Department of Energy
National Nuclear Security Administration
1301 Clay Street
Oakland, California 94612-5208

FEB 2 2 2002

Mr. John Conway
Chairman, Defense Nuclear Facilities Safety Board
625 Indiana Avenue NW, Suite 700
Washington, DC 20004

Subject: Transmittal of Lawrence Livermore National Laboratory (LLNL) Responses to DNFSB Staff Questions on Building 332 Fire Protection Systems (Doc. # AMNSNST:020012)

Reference: E-mail from Charles Coones to Ken Perkins dated November 16, 2001, *Fire Protection Questions* (NNSA-Oakland Staff were copied)

Dear Mr. Conway:

Enclosed are LLNL responses to questions that were raised by Charles Coones of the DNFSB Staff in the Reference. The second question in the Reference requested the basis for the assumption that the waste drum fire scenario involves one drum. Please note that the response to this question uses information that is not included in the NNSA-approved Building 332 Safety Basis. As a result, NNSA-Oakland has not formally reviewed this information.

If you or your staff have any questions, please contact Carol Sohn at (925) 424-3308 or Andrew De La Paz at (925) 423-4339.

Sincerely,

Carol L. Sohn

Carol Sohn
DNFSB Point of Contact
NNSA-Oakland Operations Office

Enclosures: (1) NMTP-02-011 dated January 31, 2002, J. Sefcik to M. Hooper, *Response to DNFSB Staff Questions on B332 Fire Protection Systems*
(2) NMTP-02-019 dated February 12, 2002, J. Sefcik to M. Hooper, *Correction to NMTP-02-011 dated January 31, 2002, J. Sefcik to M. Hooper, Response to DNFSB Staff Questions on B332 Fire Protection Systems*

cc:
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K. Perkins, LLNL, L-360 (w/enclosures)
J. Sefcik, LLNL, L-359 (w/enclosures)

AMNSNST:020012:ADeLaPaz:ldl:022102

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AMNSNST:020012:ADeLaPaz:ldl:022102

Lawrence Livermore National Laboratory

Defense & Nuclear Technologies
Nuclear Materials Technology Program

January 31, 2002
NMTP-02-011

Mr. Michael K. Hooper
Assistant Manager for the National Nuclear
Security Administration Operations
U.S. Department of Energy
Livermore Site Office
P.O. Box 808, L-293
Livermore, CA 94551

This submission is not yet compliant to 10CFR830, Subpart B

Subject: Response to DNFSB Staff Questions on B332 Fire Protection Systems

Dear Mr. Hooper:

Attached is our letter PuFO 02-012, from Kenneth Perkins to Charles Coones, Subject: *Response to Fire Protection Questions of November 16, 2001 E-mail*, dated January 29, 2002. Per established protocol, we are providing it to you to forward to Mr. Coones under DOE/NNSA/OAK cover.

If you have any questions, please contact me at (925) 423-0671 or Kenneth Perkins at (925) 424-6473.

Sincerely,

Dr. Joseph A. Sefcik
Program Leader
Nuclear Materials Technology Program

JAS/fk

Attachment

cc: D. Conrad, L-160
D. Eadens, L-345
K. Foote, L-360
A. Garcia, L-352
B. Goodwin, L-160
C. Guenther, L-360
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Interdepartmental letter

Mail Station: L-360

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Plutonium Facility
Facility Manager's Office

PuFO 02-012 KP/mr
January 29, 2002

Mr. Charles Coones
Defense Nuclear Facility Safety Board
625 Indiana Ave NW, STE 700
Washington, DC 20004-2901

Subject: Response to Fire Protection Questions of November 16, 2001 E-mail

Building 332 Staff has prepared responses to each of your unanswered questions from your visit the week of 11/12/01:

1. *I was not able to successfully resolve the functional classification issue for several components.* [a] *The tamper switches (SC) are tested per the TSR. However, they still report through the SS fire alarm system. The entire system has to reliably work to get annunciation for the tampers. It seems as though this is a mismatch similar to the smoke detectors.* [b] *It is still not clear what the functional classification for the various heat detection devices for the ventilation system may be, including the GBES and the downdraft table. This may include fan sensors, etc. They are discussed in the SAR, but not specifically discussed as safety equipment.*

1a: The Safety Significant fire alarm system will be soon upgraded to Safety Class when the MXL based system is implemented. The Safety Class tamper switches will then report through the Safety Class MXL system. The Safety Class fire suppression valves are locked in a designated position and monitored by Safety Class tamper switches. Every month the Lab Fire Department verifies the position of each valve and ensures the locks are in place. A bar code is used to ensure that each valve is checked. The supervised tamper switches provide indication only; they perform no control function. They are considered Safety Class for convenience only and are tested along with the isolation valves under SRP-B332-018.

