Office of Enterprise Assessments
Assessment of Savannah River Site Tritium Facility Safety System Management

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Acronyms

AHU	Air Handling Unit
ALARA	As Low as Reasonably Achievable
ANSI	American National Standards Institute
APO&C	Assessment Performance Objectives & Criteria
ASME	American Society of Mechanical Engineers
cc	cubic centimeter
CFR	Code of Federal Regulations
CGD	Commercial Grade Dedication
Ci	Curie
CM	Corrective Maintenance
CMGT	Configuration Management
CRD	Contractor Requirements Document
CSE	Cognizant System Engineer
CY	Calendar Year
DA	Design Authority
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
$ECEO_2M$	Environmental Conditioning Enclosure Oxygen Monitor
EDWS	Electronic Document Workflow System
EPFM	Engineering Plant and Facilities Management
FR	Facility Representative
FY	Fiscal Year
GBO_2M	Glovebox Oxygen Monitor
HANM	H-Area New Manufacturing
ISA	International Society of Automation
LCO	Limiting Condition for Operation
LOC	Limiting Oxidant Concentration
MAC	Materials Acquisition Center
MAS	Management Assurance System
M&O	Management and Operations
MOU	Memorandum of Understanding
M&TE	Measuring and Test Equipment
NCR	Non-Conformance Report
NFPA	National Fire Protection Association
NMMP	Nuclear Maintenance Management Program
NNSA	National Nuclear Security Administration
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
P&ID	Piping and Instrumentation Diagram
PLC	Programmable Logic Controller
PM	Preventive Maintenance
PPA	Procedure Professionals Association
QA	Quality Assurance
QAMP	Quality Assurance Management Plan
SAC	Specific Administrative Control
S/CI	Suspect/Counterfeit Items
SDD	System Design Description
SHP	System Health Presentation

SIL	Safety Integrity Level
SPF	SmartPlant Foundation
SR	Surveillance Requirement
S/RID	Standards/Requirements Identification Document
SRFO	Savannah River Field Office
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
SRTE	Savannah River Tritium Enterprise
SS	Safety Significant
SSCs	Structures, Systems, and Components
SSO	Safety System Oversight
STAR	Site Tracking, Analysis, and Reporting
TAM	Tritium Air Monitor
TEF	Tritium Extraction Facility
TF	Tritium Facility
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question
WO	Work Order

Office of Enterprise Assessments
Assessment of Savannah River Site Tritium Facility
Safety System Management

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted a safety system management assessment of the tritium air monitoring systems and glovebox oxygen monitoring systems in the H-Area New Manufacturing Facility and the Tritium Extraction Facility within the Savannah River Site Tritium Facility. An essential element of the National Nuclear Security Administration weapons program, the Tritium Facility is overseen by the National Nuclear Security Administration Savannah River Field Office and operated by sitewide contractor Savannah River Nuclear Solutions, LLC (SRNS).

EA conducts safety system management assessments to evaluate site processes for monitoring, maintaining, and operating safety related systems to ensure their continued reliable capability to perform their intended safety functions. EA selected specific systems for this assessment, with input from the Field Office, based on their importance to personnel safety in the Tritium Facility. The assessment scope included safety basis implementation in the design, configuration management, operations, maintenance, quality assurance, technical support, and feedback and improvement processes.

EA found two areas where the contractor's activities and processes constitute best practices worthy of emulation on other DOE projects:

- Human performance error reduction tools are highly integrated into the maintenance work process.
- Operations uses an automated tool linked to the watchbill for control room staffing to track proficiency hours for individual operators and ensure their continued qualification.

EA also noted positive attributes in several other areas:

- SRNS has implemented a robust process for developing, testing, revising, and maintaining software configuration security for programmable logic controller software.
- Engineering procedures are generally straightforward and detailed, supporting the development of quality products and the overall configuration management program.
- Effective implementation of quality assurance measures was evident in many of the processes reviewed and most personnel activities observed.
- System notebooks compiled by the cognizant system engineers serve as effective repositories of information on system design, function, and individual components.
- Field Office technical representatives are highly knowledgeable of the facility and safety-related systems.
- Field Office oversight efforts are comprehensive, exhibiting active involvement in tracking and evaluating contractor performance

