



Department of Energy
National Nuclear Security Administration
Washington DC 20585

February 20, 2013

OFFICE OF THE ADMINISTRATOR

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

Dear Mr. Chairman:

On December 13, 2011, the Defense Nuclear Facilities Safety Board (Board) issued a letter requesting a report and briefing describing specific actions the National Nuclear Security Administration (NNSA) has taken or plans to take to ensure that two safety systems at the Plutonium Facility at Lawrence Livermore National Laboratory (LLNL) can perform their safety functions. On March 8, 2012, NNSA issued a response to the Board addressing their concerns over legacy confinement boundaries of the Glovebox System and the potential defeat of the Fire Detection and Alarm System (FDAS) by a non-safety system.

As a follow-up to the March 2012 report and briefing to the Board, the NNSA Livermore Field Office (LFO) has confirmed that LLNL met its commitment to change the priority of the fire alarm announcement such that the non-safety site-wide evacuation voice/alarm system does not override the safety significant FDAS. In addition, LLNL has evaluated various options for upgrading existing wood-enclosed housekeeping high-efficiency particulate air (HEPA) filters and submitted to LFO a preferred approach to ensure the confinement function of the filter housings. This formal evaluation took into account regulatory requirements, current codes and standards, and additional evaluation criteria such as the safety of installation, and included the development of a prioritized list of gloveboxes for HEPA filter upgrades.

NNSA and LLNL determined that the safety benefits of upgrading the housekeeping HEPA filters to current codes and standards do not warrant the investment of constrained funding to proceed with a mass upgrade. However, when a Glovebox System modification is required, the upgrade of associated wood-enclosed housekeeping HEPA filters will be evaluated and then included in the work scope when determined to be cost effective. At a minimum, the upgrade would be to a metal-enclosed filter arrangement. Following the cost determination, NNSA will direct LLNL to upgrade associated wood-enclosed housekeeping HEPA filters for a Glovebox System modification when it is already necessary to breach the glovebox confinement boundary and establish more than minor interim radiological barriers and confinement controls. New gloveboxes will utilize housekeeping HEPA filters meeting current codes and standards.

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For worker protection, NNSA will continue to rely on existing safety significant room continuous air monitors (CAMs), contamination surveys of the Glovebox System, monitoring the pressure drop across these filters, radiation surveys looking for filter loading, and visual inspections of the filter housings.

The most likely accident scenarios that result in a large enough breach in the housekeeping HEPA filter enclosures that would challenge the capability of the Glovebox Exhaust System (GBES) to maintain an inward air flow (i.e., maintaining 125 linear feet per minute through an 8 inch port per the Department of Energy Nuclear Air Cleaning Handbook) are an explosion, a fire, and a seismic event. For an explosion, two safety significant systems provide preventive functions for hydrogen leaks. For a fire, neither the gloveboxes nor their housekeeping HEPA filters are fire rated; therefore, they are not expected to survive a significant fire. In a significant fire or contamination event, facility personnel are trained to leave the room, thus mitigating potential exposure. Lastly, all gloveboxes must meet the Performance Category 2 seismic design requirements prior to activation.

For smaller breaches, the CAMs and associated alarms are relied upon to protect facility workers from possible consequences should a loss of glovebox or GBES integrity occur in the rooms. Workers in the immediate area would exit and others would not enter the area, thus mitigating workers from incurring a significant dose.

The enclosure to this letter provides a report describing actions NNSA and LLNL have taken to address the remaining issues noted in the enclosure to the Board's letter. In response to the overall Board staff review, LFO actions included a multi-disciplinary team review of the Plutonium and Tritium Facility Structures, Systems, and Components credited in the LFO-approved Documented Safety Analyses (DSA). The review was focused on looking for similar conditions on systems not already reviewed by the Board staff. The team identified a number of potential quality improvements and has issued a report. The improvements will be addressed as part of the next DSA annual updates.