1b: The following table indicates the temperature sensing devices with active safety-related functions in the B332 glovebox exhaust system (GBES), room ventilation supply system (RVSS), room ventilation exhaust system (RVES), and downdraft exhaust system (DDES).

System	Device	Classification	Comment
Inc 1 GBES	Fusible plugs for spray deluge valves	Safety Class	
Inc 1	Fusible plugs for "fire	Safety Class	Misnomer. Requirement

System	Device	Classification	Comment
GBES	dampers"		being eliminated See Note 1
Inc 3 GBES	Fusible plugs for spray deluge valves	Safety Class	
Inc 3 GBES	Fusible plugs for "fire dampers"	Safety Class	Misnomer. Requirement being eliminated See Note 1
Inc 3 GBES	Thermal bulbs for fan shutoff	Defense in Depth	See Note 2
Inc 1 RVES	Deluge fusible plug	Safety Class	
Inc 1 RVES	Fusible links for smoke bypass dampers	Safety Class	
Inc 1 RVES	Fusible links for spray dampers	Safety Class	
Inc 3 RVES	Fusible plugs for spray deluge valves	Safety Class	
Inc 3 RVES	Fusible plugs for spray dampers	Safety Class	
DDES	Temperature sensors in exhaust and recirculation ducts for fan shutoff	Safety Class	Requirement eliminated See Note 3

Notes:

1. We have reconstituted the design basis and determined that these "fire dampers" (actually thermally-activated butterfly valves that do not fully close) are not required to close for any safety class function, and must remain at least partially open to satisfy a safety significant function. (This is the current configuration in the facility and described in the SAR.) We are in the process of preparing a USQ evaluation and SAR revision to eliminate the requirement for these dampers to close.
2. The Increment 3 GBES fan shut down is considered tertiary HEPA filter protection after the redundant water supplies to the spray plenum. As we presented to you during your visit last month, the primary and secondary water supplies are from 2nd and 3rd streets. Although the thermal bulbs are not required to be tested under a formal surveillance procedure, due to their Defense-in-Depth designation, they will be added to ACP-B332-010 and tested accordingly.
3. The Building 332 DDES is currently in redesign. The exhaust fans are now turned off and the requirement for thermal detection has been eliminated.

2. *The drum fire scenario appears to involve only one drum (SAR Section 3.4.3.5). Since glovebox fires can involve more than one glovebox, how is the drum fire limited to one drum?*

Waste drums involved in fires in the RMA are included in the source term assumed in the evaluation basis room fire. The waste drum fire event addresses waste drums in their outside storage configuration.

The B332 SAR analyzes a single 60-curie waste drum event as the most likely and bounding waste drum event. Since the B332 waste drums are not stacked and are DOT certified

containers, their interactions during external events would be minimal. This response is documented in LLNL publication titled *Fire Analysis of Hazardous Waste Material Area Segment One* (UCRL-AR-141397). This analysis concludes, *"The ignition and burning of one drum will not cause the failure of adjacent drums. The forklift piercing scenario would not pose a threat"* (p. 16).

Looking at a potential multiple drum piercing, LLNL has concluded that this would be an incredible event. As a result, the B-332 SAR correctly uses a single event drum puncture because this has a higher probability of occurrence.

