Office of Enterprise Assessments
Assessment of Conduct of Engineering
at the Los Alamos National Laboratory

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Acronyms

ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
CM	Configuration Management
CSE	Cognizant System Engineer
DCF	Design Change Form
DOE	U.S. Department of Energy
DRN	Design Revision Notice
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
EDMS	Electronic Document Management System
ES-DO	Engineering Services - Division Office
FCN	Field Change Notice
FCR	Field Change Request
FY	Fiscal Year
HEPA	High Efficiency Particulate Air
IMT	Issues Management Tool
LANL	Los Alamos National Laboratory
LANS	Los Alamos National Security, LLC
ML	Management Level
MRB	Management Review Board
NA-LA	NNSA Los Alamos Field Office
NCR	Nonconformance Report
NNSA	National Nuclear Security Administration
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
PD	Program Description
PDSA	Preliminary Documented Safety Analysis
PEI	PF-4 Equipment Installation
PFD	Probability of Failure on Demand
PFITS	Performance Feedback and Improvement Tracking System
PF-4	Plutonium Facility
PIAT	Process Improvement Action Tracking
POFMR	Parent Organization Functional Management Review
QA	Quality Assurance
QPA-DO	Quality Assurance Division Office
SD	System Description
SOW	Scope of Work and Technical Specifications
SSC	Structure, System, or Component
TA	Technical Area
TLW	Transuranic Liquid Waste
USQ	Unreviewed Safety Question
WETF	Weapons Engineering Tritium Facility

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), performed an assessment of conduct of engineering at the Los Alamos National Laboratory (LANL). The purpose of this EA assessment was to evaluate the effectiveness of engineering processes and programs implemented by the site contractor, Los Alamos National Security, LLC (LANS).

This assessment examined engineering processes in use by the sitewide engineering support organization and the application of those processes in the generation and verification of engineering products, such as specifications, calculations, drawings, and design change packages. To accomplish this assessment, EA focused on work performed for the PF-4 Equipment Installation Project in Technical Area (TA)-55 and the Transuranic Liquid Waste Project in TA-50. EA also examined the configuration management program, engineering performance monitoring, procurement, and issues management as implemented within the engineering organization. Finally, EA followed up on findings identified in previous EA reviews of engineering processes and programs to assess the efficacy of corrective actions taken in those areas.

EA noted strengths in several areas, including the engineering processes for developing and maintaining drawings, for reviewing engineering products developed by LANS and its external design agencies, and for document management. Drawings and specifications reviewed were clear and appropriate in both content and quality. Design change packages reviewed were also found to be well executed, complete, and of adequate quality. The technical baseline process was well defined and implemented. Reviews of recent procurement documentation indicated that the procurement process is consistent with DOE requirements. In reviewing actions taken at LANL in response to 17 findings documented by EA in 2 prior assessment reports, EA found a sufficient basis to conclude that 11 of those previous findings had been adequately addressed.

EA's review of calculations performed both internally by LANS and externally by design agencies provided mixed results. Calculations performed for LANS by Merrick and Company were generally of adequate quality, while several produced by LANS and by Weidlinger-Navarro Northern New Mexico contained numerous quality issues. EA identified problems with design inputs, inappropriate references, unverified assumptions, ineffective checking within the originating organization, and incorrect Management Level determinations (which are used to establish quality assurance requirements for safety related applications).

EA noted weaknesses in the calculation procedure and the design change procedure. Both procedures contain provisions that permit circumvention of the procedure requirements, even on safety-related applications. No instances were identified where the procedures were circumvented; however, these provisions challenge the design control process and could result in configuration management issues.

Although most elements of the configuration management program were adequately implemented, EA found that the internal assessment process was overly reliant on external reviews. This concern extended into other areas of engineering performance monitoring as well. The LANS engineering organization has not performed an internal management assessment in over four years, and none are planned in fiscal year 2018. The single quality metric in use was found to be ineffective at measuring the performance of individual entities within the organization.

Finally, review of a limited sampling of corrective action documents assigned to the Engineering organization identified a pattern of timeliness issues; EA also identified one document awaiting closure based on a commitment to complete an action in the future (after closure).

These results reflect an engineering program that is performing adequately, but is challenged by process weaknesses in key areas. Improvements may result from an initiative underway in 2018 to strengthen those processes. The potential for long term improvement could be enhanced by improvements to the organizational performance metrics and by increased attention to the internal assessment program.

Office of Enterprise Assessments
Assessment of Conduct of Engineering at the Los Alamos National Laboratory

1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), performed an assessment of conduct of engineering at the Los Alamos National Laboratory (LANL). The purpose of this EA assessment was to evaluate the effectiveness of engineering processes and programs implemented by the site contractor, Los Alamos National Security, LLC (LANS) site-wide Engineering Services - Division Office (ES-DO) support organization.

EA performed this assessment from November 13, 2017, through January 25, 2018. This report discusses the scope, background, methodology, results, and conclusions of the assessment, as well as the opportunities for improvement (OFIs) identified by the review team.

2.0 SCOPE

This assessment examined engineering processes in use by the site-wide ES-DO support organization, and the application of those processes in the generation and delivery of engineering products, such as specifications, calculations, drawings, and design change packages. EA also examined the flow-down of safety basis requirements into technical baseline documents, other engineering deliverables, and the procurement process. Reviews were performed of the configuration management (CM) program, engineering performance monitoring, and issues management as implemented within the engineering organization, including work performed for ES-DO by subcontractor design agencies. Finally, EA followed up on findings identified in previous EA reviews of engineering processes and programs to assess the efficacy of corrective actions taken in those areas.

This review scope was in accordance with the *Plan for the Office of Enterprise Assessments Assessment of the Conduct of Engineering at the Los Alamos National Laboratory, November 2017 – January 2018*.

EA selected two facilities as the focus for this review in cooperation with the National Nuclear Security Administration (NNSA) Los Alamos Field Office (NA-LA). The first phase of the Plutonium Facility (PF-4) Equipment Installation (PEI) Project in Technical Area (TA)-55 and the Transuranic Liquid Waste (TLW) facility in TA-50 were chosen based on their current engineering status and the challenges associated with these projects.

3.0 BACKGROUND

LANL's primary mission is to develop and apply science and technology to ensure the safety, security, and reliability of the U.S. nuclear deterrent; reduce global threats; and solve other emerging national security challenges. For more than 60 years, LANL has served as a research center for science, technology, and engineering, and has made achievements that focus on safety, security, environmental stewardship, nuclear deterrence, threat reduction, operations, communications, and community involvement.

Assessments of the conduct of engineering were identified as an Independent Oversight focus area in a memorandum from the Director, Enterprise Assessments, to DOE senior line management, dated May 3, 2016.

Engineering for the diverse facilities at LANL is accomplished through a combination of:

- Facility-specific engineering groups tasked with daily support of Operations and Maintenance, as well as development of limited-scope design changes
- A site-wide Engineering Services - Division Office (ES-DO) support organization with design and project engineering resources to accomplish larger engineering tasks
- Subcontract engineering resources available through local outside engineering companies.

This EA assessment focused on work performed by ES-DO under the LANS Associate Directorate of Nuclear and High Hazard Operations and included work performed for that organization by subcontractor design agencies.

4.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*. EA implements the independent oversight program through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. Organizations and programs within DOE use varying terms to document specific assessment results. In this report, EA uses the terms "deficiencies, findings, and OFIs" as defined in DOE Order 227.1A. In accordance with DOE Order 227.1A, DOE line management and/or contractor organizations must develop and implement corrective action plans for the deficiencies identified as findings. Other important deficiencies not meeting the criteria for a finding are also highlighted in the report and summarized in Appendix C. Responsible DOE and/or contractor management should address these deficiencies consistent with site-specific issues management procedures.

As identified in the assessment plan, this assessment considered requirements related to conduct of engineering. EA used the criteria and lines of inquiry for successful conduct of engineering identified in EA Criteria and Review Approach Document 31-13, *Conduct of Engineering*, to examine contractor performance.

EA examined key documents, such as system descriptions, calculations, procedures, manuals, design change packages, policies, procurement documents, training and qualification records, and numerous other documents. EA also interviewed key personnel responsible for developing and executing the associated programs, and performed walkdowns where appropriate. The members of the EA assessment team, the Quality Review Board, and EA management responsible for this assessment are listed in Appendix A. A detailed list of the documents reviewed, personnel interviewed, and observations made during this assessment, relevant to the conclusions of this report, is provided in Appendix B.

This assessment also examined the completion and effectiveness of corrective actions resulting from the findings of two previous EA assessments. Results of the corrective action assessments are discussed in the appropriate subsections of Section 5.0, Results, of this report.

5.0 RESULTS

5.1 Design Engineering Processes

This section discusses EA's assessment of the processes in place within ES-DO to perform engineering functions. LANS is committed to American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1-2008 with 2009 Addenda. EA used that standard in conjunction with DOE requirements to form the basis for this portion of the assessment.

Objective:
Design engineering work is performed consistent with technical standards, DOE requirements, and safety basis requirements and commitments, using approved procedures and sound engineering/scientific principles in accordance with the requirements of 10 CFR 830.

Criteria:
- *Engineering procedures are in place and contain appropriate detail to control development, approval, issuance, and revision of deliverables, as well as key processes essential to the design engineering function. (10 CFR 830)*
- *Engineering procedures provide barriers against poor performance, require participation and review by appropriate organizations, and drive communication between distinct groups. Verbatim compliance is required. (10 CFR 830)*

EA reviewed engineering processes for several primary engineering design functions, including preparation and approval of drawings, calculations, and design change packages. In most areas, the processes reviewed provide adequate guidance to accomplish the subject activities in a technically acceptable, controlled manner. The results for those processes are briefly summarized below:

- AP-341-608, *Engineering Drawings and Sketches*, in conjunction with AP-341-405, *Identification and Control of Technical Baseline, Variances, Alternate Methods, and Clarifications in Operating Facilities*, establishes adequate requirements for the development and approval of engineering drawings. The latter procedure establishes drawing categories (i.e., priority, support, general) and sets time limits for updates.
- AP-341-620, *Review of LANL Produced Design Documents*, covers both design review by other LANL organizations and engineering design verification. Design review may be used as a form of design verification, particularly for design change packages. EA found that the design verification requirements are strong and the procedure is clearly written.
- AP-341-622, *LANL Review of Designs Produced by External Design Agencies*, is similar in its requirements to AP-341-620 above. This procedure appropriately states that LANL review does not take the place of the external design agency's responsibility to provide a complete and technically accurate design, including design verification where appropriate. Section 5.2 of this report includes the results from EA's review of engineering products developed by external design agencies that had previously been reviewed by ES-DO.
- AP-341-402, *Engineering Document Management in Operating Facilities*, governs the flow of change documentation into the Electronic Document Management System (EDMS). Adequate measures are in place to ensure that design change forms (DCFs) are placed into EDMS following approval (Release for Construction). This procedure also contains requirements for posting changes against affected documents and for identifying relationships between affected drawings. This procedure is supplemented by ESDO-AP-001, *Engineering Document Control Desktop Instruction*.