The reviewed safety systems were, in general, managed by SRNS in a manner that adequately ensures their continued reliable functionality. However some weaknesses were identified. Most notably, EA found that the SRNS site wide technical training program does not meet the requirements of DOE Order 426.2, as required by contractual commitments. EA also noted problems in the maintenance program, including a significant preventive maintenance backlog, routine deferrals of planned work, mis-categorization of problems into a low significance category, and rising failure rates in some safety

significant system components. The configuration management program is poorly documented, with an implementation plan that does not address program specifics in any area except the technical baseline. System health presentations for the reviewed systems were ineffective in reporting system status and lacked trending and performance analysis. Finally, EA found that the self-assessment program was not fully effective, with assessments that lacked depth and rigor, and key areas going unevaluated for periods of several years.

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Safety System Management

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), conducted an assessment of safety system management at the Savannah River Site (SRS) Tritium Facility (TF). This assessment was conducted within the broader context of an ongoing program of assessments of the management of safety systems across the DOE complex at hazard category 1, 2, and 3 facilities. The purpose of this EA effort is to evaluate processes for monitoring, maintaining, and operating safety systems to ensure their continued reliable capability to perform their intended safety functions.

EA performed this assessment at the SRS TF from August 22 through September 29, 2016.

2.0 SCOPE

EA evaluated management of the safety significant (SS) tritium air monitor (TAM) systems and glovebox oxygen monitor (GBO_2M) systems in the H-Area New Manufacturing Building (HANM) (233-H) and the Tritium Extraction Facility Building (TEF) (264-H) within the TF. Although the TAMs in these two buildings use different detectors, the TAM designation was used collectively in this report to refer to the systems in both buildings unless noted otherwise.

EA examined the design, operation, maintenance, testing, technical baseline, configuration management, system engineering, and issues management processes as applied to the selected systems. The assessment included a review of the Federal oversight process implemented by National Nuclear Security Administration (NNSA) Savannah River Field Office (SRFO) personnel.

3.0 BACKGROUND

SRS is a 310 square mile site, located south of Aiken, South Carolina. SRS encompasses parts of Aiken, Barnwell, and Allendale counties and is bordered on the west by the Savannah River and the state of Georgia. SRFO tritium program operations are conducted in several buildings that collectively form the TF. The primary missions performed at the TF are the receipt, packaging, and shipping of reservoirs; recycling, extraction, and enrichment of tritium gas to support maintenance of the nuclear weapons stockpile; and limited-life component exchange reservoir surveillance.

Although most of SRS is the responsibility of the DOE Office of Environmental Management, the TF is the responsibility of the NNSA SRFO. Both Environmental Management and NNSA facilities share a single management and operations (M&O) contractor, Savannah River Nuclear Solutions, LLC (SRNS). Within the SRNS organization, the resources dedicated to operation of the tritium facilities are designated as the Savannah River Tritium Enterprise (SRTE).

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 opportunities for improvement (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. These deficiencies should be addressed consistent with site-specific issues management procedures.

As identified in the assessment plan, this assessment considered requirements related to all aspects of safety related system management. EA used Criteria Review and Approach Document 31-15, *Safety Systems Management Review*, in its entirety to examine contractor and field office performance relative to the criteria and lines of inquiry for successful safety system management identified therein.

EA examined key documents, such as system descriptions, work packages, procedures, manuals, analyses, policies, and training and qualification records. EA also interviewed key personnel responsible for developing and executing the associated programs; observed maintenance and operations activities; and walked down portions of the selected buildings, focusing on physical attributes of the system installation. 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 findings and conclusions of this report, is provided in Appendix B.

5.0 RESULTS

5.1 Engineering Design

This section discusses EA's assessment of the technical baseline established for the targeted systems. EA reviewed technical documents relating to the design and surveillance testing of the systems and also examined the implementing procedures to assess the processes used to develop those documents.

