Fire Hazards Analysis for the High-Level Waste Building*, page 4-31, states the crane cables do not meet standards for fire resistance.