

**Independent Oversight Review of the  
Los Alamos National Laboratory Chemistry and  
Metallurgy Research Facility  
Fire Suppression Vital Safety System**



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**Office of Safety and Emergency Management Evaluations  
Office of Enforcement and Oversight  
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## Acronyms

CM	Configuration Management
CMR	Chemistry and Metallurgy Research
CSE	Cognizant System Engineer
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
FHA	Fire Hazards Analysis
FSS	Fire Suppression System
HSS	Office of Health, Safety and Security
LANL	Los Alamos National Laboratory
LASO	Los Alamos Site Office
NFPA	National Fire Protection Association
SST	System Surveillance and Testing
TA	Technical Area
TSR	Technical Safety Requirement

# **Independent Oversight Review of the Los Alamos National Laboratory Chemistry and Metallurgy Research Facility Fire Suppression Vital Safety System**

## **1.0 PURPOSE**

The Office of Enforcement and Oversight (Independent Oversight), within the Office of Health, Safety and Security (HSS), conducted an independent review of the Los Alamos National Laboratory Chemistry and Metallurgy Research (CMR) Facility safety significant fire suppression system (FSS) vital safety system in conjunction with a scheduled Los Alamos Site Office (LASO) assessment.

The purpose of the LASO assessment was to evaluate the functionality and operability of the FSS and to ensure that the system complied with U.S. Department of Energy (DOE) orders and standards and National Fire Protection Association (NFPA) standards and requirements. The assessment was conducted July 25-August 5, 2011.

LASO was the overall lead organization for the evaluation. An HSS subject matter expert participated with a role of independently assessing selected technical areas that were delineated in the LASO assessment plan described in the scope section below, and performing an evaluation of the LASO assessment process. The HSS independent review scope was selected based on current HSS priorities to focus oversight activities on nuclear facilities, and in particular, the adequacy and implementation of nuclear facility safety basis requirements.

## **2.0 BACKGROUND**

The CMR Facility is classified as a hazard category 2 nuclear facility. Its current programmatic missions include analytical chemistry and support of major experimental programs at Los Alamos National Laboratory (LANL) and within the DOE complex; however, the facility is now being operated on a “run-to-replacement” approach in anticipation of the completion of the CMR replacement project. LANL has implemented several positive actions to restrict operations in the CMR Facility, namely reducing the material at risk in the facility by over 50 percent, and completing various facility upgrades. Despite these operational risk reduction efforts, the CMR Facility is beyond its design life and does not meet current seismic standards and safety requirements. The safety basis for the CMR Facility allows for limited operations and supports continued risk reduction activities until final decommissioning of the facility.

## **3.0 SCOPE**

The LASO assessment of the FSS vital safety system was achieved primarily through a performance-based assessment, the methodology and process of which were based on LASO Procedure MP 06.02, Rev. 4, *Safety System Oversight*. The LASO assessment evaluated five objectives: Safety Function Definition (SFD), Configuration Management (CM), System Maintenance (SM), System Surveillance and Testing (SST), and Cognizant System Engineer (CSE). Because of the reduced mission of the facility, the primary focus was on Wing 5 and Wing 9, where the primary facility activities are performed. Of particular interest was a review and walkdown of a major modification in process to add the Confinement Vessel Disposition enclosure. Assessment of the FSS included:

- Reviewing documentation supporting the design and safety basis requirements of the system, including supporting analyses, drawings, and testing and maintenance procedures

- Conducting interviews with facility engineering staff, maintenance personnel, and representatives of the LANL site Utilities Department
- Observing field performance of applicable surveillance requirements and/or system maintenance activities
- Walking down the FSS and supporting systems, including the exterior yard.

The HSS independent review placed priority attention on review of the established design and safety basis relied-on performance requirements of the FSS, and verify that the safety basis requirements were appropriately translated into technical specification and surveillance testing procedures, including compliance with applicable codes and standards.

#### 4.0 RESULTS

Overall, the LASO assessment was competently performed by knowledgeable LASO personnel using appropriate and challenging criteria. The LASO team was technically well qualified and, based on prior preparation and knowledge, demonstrated a high degree of familiarity with the CMR Facility. The LASO assessment team in conjunction with HSS identified twelve (12) findings and four (4) observations that are described in detail in the LASO assessment report and concluded that CM and SST objectives were not met. Findings were identified across all objectives except CSE. The following findings reflect concerns identified and recognized by HSS Independent Oversight's review in conjunction with the LASO assessment team as particularly significant in the SST area that could directly challenge the ability of the FSS to perform its credited safety functions as documented in the safety basis:

- The CMR valve alignment surveillance procedure, which is used to validate that an unobstructed flow path exists from the water Tanks 4 and 4A to the CMR Facility fire loop, does not validate valves in the flow path outside the CMR Facility boundary. Contrary to requirements of DOE Order 420.1B, *Facility Safety*, there is inadequate validation of a reliable water supply outside the CMR boundary for the safety significant FSS. The facility valve alignment procedure validates only one valve outside the facility (one valve at the northwest); instead, CMR relies on institutional polices for validation. Validation attributes should include a memorandum of understanding with the Utilities Department, associated conduct-of-operations procedures between the facility and Utilities, and a periodic surveillance test and verification that the valves are in their proper position to permit an unobstructed flow path from Tanks 4 and 4A.
- The Technical Safety Requirement (TSR) 4.3.1.1 surveillance test acceptance criteria for static gauge pressure at fire suppression system risers may be inadequate because the pressure required to deliver water flow from the riser to the hydraulically most remote sprinkler head is not considered in the analysis. Additionally, the analysis assumptions are not conservative because the calculation is based on the availability of two supply tanks instead of one. A surveillance acceptance criterion for the riser static pressure gauge is derived from Calculation CMR-CALC-074 and is solely based on pre-established minimum water levels in the Pajarito Storage Tanks 4 and 4A. Specifically:
  - The calculation assumes that both tanks are available to provide the water capacity. There is no assurance from the LANL Utilities Department or Los Alamos County that both tanks will be available. Numerous isolation valves in the Technical Area (TA)-3 grid could be closed and/or manipulated by the Utilities Department so as to isolate one of the tanks, leaving only the water from the other tank available. In addition, there is no memorandum of understanding to establish either the basis for a reliable water source from the TA-3 grid or the groundwork for the CMR and Utilities Department conduct of operations. Incidents have occurred at other LANL facilities in which one of two required tank sources was isolated without the impacted facility's