Objective: Engineering design documents and analyses are technically adequate and implement the requirements of the documented safety analysis such that adequate protection of the public, the workers, and the environment from facility hazards is demonstrated. (DOE-STD-3009-2014, Preparation of Nonreactor Nuclear Facility Documented Safety Analyses; 10 CFR 830, Nuclear Safety Management, Part 122)

Criteria:

1. *The approved safety analysis provides descriptions of attributes (i.e., functional requirements and performance criteria) required to support the safety functions identified in the hazard and accident analyses and to support subsequent derivation of technical safety requirements (TSRs). (DOE-STD-3009-2014)*
2. *Engineered systems, structures, and components and processes are designed using sound engineering/ scientific principles and appropriate standards. (10 CFR 830.122 Criterion 6)*
3. *Engineering design incorporates applicable requirements and design bases in design work and design changes (e.g., design calculations). (10 CFR 830.122 Criterion 6)*

4. *The adequacy of design products is verified or validated by individuals or groups other than those who performed the work. (10 CFR 830.122 Criterion 6)*
5. *Verification and validation work is completed before approval and implementation of the design. (10 CFR 830.122 Criterion 6)*
6. *Key design documents, including design basis and supporting documents, are identified and consolidated to support facility safety basis development and implementation. (DOE Order 420.1B, Facility Safety, Chapter 5 (or DOE Order 420.1C as applicable to the facility))*

EA determined that the design and surveillance test requirements for the HANM and TEF SS TAM and GBO_2M systems, and the HANM environmental conditioning enclosure oxygen monitor ($ECEO_2M$) systems ensure their capability to effectively meet specified documented safety analysis (DSA) safety function requirements.

Tritium Air Monitors

The DSA-required safety functions of the HANM and TEF SS tritium process room TAMs are to reliably detect and notify personnel with local and remote audible and visual alarms of the release of tritium into a process room. These systems, in combination with worker training, mitigate exposure to tritium through prompt evacuation of personnel from the affected space(s). The hazard and accident analyses do not require the TAMs to function during or after a natural phenomena hazard event.

EA reviewed the details of system designs, design calculations, conversion factor calculations, selected procurement records, physical installations and configurations, calibration records, surveillance testing requirements, and operating procedures for each of these systems and their components. EA confirmed that the systems provide overlapping monitoring points for monitoring redundancy and are fail safe; i.e., required SS alarms are triggered by loss of power, loss of flow, equipment malfunctions, and high tritium activity. EA also verified that the High alarm setpoints were conservatively established decades below concentrations required for SS functions and support compliance with 10 CFR 835 exposure control requirements for normal employment in nuclear facilities. Further, periodic surveillance testing procedures appropriately demonstrate the continued operability of ion chambers, picoammeters, rotameters, low flow switches, air sample valves, programmable logic controllers (PLCs), alarm relays, and audible and visual alarms necessary to support their specified safety functions. However, EA identified an anomaly with the instruments alarm set point configuration control.

- Although HANM SS TAM alarm setpoints are appropriately calibrated with correct setpoints, configuration control of setpoint value documentation has not been maintained in that the currently used documents show at least two different values. For example, WSRC-TR-2006-00460 and several other documents correctly show the TAM High Alarm setpoint is 4E-5 µCi/cc; however, although the annual Loop Check/Calibration procedure for Picoammeter K-1 also lists the correct setpoint, the associated Loop Information Sheet setpoint justification states that the basis for the setpoint "shall not exceed 2E-06 µCi/cc." SRTE acknowledged that the legacy justification statement is no longer accurate, noted that the correct setpoint requirements appeared elsewhere on the documents, and indicated their intent to remove the legacy information from the engineering databases (see **OFI-SRTE-1**).

EA noted that the TAM functional test procedure allows two legitimate attempts to meet acceptance criteria before declaring a surveillance failure requiring entry into the limiting condition for operation (LCO) action statements. After observing the surveillance at HANM and TEF and noting the TAM picoammeter's extreme sensitivity to the test signal at the very low signal levels required, the EA team concluded that repeating the test once before invoking the LCO was appropriate.

EA's interviews with the responsible engineers, document reviews, and observation of equipment and access controls indicated that HANM and TEF have established and are implementing robust processes involving procedures, training, and secure hardware for developing, testing, revising, and maintaining the configuration of the control software used by their respective PLCs, as required by SRNS-RP-00020, *Management and Operations Quality Assurance Management Plan*.

Although the HANM and TEF TAMs are SS and use a combination of hardware and software controlled digital logic solvers (in accordance with SRS Engineering Guide 01703-G and DOE-STD-1195-2011, *Design of Safety Significant Safety Instrumented Systems Used at DOE Non-Reactor Nuclear Facilities*, Section 2.9), they are appropriately not treated as SS instrumented systems. This is because these instruments only cause alarms that prompt personnel evacuation, well before approaching hazardous dose rates. As a result, these systems appropriately do not require calculations of probability of failure on demand and hardware fault tolerance as inputs to the design function.