If you have any questions concerning this letter, please contact Dr. Jerry McKamy at (301) 903-7980.

Sincerely,



Neile L. Miller
Acting Administrator

Enclosure

cc: M. Campagnone, HS-1.1
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**Enclosure: NNSA Response to Defense Nuclear Facilities Safety Board Issues
with Safety Systems at the Plutonium Facility**

Introduction

The Defense Nuclear Facilities Safety Board (Board) requested, in Reference 1, a report and briefing within 60 days describing specific actions the National Nuclear Security Administration (NNSA) has taken or plans to take to ensure the Glovebox System and Fire Detection and Alarm System (FDAS) can perform their safety functions. The letter included Board concerns over legacy confinement boundaries of the Glovebox System and the potential defeat of the FDAS by a non-safety system, concluding that those safety systems could not be relied upon to fulfill their safety functions. In a letter dated March 8, 2012, from Donald Cook, NNSA Office of Defense Programs, to Peter Winokur, Board Chairman, NNSA transmitted reports from the Livermore Field Office (LFO) and LLNL describing actions in response to the concerns raised by the Board.

Reference 1 also requested a report within one year, on or before December 13, 2012, describing any actions NNSA has taken to resolve other issues noted in the enclosed report of Reference 1. On December 6, 2012, NNSA requested an additional 60 days to complete this portion of the response. This report provides the requested one year response to the issues from the enclosed report of Reference 1.

Summary Status of LLNL Actions

On June 13, 2012, LLNL transmitted a report (Reference 2) to LFO, *Options for Upgrades of Glovebox Housekeeping HEPA Filters in the Plutonium Facility*, which fulfilled LLNL's commitment to evaluate various options for upgrading existing wood-enclosed housekeeping High-Efficiency Particulate Air (HEPA) filters. In addition, LFO confirmed that LLNL met its commitment to change the priority of the fire alarm announcement such that the non-safety site-wide evacuation voice/alarm system will not override the Fire Detection and Alarm System.

On October 15, 2012, LLNL provided a response to a LFO letter dated July 18, 2012, concerning resolution of remaining issues from the Board letter dated December 13, 2011, including a proposed path forward on the wooden housekeeping HEPA filters and Appendix A issues from the Board letter (Reference 3). Further discussion of the responses to the issues raised in Appendix A of the enclosure to the Board letter are provided in Attachment 3 of Reference 3. For ease of reference, Appendix A of the enclosure to the Board letter is included with this enclosure. As a result, LLNL will evaluate on a case-by-case basis the upgrade of housekeeping HEPA filters when it is determined that they need to be replaced. Many of the other Reference 3 actions described were completed with the recent LFO approval of the Plutonium Facility Documented Safety Analysis (DSA) Annual Update. LFO oversight of LLNL will ensure timely completion of the remaining actions in the response.

In addition to those actions described in the above LLNL responses, the following issues were also addressed.

Board Concern on Glovebox Safety Functions: The Board staff determined the safety function and performance criterion for gloveboxes in the B332 DSA does not capture and protect all

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functional requirements implied and credited in the hazard analysis, specifically for supporting an inert gas atmosphere and to protect against shrapnel hazards (i.e., Event #46b, and Event #12).

Response: As part of the Plutonium Facility DSA annual update, Hazard Analysis Table 3-8 Events #1 through #31a have been revised and re-categorized as Standard Industrial Hazards and do not require DSA coverage or credited SSCs, but remain as initiators to other Hazard Analysis events (e.g., with radiological consequences). Specifically, Event #12 (*During material testing, size reduction, or destruction, shrapnel fragments are generated*) no longer credits the glovebox to protect workers from shrapnel fragments during an explosion. Injury involving a contaminated shrapnel wound is considered in Event #38c (*Material confinement barrier is breached, due to rotating equipment or other kinetic energy source or sharp objects, resulting in a release of radioactive material*), where Event #12 is an initiator. Event #38c has an unmitigated consequence of low for which LFO requested additional data on puncture-related wounds at LLNL, which was provided in Reference 3. LFO is evaluating this data and data from other DOE sites and will incorporate this information and any corresponding changes into the next annual DSA update for the Plutonium Facility.