In other areas, EA found processes challenged by procedural weaknesses. AP-341-605, *Calculations*, exhibited the following weaknesses:

- Calculations may be issued as standalone documents; however, most are not. The procedure allows calculations supporting a design change to be inserted into and issued as part of the design change package. Only at closure of that package, following field implementation, are the calculations removed and scanned into EDMS as independently retrievable documents. It is not uncommon at LANL for design change packages to remain open for multi-year periods. In instances where the subject calculation is a revision to a previously documented calculation, this approach does not meet the retrievability requirements of ASME NQA-1, since the latest revision to the calculation might not be linked to the prior revision and therefore might not be retrievable from the records management system for an extended period. This approach further creates opportunities for the development of multiple inconsistent, possibly conflicting revisions to the same calculation. (See **OFI-LANS-01**.)
- For "simple designs," this procedure allows "an intelligent design evaluation" in lieu of a calculation. These intelligent evaluations are documented in judgment memoranda. The procedure does not limit where these memoranda can be used, allowing their application on Management Level (ML)-1 (safety class) and ML-2 (safety significant) structures, systems, and components (SSCs). The examples reviewed by EA (see Section 5.2) did not reflect sufficient technical adequacy or completeness for safety-related applications. Likewise, there is no procedural provision to ensure that an unreviewed safety question (USQ) evaluation is performed if a judgment memorandum is used on ML-1 or -2 SSCs **(Deficiency)**.
- This procedure does not contain any mechanism to track unverified assumptions or open items in issued calculations. Similarly, the DCF procedure has no mechanism to track open items in calculations inserted into design change packages. According to AP-341-517, *Design Change Form*, and AP-341-605, calculations must be in final status (numeric revision level) at design change package closure, a status that reflects an absence of any remaining open items. However, EA found no provisions to ensure that this requirement is implemented.
- Attachment A to this procedure provides limited guidance for review and acceptance of calculations generated by external subcontractors. EA concluded that the guidance in this attachment is insufficient to support adequate performance in this area. Attachment B to AP-341-622 provides detailed guidance for similar reviews of calculations performed by external design agencies, but is not referenced for this application. (See **OFI-LANS-02**.)

The design change process documented in AP-341-517 provides adequate instructions for the development, approval, implementation, and closure of design change packages; however, it also contains provisions that could be used to circumvent most internal requirements of the procedure in a manner that would significantly challenge the CM process. EA found that the procedure allows facility modifications solely using the work order process when approved by the designated design authority representative. As with the calculation procedure, no limits are placed on utilization of this option, which requires no engineering documentation of any changes made. As a result, this provision could be used to modify safety-related SSCs with no design output or other engineering involvement **(Deficiency)**. This procedure also lacks guidance on ensuring the final status of included calculations, as noted above.

AP-341-519, *Design Revision Control*, establishes the process for generating and approving field change notices (FCNs), field change requests (FCRs), and design revision notices (DRNs). The processes for issuing these documents are robust; however, the scopes of application described for the FCR and DRN are defined in a manner that creates a gap: the FCR is used for changes where no engineering documents are affected and the DRN is used for "substantial design revision". Small revisions requiring limited changes to engineering documents are not within the scope of either process **(Deficiency)**.

Engineering Process Conclusions

EA concluded that most of the engineering processes examined are adequately rigorous to accomplish the intended functions. However, review of the calculation and DCF procedures resulted in significant concerns regarding the potential for inappropriate application of selected procedural provisions in facilities with ML-1 and ML-2 SSCs. No such instances were identified during the review, but the procedural provision for such applications represents a risk to both the technical baseline and to CM. EA also identified a minor concern with applicability definitions in the procedure for design revisions.

5.2 Engineering Product Technical Review

This section focuses on the quality of engineering technical products created using the processes examined in Section 5.1. In each area, EA selected a limited sample of documents produced within the last two years for detailed review.

Objective:
Design engineering work is performed consistent with technical standards, DOE requirements, and safety basis requirements and commitments, using approved procedures and sound engineering/scientific principles in accordance with the requirements of 10 CFR 830.

Criteria:
- *Documents comprising the project technical baseline are readily identifiable and subject to appropriate control measures. System design documents and supporting documents must be identified and kept current using formal change control and work control processes. (10 CFR 830)*
- *Analyses and calculations are prepared with design inputs clearly identified and assumptions technically justified (or unverified assumptions clearly identified and tracked to resolution), prepared consistent with the design criteria and safety basis, and checked by a second party and verified by an independent verifier, as appropriate. (10 CFR 830)*
- *Design drawings are subject to interdisciplinary review as appropriate prior to issuance, accessible and retrievable in the most current version, and in accordance with applicable design criteria and industry standards. (10 CFR 830)*

Calculations

EA reviewed calculations performed by LANS personnel and by two of their design subcontractors, Merrick and Company (Merrick) and Weidlinger-Navarro Northern New Mexico (Weidlinger-Navarro). AECOM was a partner on the Weidlinger-Navarro team and provided some calculations as part of the Weidlinger-Navarro scope. LANS and Merrick calculations were related to the PEI project and were contained in design packages or their revisions. The Weidlinger-Navarro (and AECOM) calculations were all standalone calculations produced as part of the final design of the TLW project. LANS calculations were produced in accordance with AP-341-605, while the design subcontractors worked to their internal procedures.

Four calculations produced by Merrick were included with DCF-15-55-0004-923, *PEI-1 100% Fabrication Package*. An additional Merrick-produced calculation was included in DCF-15-55-0004-935-DRN-00004, *GB Stand Brace Addition*. EA reviewed all five of these calculations and found that design inputs were clearly identified, assumptions were technically justified with no unverified assumptions, and analyses were performed consistent with referenced design criteria. All calculations were checked by a second party. No issues were identified with the Merrick-produced calculations.

Forty-three calculations produced by Weidlinger-Navarro for the TLW project were included in the final design package. EA reviewed a representative sample of 10 calculations in detail. EA observed a number of calculation issues that had not been identified and corrected by Weidlinger-Navarro through routine checking and approval **(Deficiency)**. Identified issues included:

- Inappropriate or incomplete references (e.g., the revision of the drawing used was not cited)
    - 15-002-MCAL-001, *HVAC Pressurization Calculation*
    - 15-002-MCAL-002, *HVAC Ventilation and Loads Calculation*
    - 15-002-PCAL-001, *Acid TRU Waste and Caustic TRU Waste Mass Balance*
    - 15-002-PCAL-003, *Process Tank Sizing*
    - 15-002-PCAL-004, *Drum Storage Sizing*
- Inadequately identified design inputs and design inputs from unapproved/preliminary documents
    - 15-002-MCAL-002
    - 15-002-PCAL-001
    - 15-002-PCAL-003
    - 15-002-PCAL-004
- Final calculation with unverified assumptions
    - 15-002-PCAL-001.

Revision 1 of 15-002-PCAL-007, *SIL Verification Calculation*, for the safety-significant drum evaporator/dryer high temperature safety shutdown system, includes originator and checker signatures (both AECOM representatives working for Weidlinger-Navarro), but was not approved by LANS because the TLW project was placed on hold before the calculation was approved. The revision was required to address significant changes in system design, equipment, and failure rate data based on LANS comments on the previous revision of this calculation. EA acknowledges that the LANS review was incomplete when the calculation was provided to EA for review, and notes the following issues for future consideration:

- The customized LANS specification addressing the revised design had not been issued.
- The calculation did not address the increase in functional test interval to the allowed surveillance grace period of 25% beyond the preliminary documented safety analysis (PDSA)-specified period as recommended in DOE-STD-1195-2011, *Design of Safety Significant Safety Instrumented Systems Used at DOE Nonreactor Nuclear Facilities*.
- The validity of the failure rate data used in the calculation remains to be demonstrated.
- The summation of two Probabilities of Failures on Demand (PFDs) was not correct, resulting in an error in the PDSA listing of the PFD for this safety instrumented system.

Revision 2 of 15-002-PCAL-006, *Safety-Significant Instrument Setpoint Calculation*, for the safety-significant drum evaporator/dryer high temperature safety shutdown system, includes originator and checker signatures, but was not approved by LANS because the TLW project was placed on hold before the calculation was approved. The revision was required to address a change in design based on LANS comments on Revision 0 of 15-002-PCAL-007. The calculation determines a high temperature alarm setpoint that would warn operators to take action to avoid temperatures that would generate excessive nitrous oxide emissions. The calculation of the alarm setpoint was consistent with the PDSA requirement for an annual calibration, but did not reflect the potential increase in setpoint uncertainty due to sensor and temperature safety limit controller drift that could occur during the allowed surveillance grace period of 25% beyond the PDSA-specified period.

EA also reviewed four LANS-produced calculations contained in design change packages. EA identified issues with the LANS-produced calculations, including the incorrect determination of the ML, as detailed below. LANS uses the ML process as part of its graded approach to quality assurance (QA). Use of the incorrect ML will result in incorrect application of QA controls required by AP-341-502, *Management*

Level Determination and Identification of Quality Assurance and Maintenance Requirements **(Deficiency)**.