Oxygen Monitors

This portion of the design engineering assessment evaluated aspects of both the GBO_2Ms and the HANM $ECEO_2Ms$. The $ECEO_2Ms$ perform a similar function to the GBO_2Ms for several small rooms in the HANM used for environmental conditioning.

The DSA-required safety functions of the HANM and TEF SS GBO_2Ms and the HANM $ECEO_2Ms$ are to reliably monitor and provide local and remote indication and audible and visual alarms of high oxygen concentrations. These functions are needed to initiate required actions, such as suspending tritium operations and performing prompt evaluation and corrective action to limit oxygen buildup and prevent a fire or deflagration. The GBO_2Ms and $ECEO_2Ms$ are required to function during normal operations, but not during or after a natural phenomena hazard event.

EA reviewed the details of system designs, design calculations, instrument uncertainty calculations, selected procurement records, physical installations and configurations, calibration records, surveillance testing requirements and operating procedures for each of these systems and their components. EA confirmed that the GBO_2Ms and $ECEO_2Ms$ are appropriately designed and are also fail safe; i.e., the required SS alarms are triggered by loss of power, equipment malfunction, and high oxygen concentration.

EA also reviewed the SRTE bases for establishing the High oxygen alarm setpoints. The existing setpoints were conservatively established as discussed below to meet the NFPA-69, section 7.7.2.5.(2) requirement that "the equipment shall be operated at no more than 60 percent of the LOC [limiting oxidant concentrations]." However, as discussed in the next paragraph, it is not clear that the setpoints also meet the safety margin requirements of NFPA-69, section 7.7.2.4. Testing done by a vendor for SRS in 2006 and 2007 determined that the LOCs of hydrogen-air mixtures inerted with nitrogen and with argon were 4.87 volume % and 3.33 volume %, respectively. In accordance with NFPA-69, the upper limit of the alarm setpoint is required to be less than or equal to 60% of the LOC, or 2.92 volume % (nitrogen) and 2.0 volume % (argon). Because argon may be able to leak into the nitrogen-inerted gloveboxes, the lower LOC of the argon diluent was used in establishing the GBO_2M concentration High-High alarm setpoint at 1.8 volume %. Because the $ECEO_2Ms$ are used on enclosures normally filled with room air before inerting with nitrogen, the nitrogen diluent LOC was used in establishing the $ECEO_2M$ concentration High-High alarm and conditioning operation shutdown interlock setpoint of 2.5 volume %.

EA also reviewed the HANM and TEF GBO_2M and HANM $ECEO_2M$ instrument loop uncertainty evaluations. The evaluations were appropriately calculated using conservative estimates of calibration test intervals, environmental condition ranges, component accuracy specifications, calibration gas specifications, and component operating ranges. The calculated uncertainties for the GBO_2M and $ECEO_2M$ indications and alarms, while operating in the usual range of those instruments, ranged from 0.43 to 1.04 volume %. These uncertainties are within the NFPA-69 calculated argon and nitrogen diluent LOC safety margins of 1.33 volume % and 1.95 volume %, respectively. However:

- There was no documentation demonstrating that the current SS GBO_2M and $ECEO_2M$ High-High alarm setpoints also include sufficient safety margin as required by NFPA-69, Section 7.7.2.4. Specifically, NFPA-69, Section 7.7.2.4 requires that the safety margin between the LOC and normal operating conditions take into account: (1) fluctuations occurring in the system, (2) the sensitivity and reliability of monitoring and control equipment, and (3) the probability and consequences of an explosion. Although the current safety margin to the LOC is greater than 40% as required by NFPA-69, Section 7.7.2.5 (operation limited to <=60% LOC), and includes a number of conservatisms, SRTE has not demonstrated or documented that the safety margin also takes into account all three criteria listed in NFPA-69, Section 7.7.2.4 (**Deficiency**).

EA found that the GBO_2M and $ECEO_2M$ periodic surveillance testing procedures appropriately demonstrate continued operability of oxygen sensors, analyzers, rotameters, low flow switches, PLCs, alarm relays, and audible and visual alarms necessary to support their specified safety function.