Actions: (Complete) Clarified the glovebox function in the Plutonium Facility DSA as it relates to shrapnel and concomitant puncture wounds.

(In Progress) LFO is currently evaluating historical data for contaminated puncture wounds and will address any needed safety basis changes, as appropriate.

Response: Event #46b (*Spontaneous ignition of pyrophoric dispersible material causes a loss of confinement barrier, with a subsequent release of radioactive material*) involves the spontaneous combustion of pyrophoric dispersible material which has argon and nitrogen gas systems as credited controls. In the Plutonium Facility DSA annual update, the gloveboxes are credited as Safety Significant for those events that identify the Glovebox Argon Supply System and Glovebox Nitrogen Supply System as credited features. Section 6 of the Plutonium Facility Technical Safety Requirements (TSR) was modified to more clearly describe the design feature of the glovebox to provide a volume for an inert atmosphere. Also, a Specific Administrative Control (SAC) was added to limit plutonium turnings to 500 grams within a glovebox to further reduce the hazard and ensure the integrity of the glovebox is preserved.

Actions: (Complete) Clarified the glovebox function in the DSA as it relates to inert atmospheres and pyrophoric material.

(Complete) A SAC limiting plutonium turnings to 500 grams within a glovebox was added to the Plutonium Facility DSA/TSRs.

Board Concern on Plutonium Facility Paging (AW/P) System Vulnerabilities: The 2002, 2006, and 2009 Fire Hazards Analysis (FHA) determined that the Plutonium Facility Paging System does not meet National Fire Protection Association (NFPA) 72 standards for an emergency system. The deficiency as written in the 2009 FHA states, "The EVA panels were upgraded with units that are UL [Underwriters Laboratories] listed for emergency use but the speakers and wiring were not, resulting in circuits that are not supervised to show trouble conditions such as

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open, shorts or grounds.” The implications of this vulnerability are that the FDAS would not be able to perform its safety function if the system experienced shorts or grounds in the wiring.

Response: The NFPA 72 standard in effect at the time of installation of the Paging System did not require that the speakers and wiring circuit be supervised. The system has not been modified since and consequently is not required to be brought up to the current code. The Plutonium Facility DSA in Section 3.3.2.3.1 (P. 3-130) identified an enhancement to “Upgrade the building paging system to meet the NFPA criteria for monitored speakers.”

Action: No further action needed. The DSA currently includes in its list of safety enhancements the upgrade of the Paging System subject to the availability of funding.

Summary Status of LFO Actions

In response to the overall Board staff review, LFO actions included a multi-disciplinary team review of the Plutonium Facility and Tritium Facility Structures, Systems, and Components (SSC) credited in the LFO-approved DSAs. The review was focused to identify similar conditions on systems not already reviewed by the Board staff. The team identified a number of potential quality improvements concerning the Plutonium Facility and Tritium Facility DSAs and has issued a report. The improvements will be addressed as part of the next DSA annual updates. The team did not find any hazard events in which the credited system’s functional requirements did not adequately provide the mitigation credited nor were any missing controls identified.

In response to the Board’s concern on Plutonium Facility DSA Glovebox Exhaust System stack classification, LFO initiated an additional follow-up review to determine any additional benefit in designating the exhaust stacks as safety SSCs. Specifically, LFO staff analyzed potential scenarios that could impact the system from maintaining the required Limiting Condition for Operation header pressure. A seismic event leading to crushing of both stacks was the only readily apparent scenario where both exhaust stacks would be affected simultaneously. LFO obtained the services of a structural/seismic subject matter expert to review potential failures, including possible II/I concerns, related to the exhaust stack failures. The review has been finalized (Reference 4) with the assessment concluding that the stacks will not fail in a manner that would prevent the exhaust system from meeting its credited function.