- CAL-15-TA55-GB-045-S, *GB-261 Equipment Mounting Calculations*, was produced by LANS as part of DCF-15-55-0004-938, *CMRR PF4 Equipment Installation (PEI) Rm 124 Task 4*. The calculation qualifies the seismic attachment of two pieces of equipment to the floor of a glovebox. Although MLD-09-TA55-GB-058, *Glovebox Management Level Determination*, appropriately categorizes both the glovebox shell and weld studs attached to the glovebox shell as ML-2, and although AP-341-605 requires the calculation to be performed at the ML of SSCs affected or potentially affected by the calculation, CAL-15-TA55-GB-045-S was performed as an ML-4 (non-safety related) calculation without independent review or facility design authority technical review. Neither the calculation reviewer nor the calculation approver recognized the erroneous ML.
- CAL-15-TA55-GB-045-S pertains to mounting a ball mill and sample press in the glovebox. LANS engineers interviewed stated that, since ASCE 7-5 did not contain seismic coefficients for either ball mills or sample presses, the values for furnaces were used instead. This explanation did not address why "laboratory equipment" values were not used, or why the assumption that the ball mill and sample press would behave similarly to a furnace was not made explicit in the calculation. The calculation also lists "none" under assumptions; however, the body of the calculation states, "This calculation will assume the center of gravity…" which is an assumption it neither justified as being conservative, nor noted as requiring future verification.
- CAL-55-0004-209, *Controller Stand and Shelf Analysis for GB-197 and GB-198*, was produced by LANS as part of DCP-09-017-FCR-018, *124 Task 1B: PEI Programmatic Glovebox Changes*. Part of this ML-4 calculation analyzes a new shelf installation. As noted above, MLD-09-TA55-GB-058 appropriately categorizes both the glovebox shell and weld studs attached to the glovebox shell as ML-2; therefore, the calculation ML-4 designation is incorrect. EA also observed that design and dimensions of the shelf are not listed as references or inputs to the calculation.
- CAL-15-TA55-GB-044-S, *GB Repeatable Printer Mount Calculation*, was produced by LANS as part of DCP-09-013-FCR-020. As with the above calculations, this calculation analyzes the attachment of an ML-4 component to an ML-2 glovebox and should therefore be designated ML-2.

EA discussed hypothetical cases of attaching items to glovebox studs with several glovebox systems engineers during a tour of PF-4. None of the glovebox systems engineers correctly identified the attachment of items to glovebox studs as requiring an ML-2 calculation, which indicates that other calculations not reviewed by EA may also have been performed at too low of an ML (i.e., without the QA controls required to ensure safety).

Judgment Memoranda

EA reviewed four judgment memoranda. According to AP-341-605, these memoranda may be used in lieu of calculations for simple designs. All four memoranda affected ML-4 commodities/components.

- The first was for installation of a concrete pad for an air conditioning unit in TA-31. This memorandum reflected high quality with detailed justification for the proposed modification.
- The second was for installation of anchors for a replacement vacuum pump in TA-50. This memorandum did not include any evaluation and gave no technical basis, such as pump weight versus anchor capacities, for the conclusion. Further, it did not address any potential for seismic interactions with other SSCs.

- The third (TA-03) assessed weight distribution on a proposed concrete slab for installation of a nitrogen tank, but did not look at anchor bolt capacity for the tank mounting.
- The fourth (TA-40) was for a concrete repair, and provided sufficient justification for the corrective measures.

In summary, two of the four judgment memoranda provided adequate justification for proposed ML-4 modifications, while the other two did not. The scopes of application for these memoranda are addressed in Section 5.1 above. Based on these mixed results, implementation of this process is inconsistent within ES-DO **(Deficiency)**.

Drawings

EA reviewed drawings and drawing revisions produced by LANS personnel and by two LANS design subcontractors, Merrick and Weidlinger-Navarro. LANS and Merrick drawings related to the PEI project and were contained in design packages or their revisions. The Weidlinger-Navarro drawings were produced as part of the final design of the TLW project. LANS drawings were produced in accordance with AP-341-608, while the design subcontractors worked to their internal procedures.

EA found all drawings reviewed, regardless of the originator, to generally be in accordance with industry standards. Dimensioning was clear and legible, and auxiliary views were provided when appropriate for clarification.

EA identified one minor issue on drawing 55Y-202036, *Interior Mouse Trap Vacuum Assembly*; a discrepancy between the part number for the Pyrex™ cylinder and its part number on the bill of materials was missed by the LANS checker. This issue was discussed with the LANS glovebox systems first line manager, who committed to correct the drawing.

Design Change Packages

EA reviewed seven DCFs related to the PEI project, as well as the final design package for the TLW project. DCFs typically included craft-specific specifications, engineering drawings, and documentation of a USQ determination worksheet. Calculations, addressed separately above, were included in some of the DCFs. Other than those involving calculations, EA identified no issues with the design change packages.

Craft-specific specifications are based on the Construction Standards Institute format and were produced by tailoring relevant specifications from the LANL Master Specification. The use of a master specification helps to ensure that designers consider relevant codes and standards, and incorporate LANL-specific design criteria, such as operation of equipment at high altitudes. EA reviewed specifications contained in several design packages and did not identify any issues.

As the prime contractor for LANL, LANS provides technical oversight of designs produced by its subcontractors. EA found objective evidence of extensive comments produced by LANS reviewers of TLW design products produced by Weidlinger-Navarro before the hold was placed on the TLW project. EA identified the following inconsistencies and errors in the TLW final design products, in addition to those identified in the LANS reviews performed to date:

- 15-002-PLN-007, *Facility Operations Analysis and Sequence of Operations for the TA-50-0269 Transuranic Liquid Waste (TLW) Treatment Facility*, has inconsistent descriptions of where the drum filter is installed (Section 2.1.2.1 and 2.1.2.2 versus Section 2.2 of the document).

- 15-002-TRPT-010, *Facility Design Description for the TA-50-0269 Transuranic Liquid Waste (TLW) Treatment Facility*, Section 4.4.8 for Instrumentation and Controls Design Criteria does not address the need for an interlock for the drum tumbler door, even though it is identified in Table 2.2 of this design description as an important-to-safety control.

The TLW project engineer was informed of these errors and indicated that the issues would be addressed when the project hold is lifted.

Design Revisions

Design revisions at LANL are performed in accordance with AP-341-519. This procedure identifies three primary methods for design revision: the FCN, the FCR, and the DRN. EA reviewed examples of each of these methods that were produced for the PEI project. The TLW project has not matured to the point of design revision, as the final design was submitted and then placed on hold.

FCNs are used primarily for minor changes to design. FCNs must fall within the criteria defined in an approved FCN criteria document. FCNCD-16-TA-55-0001, *Custom Field Change Notice Criteria Document*, is the FCN criteria document for the PEI project. EA reviewed 13 FCNs and discussed 2 specific FCNs with LANS personnel to clarify that FCNs were the appropriate design revision mechanisms. All FCNs were found to be appropriately used to revise designs in accordance with AP-341-519.

FCRs are used during construction or fabrication when the revision is beyond the scope of an FCN, but does not require new drawings, specifications, or complex calculations. AP-341-519 states that FCRs are not to be used for implementation of new requirements and must not affect permits. EA reviewed 25 FCRs and found them generally acceptable; however, 3 of the 25 FCRs exceeded the scope defined by AP-341-519 **(Deficiency)**.

- DCP-09-012-FCR-014, *Installation of Dissolution Glovebox*, contains two new specifications and over a dozen new drawings.
- DCP-09-013-FCR-020 contains over a dozen new drawings and two calculations.
- DCP-09-017-FCR-018 contains three new specifications, three new drawings, and a new calculation.

DRNs are used when design revision is required prior to design implementation, or when substantial revision is required during design implementation. EA examined 16 DRNs and found no issues. EA noted in Section 5.1 above that the scopes of applicability for FCRs and DRN in AP-341-519 do not cover all situations that might arise during field implementation. LANS acknowledged that the gap between needing new construction documents (i.e., exceeding the scope for a FCR) and a substantial revision of the design (i.e., triggering a DRN) was a precursor to the inappropriate use of FCRs as noted above.

Engineering Product Technical Review Conclusions

Design revisions using the DRN and FCN processes were performed adequately in accordance with LANS procedures. The FCR process was also adequately implemented in most cases; however, EA identified examples of the FCR process being used inappropriately.

Drawings and specifications were clear, and appropriately considered the lower atmospheric pressure due to the elevation at LANL. Merrick-produced calculations were of adequate quality with no issues

identified. However, EA found several problems with calculations produced by LANS and Weidlinger-Navarro personnel (including their partner AECOM):

- The calculation checking and approval process was not effective in identifying errors.
- LANS personnel did not recognize that calculations for attaching ML-4 items to the glovebox and glovebox weld studs are required by AP-341-605 to be performed at the higher ML of the glovebox or the glovebox weld studs, in order to invoke the appropriate QA requirements for ensuring safety.
- Judgment memoranda prepared as alternatives to calculations did not provide adequate technical bases for the planned modifications.

5.3 Configuration Management and Change Control

The engineering role in CM includes functions associated with creating and maintaining the technical baseline for the facility, controlling the design change process, managing engineering records, and performing self-critical assessments to ensure continued adequacy of performance in these areas. Guidance for these functions is included in DOE-STD-1073-2003, *Configuration Management*, and DOE Order 420.1C.

Objective:
A documented configuration management program has been established and implemented in accordance with DOE Order 420.1 that ensures consistency among system requirements and performance criteria, system documentation, and physical configuration of the systems within the scope of the program.

Criteria:
- *Design input and output documents are appropriately established. Requirements from upper tier documents are appropriately incorporated into successor (or lower tier) documents. System design basis documents are kept current using formal change control and work control processes. (DOE-STD-1073-2003)*
- *A design change process is in place to ensure that all documents affected by a change, both predecessor and successor, are identified and revised as part of the change process; that changes are reviewed by all potentially affected disciplines and organizations; and that extant changes against technical documents are tracked from initial issuance until incorporation in an approved revision. (DOE-STD-1073-2003)*
- *A records management system has been implemented to provide accessibility to engineering documents using a process that defaults to the most recent revision; tracks unincorporated changes outstanding against issued documents; and limits outstanding changes against engineering documents, such as drawings, to avoid negative impacts from excessive change paper and difficulties in determining the current design configuration. (DOE-STD-1073-2003)*

Technical Baseline

AP-341-405 establishes requirements for the control of technical baseline documentation. It aids in the identification of baseline documents, defines three categories for drawings based on importance to the facility, and sets time limits for incorporation of changes or updates for each drawing category. It provides an adequate basis for technical baseline document identification and control.

Engineering Change Control

The design change process established in AP-341-517 was discussed in detail in Section 5.1. Although

EA noted provisions in the procedure that could be used to circumvent its requirements, no such occurrences were identified and the overall design change process defined in the procedure was adequate. Likewise, EA's review of a sampling of DCF packages (see Section 5.2) identified only minor issues and resulted in the conclusion that ES-DO is implementing this process in an acceptable manner. EA identified one deficiency in its review of AP-341-519, the LANS procedure for revisions to issued DCFs.