The GBO_2Ms and $ECEO_2Ms$ qualify as SS instrumented systems (defined as Safety Instrumented Systems by DOE-STD-1195-2011), subject to the provisions of American National Standards Institute (ANSI)/International Society of Automation (ISA)-84.00.01-2004, *Functional Safety: Safety Instrumented Systems for the Process Industry Sector*. Both systems are required to qualify for a Safety Integrity Level (SIL)-1 rating with a probability of failure on demand between 10^{-1} and 10^{-2}, and a specified hardware fault tolerance of zero. The EA-reviewed original design GBO_2M and $ECEO_2M$ SIL and hardware fault tolerance calculations included multiple conservative assumptions and met the acceptance criteria. However, in light of the recent increase in component failure rates (as discussed in greater detail in the maintenance section of this report), SRTE has not verified the safety reliability of these systems continue to meet original performance criteria. DOE Order 420.1c, Attachment 2, Chapter V, Section 3.c.(3) requires periodic reviews of system operability, reliability, and material condition, including assessing system and component performance in comparison to established performance criteria. Compliance with DOE-STD-1195-2011 and ANSI/ISA-84.00.01-2004 Part 1, which are part of the facilities' Code of Record, require the GBO_2M and $ECEO_2M$ systems to continue to meet (while operating) the reliability performance criteria of a SIL-1 system. As stated in ANSI/ISA-84.00.01-2004, Part 1, Section 5.2.5.3, "procedures shall be implemented to evaluate the performance of the safety instrumented system against its safety requirements including … assessing whether dangerous failure rates of the safety instrumented system are in accordance with those assumed during the design."

- SRTE has not demonstrated the continued validity of the required SIL-1 qualifications of the SS GBO_2M and $ECEO_2M$ systems as required by DOE Order 420.1c, DOE-STD-1195-2011 and ANSI/ISA-84.00.01-2004 Part 1, in light of recent increases in component failure rates and the use of outdated 1998 SRS sitewide failure rate data. Although SRTE indicates that trending attributes, such as time spent in LCOs, corrective maintenance, and system health reporting, should validate failure rate data and/or guide changes as necessary, a documented analysis of the continued validity of the SIL-1 rating has not been developed (**Deficiency**).

In response to increasing failure rates of oxygen monitor system components and the difficulty in getting some needed replacements of obsolete components, HANM appropriately researched commercially available systems and selected a replacement oxygen concentration monitor system meeting its specifications. The design change package for installation of a prototype of the replacement oxygen monitor system is adequate. The prototype was successfully operated in parallel with an existing older design system. In addition to providing all the SS and production support functions of the older oxygen monitor system design, the replacement system provides a desired SS alarm function in the main control room. To date, 3 of 35 oxygen monitor systems in the HANM building have been replaced, and 3 more are planned for replacement before the end of fiscal year (FY) 2017.

Engineering Process Review

SRNS engineering procedures E7 2.30, *Drawings*; E7 1.05, *Technical Baseline Identification*; and E7 2.60, *Technical Reviews*, were adequate, straightforward, and detailed. EA also found procedure E7 2.31, *Engineering Calculations*, to have well defined requirements for calculation origination, review/checking, and approval. It requires that calculations supporting a design change must be in "committed" status with no open items before the implemented change is placed into service. Inputs must have a verified source reference. If an assumption is not technically justified, an open item is created to document the assumption. This sitewide procedure requires tracking of open items but does not specify the tool to be used for that tracking. The TF has no facility-specific guidance in this area. EA raised this issue with the manager of the supporting design engineering group and verified that there is no defined method for tracking unverified assumptions or open items to ensure closure. Various means may be used to accomplish this tracking, such as placing a HOLD on the affected design change package or creating a schedule activity tied to the open item; the means would be selected based on individual preference. The lack of specific requirements or a well defined method for tracking calculation open items creates an error-likely condition and represents a deficiency in the calculation process (**Deficiency**).

Engineering Design Conclusions

The design and surveillance test requirements for the HANM and TEF SS TAM and GBO_2M systems and the HANM $ECEO_2M$ systems ensure their capability to effectively meet specified DSA safety function requirements. However, the current analysis is not adequate to verify that the GBO_2Ms and $ECEO_2Ms$ continue to meet the requirements of NFPA-69 and DOE Order 420.1C for alarm setpoint calculations and component failure rates for these instruments.