The referenced Board report also stated “assessments of safety systems performed by LSO [Livermore Site Office] ...were insufficiently detailed.” The LFO Safety System Oversight (SSO) Program has recently been updated with the following enhancements. Specifically the LFO SSO process provides a comprehensive, documented framework that describes SSO for LLNL facilities. It includes formal assessments that use the Criteria, Review, and Approach Documents (CRAD) developed in response to Board Recommendation 2000-2, *Configuration Management – Vital Safety Systems*, on a three-year cycle. In addition, in response to the recent LFO safety system self-assessment, the LFO SSO Program document has been updated to require:

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- SSO consistent with guidelines specified in Department of Energy Guide 226.1-2, *Federal Line Management Oversight of Department of Energy Nuclear Facilities*;
- System-specific CRADs that use the DSA and the System Design Description documents as primary inputs for the three-year comprehensive assessments; and
- Bi-weekly reviews that address other less formal operational awareness activities that may include, but are not limited to, the following: system walkdowns, system maintenance activities, occurrence reports, and other operability determinations.

References:

1. Letter (P. Winokur/T. D'Agostino), *Defense Nuclear Facilities Safety Board Report Review of the Design, Functionality, and Maintenance of Safety Systems at Lawrence Livermore National Laboratory*, dated December 13, 2011
2. Letter (B. Goodwin/K. Davis), *LLNL Response to issues identified in the Defense Nuclear Facilities Safety Board Letter Concerning Plutonium Facility Review*, dated June 12, 2012
3. Letter (B. Goodwin/D. Boyd/K. Davis), *LLNL Follow-up Response to Defense Nuclear Facilities Safety Board Letter Concerning Plutonium Facility Review*, dated October 15, 2012
4. ePegasus Assessment Report ASRP-DP-12.6.2012-483946, *Walkthrough and Review of Superblock Facilities Structural Condition and NPH Issues*

Appendix A

The following system deficiencies were also identified by the Board's staff during its review of the design, functionality, and maintenance of safety systems at LLNL during June 14–16, 2011.

Gloveboxes.

- Some leak test requirements for new glovebox installations specified in the LLNL *Nuclear Materials Technology Program Glovebox Manual* are inconsistent with the latest industry technical standard for nuclear glovebox fabrication and design, American Glovebox Society (AGS) Standard G006-2005, *Standard of Practice for the Design and Fabrication of Nuclear-Application Gloveboxes*.
- The Plutonium Facility's FHA provides no justification for excluding an automatic fire suppression and inerting system from the design of a recent glovebox installation (Work Station 2111). DOE Standard 1066-99, *Fire Protection Design Criteria*, states, "An automatic fire suppression or inerting system is required in all new gloveboxes unless an FHA [Fire Hazards Analysis] concludes that such a system is not warranted...."

Glovebox Exhaust System (GBES).

- The hazard table in the Plutonium Facility DSA credits the GBES to protect workers from a radiological release caused by a glovebox explosion (event 47b). One functional requirement for the GBES is to maintain gloveboxes at a negative pressure relative to the room. LLNL personnel could not explain how the system meets this functional requirement during postulated explosion events. The GBES is the only credited control that protects workers in the immediate vicinity of a glovebox explosion for several accident initiators, such as water leaking into a process furnace, leakage from a methane or acetylene torch, and ion exchange resin reactions.
- DOE Handbook 1169-2003, AGS standards, and the LLNL *Nuclear Materials Technology Program Glovebox Manual* specify that glovebox exhaust systems must be capable of maintaining 125 +/- 25 feet per minute (fpm) of inward airflow through an open glovebox gloveport to prevent the spread of contamination in the event of a glove breach. LLNL does not evaluate whether gloveboxes can meet the 125 fpm safety requirement at the GBES's most limiting condition (i.e., lowest allowable GBES header pressure in the Technical Safety Requirements (TSR)).
- The Plutonium Facility DSA does not include the GBES exhaust stack within the safety-significant boundary of the system, although the exhaust flow path through the stack is required for the GBES to perform its safety function.