knowledge. Also, LANL Report LA-14325-2007, *Seismic Fragility of the LANL Fire Water Distribution System*, concludes that the larger Tank 4A has a larger probability of failure during a seismic design basis event; therefore, the calculation should conservatively base the available water volume only on Tank 4, which has a smaller diameter. The calculation needs to determine the minimum water level necessary to support the required water volume for the two-hour design basis accident fire scenario based on the single smaller Tank 4, and the TSR and surveillance requirement need to be revised accordingly.

- The analysis that serves as the basis for the TSR acceptance criteria does not consider key requirements. The calculation addresses the required water volume as the only criterion in determining the required riser static pressure acceptance, without considering the pressure required to deliver the water flow from the riser to the hydraulically most remote design area sprinkler heads. Additionally, the original hydraulic calculation for the Wing 9 remote design area (performed in 1976) determined a required pressure of 75 psi using a hose stream of 250 gpm. The current documented safety analysis (DSA) uses this analysis to establish a 75 psi pressure requirement at the most hydraulically remote heads, but the DSA water calculation and current LANL fire protection program assume a 500 gpm hose stream. CMR should consider revising this calculation to determine the required residual flow pressure for the as-installed piping configuration, using the 500 gpm hose stream allowance. While the TSR basis (LCO 3.3.1) states that a static pressure  $\geq 103$  psig assures the minimum pressure of 75 psig for sprinkler operation for the most limiting riser (Wing 9), this statement is not technically justified in the controlled calculation, the fire hazards analysis (FHA), or the DSA.

The LASO assessment team identified other findings related to configuration management of significant importance in addition to the above, namely:

- The safety significant FSS is inappropriately supported by other CMR structures, systems, and components and is not in compliance with NFPA 13 and good engineering and construction practices. A walkdown of several CMR wings showed that suppression system pipe hangers were inappropriately attached to ductwork joint flanges, and in some cases the support rod was attached directly to the ductwork itself. Some bent hanger rods were observed, some installed rods induced lateral gravity loads, and some pipe spans between supports appeared excessive. Recognizing that the CMR FSS is not seismically designed, this finding is based solely on dead weight pipe support criteria and not seismic requirements.
- Priority drawings and labeling of the FSS are inadequate. Not all FSS risers have priority drawings, and not all existing priority drawings are accurate.
- Pressure maintenance pumps connected to the FSS downstream of the alarm check valve are not documented in the DSA, are not shown on facility control drawings, and are not documented in the Master Equipment List. Pressure pumps were added to three fire sprinkler risers to prevent nuisance alarms due to spurious pressure surges (water hammer) from the TA-3 grid system. These pumps constitute an extension of the safety significant FSS system pressure boundary and, as such, are required to be formally documented in the facility CM program.

Other findings and observations identified as part of the LASO assessment are provided in the formal LASO Safety System Oversight Report for CMR FSS, issued September 22, 2011 (ref. ePegasus No. COR-FO-9.21.2011).

## **5.0 CONCLUSIONS**

Overall, the LASO assessment was competently performed by knowledgeable LASO personnel using appropriate and challenging criteria. The LASO team was technically well qualified and, based on prior preparation and knowledge, demonstrated a high degree of familiarity with the CMR Facility.

The HSS independent review in conjunction with the LASO assessment identified a number of significant issues that require LANL management attention. Some of the issues are particularly significant because they may challenge the ability of the FSS to perform its credited safety functions as documented in the safety basis. Independent Oversight concurs with the objectives and results of the LASO assessment and believes that sufficient rigor was applied before and during the FSS review.

## **6.0 ITEMS FOR FOLLOW-UP**

The LASO report was formally issued to the contractor identifying 12 findings in the areas of Safety Function Definition, Configuration Management, System Maintenance, and System Surveillance and Testing. LANL was asked to review the report and provide confirmation that the identified issues were entered into the facility's corrective action program.

Based on the conclusions drawn in the report, and the significant nature of some of the findings, Independent Oversight will monitor potential actions being taken below or other appropriate actions to resolve selected findings identified in the LASO report.

- Development of an institutional policy to confirm unobstructed fire water flow paths to the CMR Facility.
- Revision of the analyses that support the safety basis FSS functional requirements related to adequate water supply volume and pressure at the hydraulically most remote design area. These analyses serve as the basis for TSR surveillance test acceptance criteria.
- Institute modifications to correct FSS pipe support attachments and spacing that violate NFPA requirements stating that piping shall be substantially supported from the building structure. Recognizing that the CMR building structure itself does not meet current seismic criteria, supports should be modified to meet standard industry and NFPA good working practices, not necessarily to meet current seismic supporting criteria.
- Assure that longstanding open deficiencies identified in the facility FHA are addressed and closed in a timely fashion.
- Modify the safety basis, control drawings, and other configuration management documentation to reflect the FSS as installed. Specifically-identified system attributes, such as the safety significant pressure pumps and lack of priority drawings for certain risers, should be addressed.

## **Appendix A Supplemental Information**

### **Dates of Review**

Onsite Review: July 25 – August 5, 2011

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