The engineering processes that EA reviewed were generally rigorous, although the approach for tracking and closure of unverified assumptions and open items in issued calculations is not fully effective.

5.2 Quality Assurance

This section discusses EA's assessment of quality assurance (QA) practices, processes, and implementation to ensure that safety systems conform to required standards and perform as designed. EA evaluated key aspects of SRNS-RP-2008-00020, *Management and Operations (M&O) Quality Assurance Management Plan (QAMP)*, and QAMP implementation as they relate to design, procurement, operability, and maintenance quality verification.

Objective: Quality assurance practices and processes are implemented in a manner that ensures safety systems will conform to required standards and perform as designed. (10 CFR 830 Subpart A)

Criteria:

1. *Activities that may affect the safety of DOE nuclear facilities are conducted in accordance with a DOE-approved quality assurance program meeting the quality assurance criteria specified in 10 CFR 830.122. (10 CFR 830.121)*
2. *Appropriate consensus standards, such as American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1, Quality Assurance Requirements for Nuclear Facility Applications, and other applicable quality or management system requirements are clearly identified,*

integrated, and implemented for nuclear-related work activities. (10 CFR 830.121 and DOE Order 414.1D, Quality Assurance).

3. *Requirements are established for procurement and verification of items and services. (10 CFR 830.122 Criterion 7)*
4. *Processes are established and implemented that ensure that approved suppliers continue to provide acceptable items and services. (10 CFR 830.122 Criterion 7)*
5. *Design interfaces are identified and controlled. (10 CFR 830.122 Criterion 6)*

Quality Assurance Program Verification

SRFO last approved the QAMP on April 22, 2015. The QAMP effectively communicates the flowdown of 10 CFR 830.122, DOE Order 414.1D, and ASME NQA-1-2008/ NQA-1a-2009 Addenda requirements. The QAMP specifies key implementing directives for all QA requirements and provides an effective roadmap for implementing processes. The QAMP establishes the planned and systemic processes necessary to provide adequate confidence that structures, systems, and components (SSCs) will perform the safety functions defined in the DSA and TSRs.

Design Quality Verification

EA's review of a sample of documents indicates that the SRNS design process effectively yields a comprehensive technical baseline for the TAMs and GBO_2Ms. The technical baselines are maintained in several databases, including SRNS's SmartPlant Foundation (SPF) database, AssetSuite (work package database), Engineering Plant and Facility Management Application (documents database of procedures, drawings, forms, etc.), and PeopleSoft (supply chain database). Cognizant system engineer (CSE) system notebooks provide an efficient roadmap for navigating the extensive technical baselines for the TAMs and GBO_2Ms. This approach efficiently defines the technical baseline and other important performance information without duplicating documents. This saves CSE time and effort and avoids inconsistencies between information resources. The notebooks also provide an efficient method for CSEs in training, assessors, or investigators to navigate to documents of interest.

EA reviewed the TAM and GBO_2M technical baseline content from a procedural compliance perspective and found the requisite information meets Manual E7, Procedure 1.05, *Technical Baseline Identification*. All sampled design analyses and calculations show evidence of independent verification and approval. Sample software/firmware QA documentation appropriately included verification testing.

Technical Baseline Consistency

EA sampled the consistency of quality acceptance parameters for TAMs and GBO_2M components across technical baseline documents. EA examined sample calculations/analyses, system design descriptions (SDDs), procedures, procurement documents, the SPF database, and vendor manuals. The acceptance parameters are generally consistent among most technical baseline documents, with a few discrepancies that do not affect the systems' ability to perform their safety functions.

- The TEF TAMs SDD, Q-SYD-H-00002, *System Design Description for Radiation and Contamination Sampling/Monitoring Systems- TEF*, Section 2.4.1 declares that "the detectors [TAMs] have the capability to detect beta and gamma radiation from 0.5 to 1E8 $\mu Ci/m^3$," but the manufacturer's specification states: "TRITIUM RANGE – 0.5 to 1E6 $\mu Ci/m^3$." EA confirmed that the SPF TAM detection capability specification for procurement is consistent with the manufacturer's specifications, indicating that the SDD inconsistency is a simple typographical error, which the CSE immediately addressed.

- The flow rates specified for TEF TAMs are inconsistent among the analysis, SDD, procedures, procurement documents, SPF, and vendor manual.