- The Plutonium Facility DSA requires that GBES exhaust header pressure be maintained between -3.0 and -7.0 inches of water gauge; however, the set point that initiates startup of a backup exhaust fan is -1.5 inches of water gauge.

Hydrogen Gas Control System (HGCS).

- The system boundaries for the HGCS are inadequately defined, and failure of non-safety components could preclude the system from fulfilling its safety-significant function during normal and abnormal operations. Specifically, the non-safety hydrogen sample pump and the flow meters need to be operable for the HGCS to perform its safety function and fulfill its performance criteria. These flow meters provide an indication of flow to a safety-significant programmable logic controller (PLC) for the HGCS. Although the PLC is safety-significant and the embedded software has been through SQA, the system's documentation is not clear regarding the safety classification of the PLC or whether the embedded software on the PLC has been through SQA.
- The vacuum pump that serves the programmatic Hydride/Dehydride/Casting (HYDEC) equipment interfaces with atmospheres containing significant quantities of hydrogen. It is not clear to the Board's staff that the appropriate design requirements for this service were identified and implemented for the existing vacuum pump.

Hydrogen Gas Isolation System.

- Operating Procedure-Programmatic (OPP-B332-001), *Operating procedure for HYDEC process in the Metal Conversion Glovebox*, steps 6.13.1 and 6.13.2, implements the specific administrative control (SAC) to isolate the hydrogen gas cylinder to the radioactive materials area (RMA) when hydrogen is not being used in the RMA. However, this procedure does not indicate these steps fulfill a TSR-level control. Operational Safety Plan (OSP) 332.194, *Metal Conversion Glovebox*, implements the same TSR-level control, but OSP 332.194 is a plan, not a continuous-use procedure. OSP 332.194 implements the TSR control that only a single hydrogen gas cylinder shall be connected to the hydrogen gas manifold at a time, but it is also not a continuous-use procedure. It is therefore not clear to the staff how operators are made aware that their actions implement SACs.
- Based on system specifications and conservative assumptions (i.e., maximum bottle pressure), the Board's staff determined that a sheared hydrogen gas supply tube in the glovebox could overpressurize the glovebox with hydrogen. As a result, the staff believes the excess flow shutoff valves and/or pressure regulator serve important safety functions (i.e., to prevent overpressurization), and it would be appropriate to credit at least one of these components. However, this overpressurization hazard and the related safety function are not identified in the Plutonium Facility DSA, and none of these components are credited.

Equipment Important to Safety (EITS).

- At LLNL, EITS systems are subject to more rigorous configuration management and quality assurance requirements compared with other defense-in-depth systems. Although LLNL does not credit EITS for protection of workers or the public, these systems are recognized as important contributors to safety. The documentation for configuration management of EITS systems is a system data sheet rather than a typical system design description, and the EITS configuration item owner maintains the system data sheet. LLNL's implementation and use of system data sheets is immature. For example, the training and expectations for configuration item owners are not well defined or consistent. Neither the data sheet for the Tritium Facility's fire suppression system nor that for the Hardened Engineering Test Building's ventilation system listed procedures related to system operation or maintenance. The procedures section of these data sheets only included drawings, the respective facility DSA, the more general FSP, and nonspecific emergency management division policy and procedures.
- If EITS systems are going to be recognized in a DSA as meeting certain requirements, these systems should be assessed against the stated requirements, functions, and configuration. There have been at least four discrepant as-found conditions regarding EITS systems in the past 2 years, which suggests this is not the case.
- For LLNL to benefit from the EITS designation and corresponding system data sheets, increased training for configuration item owners and clearer, written expectations concerning the structure and utilization of system data sheets are warranted. Similarly, expectations need to be defined for the site office's oversight of EITS systems.