Engineering Document Control

AP-341-402, also discussed in Section 5.1, addresses the basic records management functions necessary to CM. Change documents are entered into EDMS upon engineering approval and again at closure. Relationships are created in EDMS, linking approved drawing changes to the parent drawings. EA did not identify any document control process-related issues during review of this procedure; however, EA identified two areas where CM aspects of this process could be enhanced:

- Relationships are not created to link other types of documents that might be placed into a predecessor-successor hierarchy as a result of the engineering process. For example, a new calculation might rely on a previously existing calculation for design input. Subsequent revisions to that predecessor calculation might affect the results of the new calculation. EDMS can be used to track the relationship between these documents, making it easier and more reliable to identify impacts of future revisions. (See **OFI-LANS-03**.)
- Vendor information received during the process of designing and implementing a design change is inserted into the DCF package. It is not separated at any stage and remains retrievable only with knowledge of the DCF number. This process is burdensome for other organizations, such as Maintenance, that use vendor information to establish preventive maintenance requirements.

Assessments

LANS Program Description (PD) 340, *Conduct of Engineering and Configuration Management for Facility Work*, describes the requirements for assessing the formality of engineering and engineering programs, including its CM program. Specifically, PD 340 states that ES-DO will perform an assessment twice annually of one of the three core areas (i.e., facility engineering processes, engineering standards, and facility engineering training and qualification). At the discretion of the site chief engineer, PD 340 allows assessments (either internal or external) that evaluate the conduct of engineering to be used in lieu of these prescribed ES-DO assessments. As discussed in Section 5.5, ES-DO has not performed a management assessment in more than four years, but has committed to take the following, significant actions due to feedback from Parent Organization Functional Management Reviews (POFMRs) and assessments performed by the independent LANL Quality Assurance Division Office (QPA-DO) to improve its CM:

- POFMR 2016-22, *Transuranic Liquid Waste Project*, identified weaknesses in LANS design control (inadequate flowdown of functional requirements into system-level requirements) and informal CM by the LANS subcontracted architect-engineer firm. ES-DO appropriately took action to update the functional requirement document to include more system-level requirements; added a chapter to its Engineering Standards Manual on systems engineering principles for requirements development and verification; and stated that ES-DO would continue to develop this chapter in its Engineering Standards Manual to improve its technical baseline control and integration, system analysis and development, CM, and technical risk management.
- QPA-DO: 17-121, *Transmittal of Audit Report AR(17)-010.000, Audit of Design Control Implementation on Nuclear Projects*, identified errors in the documentation recorded for DCFs of existing facilities that accessed the DCF form from the ES-DO SharePoint site. ES-DO subsequently committed to update requirements in AP-341-517 and the electronic forms on the

SharePoint site by September 2018. Although these actions should improve the future documentation of DCFs, QPA-DO: 17-148, *Transmittal of OR (17)-038.000, CMRR PEI Review of DCF-937 Closeout Documentation (DRNs and FCRs Only)*, noted that the extent of the weaknesses in DCF documentation is larger than that identified in QPA-DO: 17-121. As discussed later in Section 5.5, ES-DO action on QPA-DO: 17-148 has been unnecessarily delayed.

Configuration Management Conclusions

Overall, EA found that the technical baseline is adequately established. Weaknesses were noted in the design change implementing procedures (see Section 5.1), however, a sampling of issued design change packages identified only minor issues and resulted in the conclusion that ES-DO is implementing this process in an acceptable manner. This assessment also concluded that the approach to internal assessments of CM is overly reliant on external reviews. While ES-DO was responsive to those reviews, assessments by external organizations may not achieve the same level of effectiveness and introspection that can result from well-executed self-assessments (i.e., management assessments).

5.4 Engineering Procurement

Engineering supports the procurement process by establishing technical requirements as outlined below. Those requirements establish minimum standards for equipment performance and ensure compliance with the safety basis.

Objective:
Design engineering work is performed consistent with technical standards, DOE requirements, and safety basis requirements and commitments, using approved procedures and sound engineering/scientific principles in accordance with the requirements of 10 CFR 830.

Criteria:
Engineering procedures for procurement specifications are in place and contain appropriate detail to control development, approval, issuance, and revision. Specifications for equipment procurement adequately reflect:

- *Design criteria and safety basis functional and performance requirements*
- *Technical requirements, including reference to applicable drawings and industry codes and standards*
- *Safety classification*
- *Quality requirements*
- *Environmental qualification criteria*
- *Labeling criteria*
- *Test, inspection, and acceptance criteria*

Engineering input to the procurement process at LANL is performed in accordance with P840-1, *Quality Assurance for Procurements*. The technical subject matter expert determines the ML of the item or service to be procured, and appropriate suppliers for items with more stringent quality requirements are identified using the institutional evaluated suppliers list. If other engineering documents, such as drawings, specifications, or master equipment lists, specify the ML of the item or service to be procured, the technical subject matter expert uses the existing ML determination. The institutional evaluated suppliers list identifies acceptable suppliers for identified items, as well as any restrictions or compensatory measures defined by LANS to ensure that the supplier delivers items or services in conformance with ASME NQA-1.

EA examined the procurement documentation for a sample of items procured for the PEI project. No equipment procurements were placed for the TLW project prior to it being placed on hold. EA confined its assessment to the technical content of the procurement packages.

EA assessed the documentation for procurement of high efficiency particulate air (HEPA) filters for glovebox inlet and outlet filtration for the PEI project. The specification for the HEPA filters was based upon the LANL master specification, and was appropriately customized for use with the specific application. During the receipt inspection of the HEPA filters, LANS identified a discrepancy in the documentation provided by the supplier. Per LANS nonconformance report (NCR) NCR-2017-199, *Deficient Documentation for PO#420103*, the discrepancy related to a change in DOE-STD-3020-2015, *Specification for HEPA Filters Used by DOE Contractors*. The most recent revision of the standard no longer allows the filter manufacturer to use successful tests to qualify filters of similar construction. The NCR was dispositioned "use-as-is" since the project code of record invoked the earlier version of DOE-STD-3020-2005. Engineering appropriately changed the specification in the procurement package based on this NCR, using the LANS FCR process described in Section 5.2. EA identified no additional issues.

EA examined the documentation for procurement of gloves for the gloveboxes and glovebox rings. Both of these procurements identified the QA requirements for the equipment involved; required documentation; required inspections and tests; and included requirements for packaging, handling, shipping, and storage. Industry codes and standards were appropriately required by each procurement. EA confirmed that the selected suppliers were listed on the LANS institutional evaluated suppliers list for the type of equipment they were providing. EA did not identify any issues with either of these procurements.

EA reviewed procurement documentation for surface optics equipment. The "Scope of Work and Technical Specifications" (SOW) provided appropriate technical specifications and requirements for providing training, as well as support for developing and implementing factory acceptance testing and site acceptance testing. Initial EA questions concerning the ability of the factory acceptance test to obtain required data at the edge of the test hemisphere were resolved based on discussions with involved LANS personnel, who described the equipment test configuration. EA did not identify any issues with this procurement documentation.

Finally, EA reviewed procurement documentation for the glovebox vacuum atmosphere equipment. The SOW provided appropriate technical specifications and requirements for equipment required to support glovebox safety. Because the selected supplier did not have an NQA-1 qualified QA plan, the SOW also identified appropriate critical safety-related characteristics that had to be verified by testing or inspection to support the LANS commercial grade dedication process. LANL master specifications for "Glovebox Instrumentation" and "Glovebox Atmosphere Regenerable Purification Systems" were appropriately customized utilizing the FCR process to provide additional supplier, quality control, and installation requirements necessary to ensure that the equipment received and installed was acceptable. Initial EA questions about the acceptability of the technical specifications for two components listed on the supplier's bill of material that were different from those listed in the SOW were resolved by review of the customized specifications that clearly state that the provisions of the specification take precedence. The supplier's bill of material appropriately included components meeting the specification requirements. EA also questioned the adequacy of a factory acceptance test report, Section 5.8.2, with only one QA stamp of acceptance for a step that required two verifications. The initial verification tested for a closed circuit between pins J11-1 (the common) and J11-2 when oxygen was below 4%. The second verification required an open circuit between circuit pins J11-2 and J11-2 when oxygen was greater than 4%. However, it is not possible to have an open circuit between two connections to the same pin, and this is likely a typographical error in the test procedure. (Post-review, LANS contacted the vendor and

confirmed that the first pin reference was a typo and that the correct pins were tested. The vendor is resubmitting the corrected factory acceptance test documentation.) LANS QA personnel interviewed stated that they were satisfied that both the closed and open circuit verification tests were performed appropriately **(Deficiency)**.

Finally, the EA review included the LANS commercial grade dedication document, titled "Technical Evaluation and Acceptance Plan," which appropriately listed each safety-related item, its safety critical characteristics, the acceptance criteria (including tolerances where required), method of acceptance, technical justifications, and supporting information. No additional questions were identified.

Engineering Procurement Conclusions

LANS procurement processes are consistent with DOE and LANL requirements. EA identified one test discrepancy for resolution. However, the overall quality of the procurement documents reviewed is adequate.

5.5 Engineering Performance Monitoring and Issues Management

Engineering often has a key role in identifying problems, determining the needed corrective actions, and implementing those actions through the engineering change process. This section discusses EA's assessment of ES-DO's implementation of issues management and performance assessment processes to improve its performance.

Objective:
Programs and processes are in place to identify and correct problems, ensure that personnel are appropriately trained and qualified, and assess internal performance, identifying lessons learned and implementing appropriate corrective actions. (10 CFR 830)

Criteria:
- *Internal assessments are performed on a periodic basis to examine performance with regard to procedural and programmatic requirements. Assessors are independent of the area being examined. Lessons learned are identified and communicated to engineering personnel. Identified problems are documented using the contractor assurance system and tracked to completion of corrective actions. (10 CFR 830)*
- *An effective contractor assurance process is in place wherein problems are identified and corrective actions are determined and accomplished in a timely manner. Corrective actions are effective in addressing both the extent of condition of the identified problem and recurrence control. (10 CFR 830)*

Performance Assessment

POFMR 2014-214, *Conduct of Engineering Implementation and Continuous Improvement*, recommended that ES-DO develop a process for continuous improvement of the LANS conduct of engineering program, including "regular program evaluations through self-assessments and independent assessments, and more regular interaction with and feedback from the LANL and NNSA Field Office stakeholders." ES-DO accordingly revised LANS PD 340 to state that ES-DO would:

- Perform an assessment twice annually of one of the three core areas (i.e., facility engineering processes, engineering standards, and facility engineering training and qualification). At the discretion of the site chief engineer, assessments (either internal or external) that evaluate the conduct of engineering may be used in lieu of these prescribed ES-DO assessments.