The probability of both drums being penetrated and igniting such that 100% of the drum contents are involved in the fire and burn to completion is given as follows:

Probability = $(50)(5 \times 10^{-6})(1 \times 10^{-2})\ (1 \times 10^{-1}) = 2.5 \times 10^{-7}$, where:

Top Event Name/Description	Value	Data Source/Justification
Forklift operation on TRU waste drum	50 operations	Data from HF Group
Forklift punctures drum	5×10^{-6}	WSRS* data for a standardize load, spotter present.
Forklift punctures both drums simultaneously	1×10^{-2}	Engineering judgment that 1 in 100 impacts will puncture both drums.
Fire ignites contents of breached drum	1×10^{-1}	Engineering judgment that 1 in 10 punctures will cause a drum fire.

As shown above, the probability of both drums being penetrated and causing a fire where 100% of the contents are burned is beyond extremely unlikely (2.5×10^{-7}). The probability of a single drum event is given in the SAR as 2.8×10^{-3}. Thus, the single drum event is the more likely credible event and was analyzed in the SAR.

Note that in both the single drum and two drum events, no credit was given for fire detection or suppression. In order for a waste drum fire event to occur where all drum contents are burned to completion, the fire must go unnoticed. Since drum handling operations are three-person operations, it is unlikely that the operators will not notice the fire occurring and manually suppress the fire. An additional reduction of 3×10^{-3} can be applied to the probability if credit is given for operator actions. With operator actions, the probability for the single drum fire and the two drum fire event will be reduced to 8.4×10^{-6} and 7.5×10^{-10}, respectively.

Top Event Name/Description	Value	Data Source/Justification
Failure of manual fire detection	1×10^{-2}	WSRS*, Area occupied 100% of time.
Failure of manual fire suppression by occupant	3×10^{-1}	WSRS*, typical fire extinguisher installation/maintenance.

* Benhardt, S.A. et al. (1994), *Savannah River Site Human Error Data Base Development for Nonreactor Nuclear Facilities*, Westinghouse Savannah River Company, WSRC-TR-93-581 (February 1994).

3. *What is the combustible loading basis for the fire that yields 815C in the rooms?*

The basis for the fire temperature in a room reaching 815°C is found in the NFPA Fire Protection Handbook, 18th Edition, Figure 7-5A and Table 7-5A. This table starts at 5 psf of combustible loading. In order to appropriately apply the Building 332 fire loading of 3 psf an extrapolation of Figure 7-5A was done that yielded the 815°C temperature assumed in the room design basis fire.

As discussed during your November visit, a fire protection engineer calculates the actual combustible loading at least triennially and performs biweekly inspections to identify and qualitatively assess significant changes. As SME for determining the triennial combustible loading, the fire protection engineer uses his engineering judgment to assess the effect of changed conditions on the calculation. These activities are controlled by ACP-332-019. The fire protection engineer also maintains a high level of awareness of activities and changes within B332 by regularly participating in Work Permit meetings and Engineering Design Reviews. The combustible loading is recalculated when significant changes are planned or observed. The calculation considers the heat content of the various materials, including plastics and flammable liquids.

To provide additional confidence in the current combustible loading calculation, an independent inspection and calculation are planned.

4. *How are the diesel-backed emergency lights verified operational?*

Diesel-backed lights in the RMA and loft, while connected to the generators, are not relied upon for personnel safety. They are provided to allow light for securing the laboratories in the event of a long power outage. If they do not function, securing equipment in the RMA and loft can be accomplished by using handheld battery lights.

NFPA egress lighting requirements are met by wall mounted battery operated lanterns complying with NFPA requirements. These lights are tested monthly for 30 seconds and annually for 90 minutes per NFPA requirements using a facility procedure. Based on this review we are converting this procedure to an Administrative Control Procedure.

In addition, three more battery-operated lanterns were determined to be needed in the loft and are being purchased and installed.

5. *It is still not clear how the bypass dampers on the room exhaust will reliably function as described in the analysis. If the plugging of the room HEPA is assumed due to smoky, relatively cool fire, when is a 165°F fusible link 6 feet from the ceiling expected to operate? Given the fire modeling in the room, when does the damper open?*

The opening of the Increment 1 room exhaust ventilation smoke bypass dampers was not relied on to mitigate the offsite consequences of a cold smoky fire or the Evaluation Basis Fire (EBF) due to overpressurization. SAR section 4.3.1.4, Room Fire (EBF), discusses a potential room overpressurization scenario, and states that the radiological consequences of this situation are expected to be no worse that those analyzed for the unfiltered release for other analyzed events.