TEF TAM Internal Flow Specification Inconsistencies		
Analysis	6 liters/min	WSRC-TR-2006-00460, An Analysis of the Safety Function of the TEF Tritium Air Monitoring System, February, 21, 2007
SDD	0-10 liters/min	Q-SYD-H-00002 Rev13, *System Design Description for Radiation and Contamination Sampling/ Monitoring Systems- TEF*, March 4, 2016
Procedures	>/= 7 liters/min	SURV 264-H-5908 Rev17, *TEF Tritium Air Monitoring Systems Monthly Functional Surveillance* June 23, 2015
Procurement Document	>7 liters/min	J-SPP-H-00229, Procurement Specification Tritium Room Monitors, June 6, 2002
SPF	2-10 liters/ min	SPF data entry
Vendor Manual	7 liters/ min	Canberra Tritium Monitor TAM-100D, Manual Number MO866, May 5, 2003

- TEF GBO_2M alarm setpoints are inconsistent among technical baseline documents.

During walkdowns, EA observed several TAM and GBO_2M stations. SRTE consistently and effectively labeled each system's components with unique identifiers. These labels include purchase order numbers that improve the accuracy and efficiency of component purchase verifications.

Operability Quality Verification

Implementation of TSR surveillance requirement (SR) daily operability checks confirms operability of TAMs and GBO_2Ms. EA examined each TSR SR implementing mechanism for each system in each facility. The SRTE operators perform all system daily operability checks more frequently than specified in the corresponding TSR SRs. EA also found conservatism built into the system operability checks. For example, TEF TSR SR 4.4.6.1 requires daily verification that the glovebox oxygen concentration is less than 2.0 volume %. However, DS-6-OS-001, *Glovebox Oxygen and Hydrogen Monitor Rounds*, specifies less than 1.8 volume %. EA observed a TEF GBO_2M daily check per DS-6-OS-001 in which the technician used an electronic tablet to verify the proper data sheet revision prior to the walkdown, confirmed previous training and understanding of suspect/counterfeit items (S/CI), and indicated management's support for issue identification.

Maintenance Quality Verification

EA identified some positive QA themes in the sample of maintenance procedures and completed work packages that EA reviewed. The assigned CSE or engineering manager appropriately reviewed the procedures, which appropriately involve QA inspectors as needed. Record blocks for the shift operator and the second person verifier initials appropriately accompany procedural HOLD/Witness Points. Procedures identify measurement and test equipment, and the calibration status is verified and recorded. All reviewed component installation work packages adequately specify installation instructions and post-modification testing instructions/acceptance criteria, which flow down from design documentation and appropriately verify the physical and functional requirements. Sufficiently detailed post-maintenance inspection/testing instructions identify emergent conditions requiring corrective maintenance and expected conditions to ensure that the system is capable of performing its safety function.

The SRTE Maintenance Manager explained that all maintenance personnel performing these procedures are qualified through an on-the-job training approach that includes S/CI inspection training. EA confirmed this training though review of worker training records, interviews with maintenance workers, and an observed maintenance evolution. Procedures do not specifically identify S/CI monitoring as a procedural step, but worker interviews confirmed that this aspect is inherent in their work.

EA observed a monthly functional test of the TF HANM KANNE #K6 per TSR/SR 4.3.2.2 using procedure SURV-233-59116, *Functional Surveillance of 233-H Non-Effluent Kannes*. Interviewed workers clearly understood the operational features of the system, the safety requirements, and performance criteria. The pre-job brief addressed the identified hazards and controls addressed in the procedure. System labels conformed to procedural references. The workers confirmed the proper version of the implementing procedure. EA observed proper use of HOLD points, read/repeat performance execution, and record entries as specified in the procedure. When questioned about emergent conditions, each worker was able to address planned response actions, indicating familiarity with the system. The workers indicated their willingness to pause/stop work if any concern was raised. If needed, workers could consult with the CSE. Workers also demonstrated ownership of their work, pride in workmanship, a questioning attitude, and a willingness to raise issues. Completing the work package/procedure returned the system to full service, fit for use. These observations provide confidence that SRTE has cultivated a positive work performance environment among the workforce.