- Regularly share metrics and initiatives with NA-LA.

ES-DO has taken significant action to improve its conduct of engineering processes based on feedback from POFMRs, the LANS QPA-DO, and over ten readiness assessments performed per DOE Order 425.1D, *Verification of Readiness to Start Up or Restart Nuclear Facilities*. However, for more than four years, ES-DO has not performed a management assessment per LANL procedure P 328-3, *Management Assessment*, relying on assessments by external teams and the LANS independent QA organization. ES-DO did not list any management assessments in the LANS Site Integrated Assessment Plan for fiscal year (FY) 2018 to meet the requirement in Section 3.6 of PD 340 to twice annually assess one of the three core areas of its conduct of engineering program **(Deficiency)**.

ES-DO managers meet with the NA-LA safety system oversight lead monthly to discuss metrics on the condition of safety systems and the timeliness and adequacy of system health reports and vital safety system evaluations. EA attended the meeting in January 2018. The status of ES-DO's major initiatives for its conduct of engineering program and metrics on the quality of engineering performed by ES-DO personnel or LANS subcontractors were not discussed during this meeting. (See **OFI-LANS-04**.) In the last quarter of 2017, ES-DO briefed management of the Associate Directorate for Nuclear High Hazard Operations on ES-DO major initiatives to:

- Update out-of-date conduct of engineering procedures by September 2018
- Update its master specifications by March 2018
- Update chapters in the Engineering Standards Manual by September 2018
- Develop a plan to better manage the backlog of old DCFs and changes to technical baselines for all LANL facilities by September 2018.

The ES-DO major initiatives are appropriately focused on key elements of its conduct of engineering program. ES-DO included the initiative for the backlog of DCFs and changes to technical baselines due to unsuccessful efforts in the past to control the backlog of extant design changes, which includes incorporation of drawing revisions for completed changes into the affected drawings. ES-DO stated that the backlog is not growing as new design changes are incorporated per AP-341-405, however a focused effort is needed to accelerate reduction in the backlog. EA agrees with the goal of this initiative, however, the commitment to develop a plan by September 2018 provides excessive time (over nine months) to develop a plan, delaying potential improvements to the configuration management of SSCs important to nuclear safety.

ES-DO also briefs the LANS Manager of Projects monthly on the productivity (i.e., cost and schedule performance), quality, compliance (based on a qualitative assessment by ES-DO management), staffing, and training of personnel supporting capital projects. The metric for quality is a three-month rolling average of the number of compliance comments per page across all contracts and projects. The number of compliance comments per page is a poor indicator of the quality of engineering. Averaging this data on quality into one metric obscures the performance of individual subcontractors and LANS engineering groups, and performance in specific disciplines (e.g., mechanical engineering, electrical engineering). Paragraph 3.1.3.a. of System Description (SD) 320, *Los Alamos National Laboratory Contractor Assurance System*, states that the LANS "metrics process creates an environment for aligned and fact-based improvement of LANS performance and provides the basis for performance accountability." This requirement is not being met by the metric for quality currently used by ES-DO. For example:

- The three-month rolling average metric for quality reported in September 2017 was 0.04, with scores up to 0.35 for individual tasks, which significantly exceeds the target of 0.2 (including ratios of 0.11 and 0.24 comments per sheet on 245- and 221-page documents for work performed by LANS engineering personnel).

- The overall (averaged) metric for quality in February 2017 was "green" despite 16 out of 26 design reviews with ratios of comments per page greater than 0.2 for work performed by LANS engineering personnel supporting projects within TA-55.
- This metric does not indicate issues with the quality of engineering design work identified during construction or installation activities.

Overall, EA identified that the ES-DO metric for quality does not support "monitoring activities against acceptance criteria in a sufficient manner to provide assurance that the activities affecting quality are performed sufficiently," as required by SD 330, *Los Alamos National Laboratory Quality Assurance Program* **(Deficiency)**. In contrast, the LANS nuclear criticality safety program (NCSP) uses a more comprehensive set of 22 metrics (with five related to work quality) to track and trend performance relative to defined performance targets for each month. An overall summary of NCSP accomplishments and areas of concern is distributed to LANS and NA-LA management, along with the metrics to ensure alignment on progress in addressing known performance and compliance issues with the NCSP.

Issues Management

ES-DO manages its issues per P322-4, *Issues Management*. P322-4 defines qualitative criteria for categorizing issues as high, moderate, low, or potential risk, and establishes roles, responsibilities, and processes for communicating and correcting issues in a timely manner and distributing lessons learned. P322-4 allows alternative approaches to collect, evaluate, and address issues based on the level of risk involved. For example, causal analyses, extent-of-condition reviews, and effectiveness evaluations are required only for high risk issues.

Until September 2017, LANL used its Performance Feedback and Improvement Tracking System (PFITS) to track issues with its performance. In September 2017, LANL replaced PFITS with a new Issues Management Tool (IMT) for tracking issues. Other feedback and initiatives identified after IMT implementation may be tracked in the Non-Issues Tracking module of the IMT at the discretion of the responsible manager. PFITS interfaces with the IMT and will be used until the end of FY 2018.

Per NHHO-CTR-008, *Engineering Services Division Management Review Board Charter*, the ES-DO Management Review Board (MRB) meets monthly to discuss assessments, open actions due in 30 days, overdue actions, unscreened issues, issues without actions, and extensions for existing reviews. The MRB did not meet while EA was on site. EA reviewed materials presented to the MRB in January 2018 and open IMT items that are important to ES-DO. Although ES-DO had only one overdue action, EA identified the following instances where management of issues has not met the requirements of P322-4 for communicating and correcting issues in a timely manner **(Deficiency)**:

- An action to commission the ES Division Software Quality Management Project Implementation Plan in the Process Improvement Action Tracking (PIAT) module of PFITS (i.e., action PIAT 2015-1228) was 448 days overdue and still "awaiting acceptance of action." On January 23, 2018, the action was transferred to the new IMT with a new due date of April 23, 2018. This was unnecessary, since the PIAT module will not be retired until September 2018, however, it reset the tracking date and obscured the timeliness issue.
- Five findings and seven OFIs from QPA-DO-18-075, *Transmittal of Audit Report AR(17)-025.000 Evaluation of Design Control for Non-nuclear Projects*, had not been assigned for evaluation for 61 days. The MRB Chairman (i.e., the ES-DO Leader) stated that the MRB had just been informed about these unassigned issues the first week in January, despite functionality in the IMT to issue standard reports listing the number of unassigned issues for ES-DO.

- ES-DO actions for QPA-DO: 17-121, *Transmittal of Audit Report AR(17)-010.000, Audit of Design Control Implementation on Nuclear Projects*, did not preclude recurrence of the finding in DCFs developed for other projects outside the scope of that QPA. QPA-DO: 17-148 identified the same issue for the PEI project. Over seven months later, no action has been entered into the IMT for the finding in QPA-DO: 17-148, despite the issue being categorized as a moderate risk issue (specifically a Risk Level 2 issue per LANL procedure P322-4, *Laboratory Performance Feedback and Improvement Process*).
- Action by ES-DO personnel for the TA-55 Facility Operations Director for PIAT 2017-1637 has been "awaiting review for closure" since November 6, 2017. The documentation provided to support closure states that the action will be completed as part of the ongoing revision to the process for system design descriptions. A "promise" to complete an action in the future is listed as unacceptable objective evidence in P322-4 for closure of an action.

Engineering Performance Monitoring and Issues Management Conclusion

ES-DO has taken significant action to improve its conduct of engineering processes and their implementation based on feedback from POFMRs, the LANS independent QPA-DO, and over ten readiness assessments. However, the engineering organization has been solely reliant on external reviews for its assessments for more than four years and has no internal management assessments planned for FY 2018. EA found that the sole ES-DO metric on quality is ineffective since it obscures the performance of individual subcontractors and LANS engineering groups, misrepresents the significance and/or validity of performance feedback, and does not reflect engineering design issues identified during construction or installation activities.

Although ES-DO had only one overdue action, EA identified several instances where ES-DO management of issues has not met the requirements of P322-4 for communicating and correcting issues in a timely manner.

5.6 Follow-up on Previous Findings

In accordance with DOE Order 227.1A, EA performs follow up reviews of issues identified as findings in prior assessment reports to ensure that those issues have been adequately addressed by the facility or site assessed.

Objective:
Corrective action plans must be developed and implemented for independent oversight appraisal findings.

Criterion:
The contractor must prepare, implement, and track to completion corrective actions to address findings identified in EA appraisal reports. Findings and other deficiencies identified in appraisal reports are managed in accordance with established issues management systems (DOE Order 226.1) and quality assurance programs (DOE Order 414.1 and 10 CFR Part 830). (DOE Order 227.1A)

EA followed up on 17 findings from 2 previous assessment reports to assess whether corrective measures taken provided adequate bases to close the findings. Results were not conclusive for 6 of the 17. The results for the remaining 11 are summarized below.

Inspection of Environment, Safety, and Health Programs at Los Alamos National Laboratory, dated January 2008	
Finding	**Resolution**
E1: The cognizant system engineer programs for safety systems at LANL nuclear facilities, TA-55 and Weapons Engineering Tritium Facility (WETF), do not fully comply with the requirements of DOE Order 420.1B, and the facilities do not have interim mechanisms or compensatory measures in place to provide a high level of assurance of safety system operability, reliability, and material condition during transition to full and adequate implementation of its integrated formality of operations effort.	Corrective actions for this issue were tracked under PFITS Item 2007-6286. LANS provided evidence of requirements established for cognizant system engineer (CSE) qualification and of interim qualifications documented for existing CSEs at that time for the Chemistry and Metallurgy Research Facility; Radioassay & Nondestructive Testing Facility; TA-55; Waste Characterization, Reduction, and Repackaging Facility; and WETF. LANS also issued a procedure for conduct of engineering. Baseline operability determinations were made for all affected facilities. A formality of operations program was defined and implemented to improve nuclear facility operations, engineering, maintenance, and training. This item tracks completion of a multi-year performance improvement program, which was initiated in 2006 and continued into 2008 with modifications based on the findings in the referenced January 2008 report. Extensive evidence was provided and reviewed to support the conclusion that this finding has been adequately addressed.