In Increment 1 laboratories the room ventilation bypass dampers will open when the temperature at the fusible link reaches 160°F. The cold, smoky fire was not previously

modeled. To specifically answer your question on the time to actuate the smoke bypass damper in a cool fire, a fire model was recently completed by Joong M. Yang. His conclusion was: Actuation is predicted to occur even for a slow-growth fire of a small magnitude. The smallest magnitude of the fire that could actuate the bypass damper is estimated to be approximately 200 kW, which is determined by natural ventilation permitted by the 12-in×18-in (0.305-m×0.457-m) opening at the floor. The predicted actuation time for the 160°F fusible link on the bypass damper is 2,080 seconds (34.7 minutes).

In Increment 3 laboratories, the room ventilation bypass dampers will open when the exhaust flow reaches approximately 50%, thus preventing overpressurization of the involved room. This is controlled by an airflow measuring station in the exhaust line that is connected to Photohelic gauge set to open the bypass damper when normal flow is reduced to 50%. This is tested under SRP-B332-004. In addition Increment 3 room differential controllers automatically adjust the room supply damper to maintain the room pressure at -0.30 inches WG relative to the exterior atmosphere.

6. *Did you find the spray damper reference?*

The Spray Damper reference as used in the Building 332 SAR Section 4.3.7.4.1 is Gaskill and Murrow 1972. This is a UCRL Document #73800. A copy is enclosed.

Please feel free to contact Chris Holm or me if additional clarification is needed to any of your questions.

Reviewed by:

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Pu Facility Nuclear Engineer

Lothar Westfall
Pu Facility Engineering Manager

Roger Rocha
Pu Facility Operations
& Maintenance Manager

Jim Lewis
Pu Facility Safety Manager

Approved by:
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Pu Facility Manager

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Steve Leeds
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Carol Sohn

Lawrence Livermore National Laboratory

Defense and Nuclear Technologies
Nuclear Materials Technology Program

February 12, 2002
NMTP-02-019

Mr. Michael K. Hooper
Assistant Manager for the National Nuclear
Security Administration Operations
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Livermore Site Office
P. O. Box 808, L-293
Livermore, CA 94551

This submission is not yet compliant to 10CFR830, Subpart B

Subject: Correction to NMTP-02-011 dated January 31, 2002, J. Sefcik to M. Hooper, *Response to DNFSB Staff Questions on B332 Fire Protection Systems*

Dear Mr. Hooper:

It has come to our attention through discussions with the B332 DOE Facility Representative that the table provided in response to Item 1.b. in the attachment (PuFO 02-012) to the subject letter contained an error. The table in response to Item 1.b should indicate that the safety classification of the Increment 1 smoke bypass dampers is Safety Significant, rather than Safety Class. Therefore, please substitute the attached table in place of the table previously provided.

If you have any questions, please contact me at (925) 423-0671, or Kenneth Perkins at (925) 424-6473.

Sincerely,

Dr. Joseph A. Sefcik
Program Leader
Nuclear Materials Technology Program

Attachment

cc: D. Conrad, L-160
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DDES	Temperature sensors in exhaust and re-circulation ducts for fan shutoff	Safety Class	Requirement eliminated See Note 3

Notes:

1. We have reconstituted the design basis and determined that these so called "fire dampers" (actually thermally-activated butterfly valves) are not required to close for any safety class function, and must remain at least partially open to satisfy a safety significant function. (This is the current configuration in the facility and described in the SAR.) We are in the process of preparing a USQ evaluation and SAR revision to clarify function of these valves.
2. The Increment 3 GBES fan shut down is considered tertiary HEPA filter protection after the redundant water supplies to the spray plenum. As we presented to you during your visit last month, the primary and secondary water supplies are from 2nd and 3rd streets. Although there is no requirement to test the thermal bulbs under a formal surveillance procedure, due to their Defense-in-Depth designation, they will be added to ACP-B332-010 and tested accordingly.
3. The Building 332 DDES is currently in redesign. The exhaust fans are now permanently removed from service and the requirement for thermal detection has been eliminated.