Inspection of Environment, Safety, and Health Programs at Los Alamos National Laboratory, dated January 2008	
Finding	**Resolution**
E2: LANL did not adequately screen, evaluate, and resolve certain technical issues related to the TA-55 ventilation system's vulnerabilities to fire, as required by site unreviewed safety question and corrective action processes, DOE Order 414.1C, and 10 CFR 830.	LANS tracked this issue as PFITS Item 2007-6287. Actions included updating fire modeling performance criteria, revisions to portions of the TA-55 fire screen safety analysis, and consequent revisions to the documented safety analysis (DSA). Evidence was provided to document successful accomplishment of these actions. LANS also revised the calculation procedure, AP-341-605, to include provisions applicable to calculations performed to support safety bases analyses. NA-LA documented concurrence with this approach and subsequently approved the updated DSA. Additionally, EA's recent "Assessment of the Development and Maintenance of Safety Bases at Los Alamos National Laboratory" report documented that the USQ processes have improved the screening and evaluation of technical issues. The documentation provided was sufficient to support the conclusion that this finding has been adequately addressed.
E7: WETF has not effectively implemented a program for independent verification of safety-significant activities in accordance with DOE Order 5480.19, LANL procedure IMP-31 5.0, *Conduct of Operations*, and ISD 315-1, *Conduct of Operations Manual*.	Corrective actions for finding E7 were rolled into the corrective actions for E1. The Conduct of Operations Manual was issued as documented in E1. Separately, EA reviewed AP-341-620, which defines the independent design verification process for LANS. EA found this procedure to be well developed and comprehensive. This finding has been adequately addressed.
E9: WETF has not implemented the software quality assurance plan for Instrumentation and Control System improvements in accordance with DOE Order 414.1C, *Quality Assurance*; the ESA TSE-QMP; the Tritium Science and Engineering Group (ESA-TSE) Software Quality Assurance Plan, TSE-QP-13; and the Instrumentation and Control System system description document.	LANS tracked this issue as PFITS Item 2007-6294. Documentation reviewed by EA provided adequate evidence that a Software Configuration Management Plan was issued for WETF, including specific guidance on software configuration control. This finding has been adequately addressed.

Inspection of Environment, Safety, and Health Programs at Los Alamos National Laboratory, dated January 2008	
Finding	**Resolution**
E10: WETF procured and installed a 40 psid rupture disk in the tritium gas handling system and a two-stage pressure regulator in the tritium gas containment system that did not meet design requirements for these safety-significant systems, as required by DOE Order 414.1C, *Quality Assurance*.	LANS tracked this issue as PFITS Item 2007-6295. LANS provided training in formality of operations for the WETF engineers and issued a new procedure on life cycle management. An evaluation was performed to validate acceptability of the pressure disc. This finding has been adequately addressed.
E11: LANL has not assigned a qualified cognizant system engineer for the safety-significant fire protection system serving the WETF hazard category 2 nuclear facility as required by DOE Order 420.1 B, *Facility Safety*.	EA report, "Office of Enterprise Assessments Review of the Los Alamos National Laboratory Weapons Engineering Tritium Facility Fire Suppression System – November 2014" validated that WETF had an assigned fully qualified CSE for the fire suppression system. This finding has been adequately addressed.
E12: WETF did not initiate timely nonconformance report(s), did not promptly assess tritium gas handling system and tritium gas containment system operability, and did not implement compensatory measures in an expeditious manner following recognition of the installation of procured parts that did not meet or may not have met the design requirements for these safety-significant systems, as required by DOE Order 414.1C, *Quality Assurance*, and the DOE-approved LANL quality assurance program.	Specific guidance for timeliness of nonconformance reporting was added to P330-6, R1 issued June 26, 2008, *Nonconformance Reporting Procedure*. This requirement was removed in revision 3, dated August 19, 2009, when reliance was placed on timeliness requirements established elsewhere for operability evaluations upon the discovery of a nonconforming condition. NA-LA accepted this change. However, timeliness requirements were reintroduced in a later revision and remain in the current revision 12 (Section 3.5). Separately, sufficient evidence was provided that the facility engineers affected by this issue were trained in nonconformance reporting requirements. The corrective actions reviewed were sufficient to conclude that this finding has been adequately addressed.

Targeted Review of the Safety Significant Ventilation System and Interconnected Portions of the Associated Safety Class Confinement System, and Review of Federal Assurance Capability at the Los Alamos National Laboratory Technical Area 55, dated August 2015	
Finding	**Resolution**
LANS-CSE/CM-2: Contrary to the requirements of DOE Order 420.1B Change 1, LANS made changes to the physical configuration of VSS [vital safety system] components without adequately documenting that the changes were technically acceptable and would not invalidate the capability of those components to perform their required functions. This lack of adequate technical basis was also carried forward into USQ determinations, which are not always accurate or factual and therefore do not meet the requirements of 10 CFR 830.	This issue was found during review of change package DCP-09-004. EA found that an anchor bolt design change documented in FCR-004 in that package was not supported by technical evaluation either in the DCP or retrievable from other sources. LANS documented this issue in PFITS Item 2015-2260, with a single action to "Adjudicate Finding." The closure statement notes that the FCR change is backed by Merrick calculation 5789-09-S-01; however, during the original review, EA found that LANS did not have the Merrick calculation. During this 2018 review, LANS was able to provide Revision 1 to the Merrick calculation. EA's review indicated that the revised calculation adequately assessed the modified equipment anchorage. Additionally, EA's recent "Assessment of the Development and Maintenance of Safety Bases at Los Alamos National Laboratory" report documented that the USQ processes have improved the screening and evaluation of technical issues. This finding has been adequately addressed.
LANS-CSE/CM-4: Contrary to the requirements of DOE-STD-1073-2003 (required by DOE Order 420.1B), facility-wide procedures do not adequately address the posting of design changes against affected documents and drawings as required to ensure that the design change impact information is identifiable and retrievable by other users of those documents.	LANS documented this issue in PFITS Item 2015-2262, with a single action to "Adjudicate Finding." The Action Taken block notes that all DCFs are now placed in EDMS and linked to the affected master documents. It references AP-341-402, which calls for that action after approval (prior to implementation) in accordance with ESDO-AP-001, *ES-DO Engineering Document Control Desktop Instruction*. The desktop procedure contains guidance for posting changes against affected documents, including creating relationships as an aid in identifying future impacted documents. These measures, in aggregate, are sufficient to conclude that this finding has been adequately addressed.

Targeted Review of the Safety Significant Ventilation System and Interconnected Portions of the Associated Safety Class Confinement System, and Review of Federal Assurance Capability at the Los Alamos National Laboratory Technical Area 55, dated August 2015	
Finding	**Resolution**
LANS-OPS-1: LANS did not implement the equipment operator (EO) qualification program sufficiently to ensure that the facility is staffed with qualified EOs as required by DOE Order 426.2 and the DSA.	PFITS Item 2015-2258 documented completion of qualifications by seven individuals with a closure date of September 9, 2015. A new search performed January 19, 2018, indicated that the seven individuals qualified in 2015 have maintained their qualifications through annual renewals and that additional equipment operators have been qualified. This finding has been adequately addressed.
LANS-CSE/CM-1: Contrary to the requirements of DOE STD-3020-2005, safety class high efficiency particulate air filters in the PF-4 ventilation system exhausts may be exposed to flow rates in excess of their rated capacity during a design basis event, resulting in reduced efficiency and potential failure to meet design performance requirements.	LANS chose to address this issue by replacing the affected HEPA filters with new filters rated for flow rates in excess of the fan capacity. This approach is acceptable to fully resolve the finding. Adequate documentary evidence was provided during this assessment to allow confirmation that the filter replacements were accomplished. LANS actions relative to this finding were documented in PFITS Item 2015-2259. This finding has been adequately addressed.

Findings Follow-up Conclusions

EA found sufficient bases during this assessment to conclude that 11 pre-existing findings from two prior assessments had been adequately addressed through completed corrective actions. These results were based on extensive documentary evidence provided by LANS.

6.0 FINDINGS

EA did not identify any findings during this assessment. Deficiencies that did not meet the criteria for a finding are listed in Appendix C of this report, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified some OFIs to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in appraisal reports, they may also address other conditions observed during the appraisal process. EA offers these OFIs only as recommendations for line management consideration; they do not require formal resolution by management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

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OFI-LANS-01 Consider revising AP-341-605 to require that all calculations be issued as standalone documents and entered into EDMS as such to meet the retrievability requirements of NQA-1.

OFI-LANS-02 Consider revising AP-341-605 to provide more detailed guidance in Attachment A for the technical review of external subcontractor-produced calculations. Reference to Attachment B of AP-341-622 would be appropriate in this application.

OFI-LANS-03 Consider using capabilities inherent in the EDMS software to track predecessor-successor relationships between documents in design change packages (i.e., calculations using design input from higher-tier calculations) as an aid in identifying impacted documents for future design changes.

OFI-LANS-04 Consider periodically providing ES-DO personnel and NA-LA the status of ES-DO's major initiatives and metrics, and/or assessments of the quality of engineering products.

Appendix A
Supplemental Information

Dates of Assessment

Onsite Assessment: November 13-16, 2017 and January 16-25, 2018

Office of Enterprise Assessments (EA) Management

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Appendix B
Key Documents Reviewed, Interviews, and Observations

Documents Reviewed

15-002-LIST-003, *Long-Lead Equipment List for the TA-50-0269 TRU Liquid Waste (TLW) Project*, Revision 0, 4/5/2017
15-002-PLN-006, *Field Change Notice Criteria Document*, Revision 0, 6/23/2017
15-002-PLN-007, *Facility Operations Analysis and Sequence of Operations for the TA-50-0269 Transuranic Liquid Waste (TLW) Treatment Facility*, Revision 0, 4/5/2017
15-002-SDD-001, *Chemical Spray Shields, System Design Description for the TA-50-0269 Transuranic Liquid Waste (TLW) Treatment Facility*, Revision 0, 4/5/2017
15-002-SDD-005, *TLW Primary Treatment Process*, Revision 0, 4/5/2017
15-002-SPEC-001, Section 11 5000, *Drum Tumbler Enclosure Fabrication*, Revision 0
15-002-SPEC-001, Section 11 5100, *Drum Transport and Tumbling System*, Revision 0
15-002-TRPT-002, *Preliminary Fire Hazards Analysis for the TA-50-0269 Transuranic Liquid Waste (TLW) Treatment Facility*, Revision 6, 5/24/2017
15-002-TRPT-004, *Design Basis Document for the TA-50-0269 Transuranic Liquid Waste (TLW) Treatment Facility*, Revision 2, 4/5/2017
15-002-TRPT-010, *Facility Design Description for the TA-50-0269 Transuranic Liquid Waste (TLW) Treatment Facility*, Revision 0, 4/5/2017
15-002-TRPT-014, *White Paper: Material Compatibility Analysis for the Process Systems for the TA-50-0269 Transuranic Liquid Waste (TLW) Treatment Facility*, Revision 0, 4/5/2017
55Y-202036, *Interior Mouse Trap Vacuum Assembly*
AP-341-402, *Engineering Document Management in Operating Facilities*, Revision 0.1, 7/10/2014
AP-341-405, *Identification and Control of Technical Baseline, Variances, Alternate Methods, and Clarifications in Operating Facilities*, Revision 3.1, 12/15/2013
AP-341-502, *Management Level Determination and Identification of Quality Assurance and Maintenance Requirements*, Revision 4, 6/15/2014
AP-341-517, *Design Change Form*, Revision 1.1, 5/18/2012
AP-341-519, *Design Revision Control*, Revision 4, 12/2/2015
AP-341-601, *Functions & Requirements Document*, Revision 1, 6/27/2013
AP-341-602, *Requirements and Criteria Document*, Revision 2, 4/23/2017
AP-341-604, *Engineering Input and Coordination of Conceptual Design Report*, Revision 0, 11/03/2010
AP-341-605, *Calculations*, Revision 3, 7/24/2013
AP-341-607, *Determining Critical Characteristics of Safety Related Items*, Revision 1, 8/30/2014
AP-341-608, *Engineering Drawings and Sketches*, Revision 1, 7/24/2013
AP-341-611, *System Design Descriptions*, Revision 2, 9/10/2015
AP-341-613, *Instrumentation Set Point Control*, Revision 1.1, 3/30/2014
AP-341-620, *Review of LANL Produced Design Documents*, Revision 2, 10/17/2013
AP-341-622, *LANL Review of Designs Produced by External Design Agencies*, Revision 2, 10/17/2013
AP-341-624, *Independent External Design Review*, Revision 1, 11/3/2010
AP-341-626, *Design Interface Control*, Revision 0, 8/20/2010
AP-341-627, *Design Coordination*, Revision 0.1, 3/13/2014
AP-341-702, *Statements of Work*, Revision 0, 11/3/2010
AP-341-703, Commercial Grade Dedication, Revision 4, 12/15/2015
C57214, Sheet D-0002, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Process P&ID Symbol Legend*, Revision 0, 4/5/2017
C57214, Sheet D-0003, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Process P&ID Symbol Legend*, Revision 0, 4/5/2017

C57214, Sheet D-0004, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Process P&ID Symbol Legend*, Revision 0, 4/5/2017
C57214, Sheet D-3005, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility*, Revision 0, 4/5/2017
C57214, Sheet D-6000, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Process Flow Diagram*, Revision 0, 4/5/2017
C57214, Sheet D-6015, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Process & Instrumentation Diagram*, Revision 0, 4/5/2017
C57214, Sheet E-0001, *Electrical Symbol Legend and Abbreviations*, Revision 0, 4/5/2017
C57214, Sheet E-1000, *Electrical Site Utility Plan*, Revision 0, 4/5/2017
C57214, Sheet E-6000, *One-Line Diagram SWBD-A & PP-1*, Revision 2, 4/5/2017
C57214, Sheet E-6001, *One-Line Diagram MCC-A & PP-B*, Revision 2, 4/5/2017
C57214, Sheet E-6002, *One-Line Diagram PP-C & UPS-1*, Revision 2, 4/5/2017
C57214, Sheet E-6003, *One-Line Diagram 13.2 kV System*, Revision 2, 4/5/2017
C57214, Sheet E-6211, *Motor Control Diagram (Evaporator/Dryers and Drum Tumbler)*, Revision 0, 4/5/2017
C57214 Sheet J-6084, *Instrument Loop Diagram TSHH-2502*, Revision 0, 4/5/2017
C57214 Sheet J-6085, *Instrument Loop Diagram TSHH-2503*, Revision 0, 4/5/2017
C57214, Sheet M-0001, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Symbol Legend & General Notes*, Revision 0, 4/5/2017
C57214, Sheet M-0002, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Symbol Legend & General Notes*, Revision 0, 4/5/2017
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C57214, Sheet M-1001, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Zone Pressure Plan*, Revision 0, 4/5/2017
C57214, Sheet M-1002, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Roof HVAC Plan*, Revision 0, 4/5/2017
C57214, Sheet M-1003, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Zone Pressure Plan*, Revision 0, 4/5/2017
C57214, Sheet M-3000, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Section*, Revision 0, 4/5/2017
C57214, Sheet M-3002, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Section*, Revision 0, 4/5/2017
C57214, Sheet M-3004, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Section*, Revision 0, 4/5/2017
C57214, Sheet M-6021, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Mechanical Sequence of Operations*, Revision 0, 4/5/2017
C57214, Sheet M-6022, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Mechanical Sequence of Operations*, Revision 0, 4/5/2017
C57214, Sheet M-6023, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Mechanical Sequence of Operations*, Revision 0, 4/5/2017
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C57214, Sheet M-6025, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Mechanical Sequence of Operations*, Revision 0, 4/5/2017
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C57214, Sheet M-6027, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Mechanical Sequence of Operations*, Revision 0, 4/5/2017
C57214, Sheet M-7000, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Mechanical Equipment Schedule*, Revision 0, 4/5/2017

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C57214, Sheet Q-5000, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Drum Tumbler Installation Detail*, Revision 0, 4/5/2017
C57214, Sheet Q-5001, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Drum Tumbler Enclosure Detail*, Revision 0, 4/5/2017
C57214, Sheet Q-5002, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Drum Fill Hood Detail*, Revision 0, 4/5/2017
C57214, Sheet Q-5003, *RLWTF Upgrade TRU Liquid Waste (TLW) Facility Tank Anchorage Detail*, Revision 0, 4/5/2017
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Calculation 15-002-PCAL-001, *Acid TRU Waste and Caustic TRU Waste Mass Balance*, Revision 2, 4/5/2017
Calculation 15-002-PCAL-003, *Process Tank Sizing*, Revision 0, 4/5/2017
Calculation 15-002-PCAL-004, *Drum Storage Sizing*, Revision 0, 4/5/2017
Calculation 15-002-PCAL-006, *Safety-Significant Instrument Setpoint Calculation*, Revision 1, 5/24/2017
Calculation 15-002-PCAL-006_R2, *Safety-Significant Instrument Setpoint Calculation*, Revision 2 (unissued)
Calculation 15-002-PCAL-007-R0, *SIL Verification Calculation*, Revision 0, 5/24/2017
Calculation 15-002-PCAL-007-R1, *SIL Verification Calculation*, Revision 1 (unissued)
Calculation 15-002-SCAL-002, *Site Retaining Walls*, Revision 0, 4/3/2017
Calculation 8735-M-CAL-002, *Enclosure Interior Shelf Capacity Calculation*, Revision 0, 10/15/2015
Calculation 8735-S-CAL-001, *PF-4 Equipment Installation (PEI) Glovebox Design and Analysis XB 1x1*, Revision 0, 10/15/2015
Calculation 8735-S-CAL-002, *PF-4 Equipment Installation (PEI) Glovebox Design and Analysis GB 1x3*, Revision 0, 10/15/2015
Calculation 8735-S-CAL-003, *PF-4 Equipment Installation (PEI) Glovebox Design and Analysis GB 1x2*, Revision 0, 10/15/2015
Calculation CAL-15-TA55-GB-031-S, *GB 1132 Furnace and Power Supply Seismic Anchorage*, Revision 0, 8/11/2015

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CMRR-PLAN-PM-0101, *CD-1 Reaffirmation for the REI2 and PEI Subprojects Program Requirements Document*, Revision 3
DCF-14-55-0004-641-DRN-001, *Removal of Legacy Items in Room 124*, Revision 0, 4/11/2016
DCF-14-55-0004-641-DRN-002, *D&D of GBs and Equipment in Room 124 – Piping Service Removal Changes*, Revision 0, 2/5/2016
DCF-14-55-0004-641-FCN-00001, *Zone 2 Longer Flange Bolt Needed*, Revision 0, 5/5/2017
DCF-14-55-0004-641-FCR-00024, *Point of Removal for PPCCW Return/Supply Lines*, Revision 0, 10/20/2017
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DCF-14-55-0004-857-FCR-019, *LOAD BALANCE PP-115D CIRCUIT CHANGES DCF-15-55-0004-857-FCR-019) and XRD Installation (WOIWD # 513590-04)*, 12/9/2016
DCF-15-50-0037-1114-FCR-001, *PMT Voltage*, 8/1/2016
DCF-15-55-0004-923, *PEI-1 100% Fabrication Package*, Revision 0, 12/1/2015
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DCF-15-55-0004-923B-DRN-003, *Replace B-Line Products*, Revision 0, 12/6/2016
DCF-15-55-0004-923B-DRN-00004, *Incorporate Changes to GB-1151/1152 Design Documents Requested by Field Engineering*, Revision 0, 5/5/2017
DCF-15-55-0004-923B-DRN-00005, *Enclosure Modifications*, Revision 0, 6/22/2017
DCF-15-55-0004-923B-DRN-00008, *Incorporate Off-Site Welding Spec*, Revision 0, 8/24/2017
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DCF-15-55-0004-923B-FCR-00008, *Electrical Changes*, 2/24/2017
DCF-15-55-0004-923B-FCR-00019, *Circuit Breaker Spec Update*, 5/4/2017
DCF-15-55-0004-923B-FCR-00028, *Electrical Load List Corrections*, 10/10/2017
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DCF-15-55-0004-934, *CMRR PF4 Equipment Installation (PEI) Rm 124 Task 3B*, Revision 0, 1/7/2016
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DCF-15-55-0004-935, *CMRR PF-4 Equipment Install (PEI) Room 124 Task 3A*, Revision 0, 1/7/2016
DCF-15-55-0004-935-DRN-00002, *Receptacle Changes*, Revision 0, 6/9/2017
DCF-15-55-0004-935-DRN-00003, *Address Constructability Comments*, Revision 0, 6/19/2017
DCF-15-55-0004-935-DRN-00004, *GB Stand Brace Addition*, Revision 0, 7/17/2017
DCF-15-55-0004-935-FCR-001, *Clarifications to Specifications 11 5311.17 and 11 5311.1*, 10/25/2016
DCF-15-55-0004-935-FCR-00002, *Hilti Anchors & Conduit Routing*, Revision 0, 5/1/2017
DCF-15-55-0004-935-FCR-00023, *Feedthrough Modifications*, Revision 0, 8/16/2017
DCF-15-55-0004-937, *CMRR PF4 Equipment Installation (PEI) Rm 124 Task 2B*, Revision 0, 7/13/2015
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DCF-15-55-0004-938-DRN-00001, *Resolutions to Constructability Issues,* Revision 0, 10/17/2017
DCF-15-55-0004-938-FCN-00001, *Change Thickness of SST Angle to 3/8*, Revision 0, 6/28/2017
DCF-15-55-0004-938-FCN-00004, *S. S. Plugs ASTM A182 or ASTM A403,* Revision 0, 7/17/2017
DCF-15-55-0004-941, *CMRR PF4 Equipment Installation (PEI) Rm 115 Task 1,* Revision 0, 1/6/2016
DCF-15-55-0004-941-DRN-00001, *Additional Specifications,* Revision 0, 5/17/2017
DCF-15-55-0004-941-DRN-00002, *Equipment Replacement,* Revision 0, 6/19/2017
DCF-15-55-0004-941-FCN-00001, *¼" Soft Solder Ball Valve,* Revision 0, 12/22/2016
DCF-15-55-0004-941-FCN-00002, *Administrative Drafting Error on Pipe Part Number Call-out,* Revision 0, 6/7/2017
DCF-15-55-0004-941-FCN-00003, *Administrative Drafting Error on Pipe Part Number Call-out,* Revision 0, 6/7/2017
DCF-15-55-0004-941-FCR-00016, *Externally Pressurized Copper Component Hot Tie-In Testing,* Revision 0, 10/5/2017
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DCP-09-013-FCR-020, *Installation of Mass Spec Gloveboxes GB-1132 & GB-1133*, Revision 0, 1/11/2016
DCP-09-013-FCR-024, *Modification of Service Panels on GB-1132*, Revision 0, 4/24/2017
DCP-09-013-FCR-025, *Secure Power Supply*, Revision 0, 7/18/2016
DCP-09-013-FCR-00034, *Feedthrough Modifications*, Revision 0, 7/10/2017
DCP-09-017-FCN-00002, *Modify Weld Callouts of Shelve [sic] Pans in Rm. 124*, Revision 0, 5/17/2017
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DCP-09-017-FCR-018, *124 Task 1B: PEI Programmatic Glovebox Changes,* Revision 0, 7/13/2015
DCP-09-017-FCR-022, *Shelve [sic] Weld Detail*, Revision 0, 8/24/2016
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PEI Project Specification 40 9100.1, *Monitoring And Shutdown System–High Confidence*
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Memorandum, Deines to de Nevers, 5/25/2016, *TA-50-0001 – Engineering Judgment – Vacuum Pump Anchors*
Memorandum, Deines to Khan, 7/22/2016, *Engineering Judgment – TA-03-2010 – Nitrogen Tank and Concrete Slab Installation*
Memorandum, Deines to Gentzlinger, 8/29/2016, *Engineering Judgment – TA-40-0015 – Chamber 15 Foundation Repair*
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P322-4, *Issues Management*, Revision 12, Change 2, 12/4/2017
P328-3, *Management Assessment*, Revision 8, Administrative Change 3, 5/4/2017
P330-6, *Nonconformance Reporting*, Revision 12, 7/18/2017
P341, *Facility Engineering Processes Manual*, Revision 6 Admin Change 1, 9/7/2017
P342, *Engineering Standards*, Revision 2, 8/24/2016
P840-1, *Quality Assurance for Procurements*, Revision 9, 11/29/2017
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PO 423412-Vacuum Atmosphere, Appendix_D-1 S*crubbed Dri Train Drawings 423412*
PO 423412-Vacuum Atmosphere, Exhibit D *DriTrain 423412*
PO 423412-Vacuum Atmosphere, Exhibit F - PO 423412 *Vacuum Atmosphere Dri Trains*
PO 423412-Vacuum Atmosphere, Exhibit G PO 423412 *Vacuum Atmosphere Dri Trains*
PO 423412-Vacuum Atmosphere, Exhibit H PO 423412 *Vacuum Atmosphere Dri Trains*
PO 423412-Vacuum Atmosphere, Exhibit I Attachment B - *Subcontractor Submittal*
PO 423412-Vacuum Atmosphere, *SBT-423412-5001 I&OM -Final*
PO 423412-Vacuum Atmosphere, SBT-423412-5002 *General Arrangement and Assembly D*
PO 423412-Vacuum Atmosphere, SBT-423412-5003 *Factory Acceptance Test Plan*
PO 423412-Vacuum Atmosphere, SBT-423412-5004 *Standard Test Reports-Helium Leak*
PO 423412-Vacuum Atmosphere, SBT-423412-5005 *Packing and Shipping Procedure*
PO 423412-Vacuum Atmosphere, SBT-423412-5006 *Spare Parts Miscellaneous Item List*
PO 423412-Vacuum Atmosphere, SBT-423412-5007 *Welding Procedure Specifications*
PO 423412-Vacuum Atmosphere, SBT-423412-5008 *Welder Performance Qualification*
PO 423412-Vacuum Atmosphere, SBT-423412-5009 *AWS QCL CWI certifications - Visual*
PO 423412-Vacuum Atmosphere, SBT-423412-5010 *Welding and NDE Personnel*
PO 423412-Vacuum Atmosphere, SBT-423412-5011 *Shop Traveler Procedure*
PO 423412-Vacuum Atmosphere, SBT-423412-5012 *Shop Traveler*

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PO 423412-Vacuum Atmosphere, SBT-423412-5015 *Material Control Procedure*
PO 423412-Vacuum Atmosphere, SBT-423412-5016 *ASNT SNT TC 1A, Level II or III certified*
PO 423412-Vacuum Atmosphere, SBT-423412-7002 *Certificate of Conformance*
PO 423412-Vacuum Atmosphere, SBT-423412-7003 *Certification of Calibration*
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Interviews

LANS

- Engineering Support Division Leader
- Engineering Procedure Specialist
- Safety Basis Division Leader
- Safety Basis Division Deputy Leader
- Chemist
- CMRR Project Manager
- Conduct of Engineering Manager
- Conduct of Engineering Process Manager
- Conduct of Engineering Standards Manager
- Construction Engineer
- Contractor Engineer (2)
- Contractor Administrative Support Deputy Division Leader
- Engineering Product Delivery Manager
- Engineering Project Delivery Deputy Division Leader
- Engineering Services Division Senior Advisor
- Engineering Services Issues Management Coordinator
- Environment and Waste Management Facility Operations Engineering Manager
- Glovebox Systems First Line Manager
- Glovebox Systems Engineer (3)
- Mechanical Design Engineering Manager
- Mechanical, Fire Protection, and Pressure Safety Engineer
- PEI Senior Project Engineer
- PEI Project Engineer
- Project Engineer
- Procurement Engineering Lead
- Procurement Engineer
- TA-55 Chief Engineer
- TA-55 Facility Operations Director
- TA-55 Facility Design Authority Representative
- TA-55 Modification Engineering Manager
- TLW Project Engineer

DOE Acquisitions and Project Management

- Project Management Director for Chemistry and Metallurgy Research Replacement Project
- Federal Project Director for PEI
- Deputy Federal Project Director for PEI
- Federal Project Director for TLW

NA-LA

- Safety System Oversight Engineer
- Facility Representative

Observations

- Engineering Managers Council Meeting
- ES-DO and NA-LA Engineering – Safety System Oversight Monthly Interface Meeting
- PEI Construction Meeting (War Room Meeting)
- Quality Assurance/Engineering Services Monthly Meeting
- TA-55 Change Control Board Meeting
- Walkdown of TLW Site
- Walkdown of PEI Rooms in TA-55

Appendix C
Deficiencies

Deficiencies that did not meet the criteria for a finding are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

- Contrary to 10 CFR 830.122 and ASME NQA-1, procedure AP-341-605 permits "intelligent design evaluations" in lieu of calculations on safety-related applications, bypassing all engineering requirements for identification of design inputs, checking, and design verification.
- Contrary to ASME NQA-1 and DOE-STD-1073-2003, procedure AP-341-517 permits modifications to be made to safety-related SSCs with no engineering design output, bypassing the design change requirements in that procedure.
- Procedure AP-341-519 defines applicability for the use of FCRs and DRNs in a manner that creates a population of revisions (requiring limited changes to engineering documents) that cannot be accomplished without violating procedure requirements.
- Contrary to the requirements of ASME NQA-1, LANS and its subcontractor, Weidlinger-Navarro, did not perform sufficient checking and design verification to ensure that design inputs were identified and controlled, and that unverified portions of the design were identified and controlled.
- Contrary to the requirements of AP-341-605, LANS did not correctly identify the Management Level of several issued calculations.
- Contrary to 10 CFR 830.122, judgment memoranda, or "intelligent design evaluations" dated May 25, 2016, and July 22, 2016, per AP-341-605, were used as the bases for facility modifications without providing adequate technical justification.
- Contrary to the requirements of AP-341-519, LANS inappropriately used FCRs to perform extensive design revisions requiring the creation of new construction documents.
- Contrary to SD 330, Appendix A, Criterion 5, LANS QA personnel accepted an open circuit verification for the glovebox vacuum atmosphere equipment, which could not be performed as written in the factory acceptance test procedure.
- Contrary to Section 3.6 of PD 340, ES-DO did not list any management assessments on the LANS Site Integrated Assessment Plan for FY 2018 to meet the requirement to twice annually assess one of the three core areas of its conduct of engineering program.
- Contrary to SD 330, the ES-DO metric for quality does not support "monitoring activities against acceptance criteria in a sufficient manner to provide assurance that the activities affecting quality are performed sufficiently."
- Contrary to the requirements of P322-4, several instances were noted where ES-DO has not communicated and corrected issues in a timely manner.