EA confirmed that SRTE appropriately manages maintenance procedural changes. For example, Immediate Procedure Change of PP T-750512, *HANM Kanne Flow Indicating Switch Setting*, received appropriate approvals and an unreviewed safety question (USQ) review. Immediate Procedure Change of T-782521, *233H Room Kanne Pico Loop Check*, was a minor clarification not requiring any CSE involvement or USQ review; this position is reasonable based on the content of the changes. SRTE modified procedure T-706515, *Delta F Corporation Series 100 O2 Analyzer Calibration/Loop Check* to remove a redundant oxygen monitor from a glovebox. This change also received appropriate approvals and a USQ review. In each example, SRTE documented an appropriate justification for the change.

Procurement

Procurement implementing procedures appropriately integrate QAMP quality requirements and provide for independent purchase order review and approval for safety related applications. The QAMP, Section 7.2 addresses the acquisition of products and services from qualified suppliers. The implementing directive, Manual 1Q, Procedure 18-3, *Quality Assurance External Audits*, provides a fully satisfactory process for meeting NQA-1 Requirement 7, Section 200, *Supplier Evaluation and Selection*. However, due to the age of these safety systems, SRTE procures many replacement components as off-the-shelf commercial grade items and evaluates them through a Commercial Grade Dedication (CGD) process to obtain reasonable assurance that each component will perform its safety function. These processes satisfactorily meet the ASME NQA-1-2008 with NQA-1a-2009 Addenda CGD requirements.

EA found the system CSEs very knowledgeable of the SRNS procurement process and observed adept use of the SPF database for obtaining information on procurement of safety system components. EA reviewed each CSE's training record and found evidence of procurement training for all and S/CI training for all but the HANM TAM CSE.

SRTE purchases TEF TAM units and replacement components from the manufacturer, who has been qualified as a NQA-1 supplier. Because the supplier has been on the qualified vendor list for many years, EA examined the supplier's requalification. A four-member SRNS audit team conducted the most recent supplier audit, 2015-VAR-18-0009, *Canberra Industries*, March 9, 2016. The audit package included the audit criteria, results, identified non-conformances, and the supplier's response to the non-conformance reports (NCRs). The audit checklist was extensive with 116 pages of detailed inquiry and documented evidence descriptions. This performance-based audit satisfactorily included documentation reviews, interviews, and performance observations.

EA reviewed selected CGD packages and found all in conformance with procedural requirements. Each CGD package consistently used the SPF tool (a standardized information format) for CGD documentation. Equivalency determinations included adequate technical bases. Critical characteristics and verification methods were consistent with the most important performance characteristics. For example, E-CGD-H- 00805, *Electrical Relay for the Kanne Horn and Flasher Alarm Circuits*, provides a failure modes and effects analysis with specified critical characteristics bench tests, which address each identified failure mechanism.

Receipt Inspection

Initial receipt of items occurs at the SNRS N-Area receiving warehouse, which contains a secure and segregated area for Level 1 (safety class) and Level 2 (SS) items requiring receipt inspection; Level 1 items are separated from Level 2 items. The area is tidy and well maintained. The N-Area receipt inspectors perform a basic receipt inspection, including quantity verification, shipping damage inspections, manufacturer's name confirmation, product identification number confirmation, etc. The receipt inspectors label received items with unique identification numbers. Once the N-Area receipt inspection is complete, the item is either stored at the N-Area warehouse complex until requested by SRTE or shipped to the TF for storage, as specified in the PeopleSoft application. Qualified receipt inspectors perform critical characteristics bench testing, inspection, and/or post-installation testing at the TF.

Manual 1Q, Procedure 7-2, *Control of Purchased Items and Services*, Section 5.11, requires Level 2 (SS) component receipt inspectors to complete training in inspection principles specific to the receipt activity and successfully complete an Area Specific Job Performance Measure. EA examined this training approach and training records. The interviewed receipt inspector described completed training and job performance measures, which EA later confirmed in the official records. This individual also explained continued monitoring of items for S/CI concerns.

Critical Spare Parts in Stores

EA confirmed that each CSE maintains a spare parts list as a part of the system's technical baseline. CSE spare parts lists have procurement minimum/maximum quantities specified for the most frequently replaced parts. EA found that for every sampled critical component, the SPF recorded a minimum/ maximum quantity consistent with the SRNS sitewide procurement database (PeopleSoft) replenishment criteria. This arrangement allows for automated reorders through established vendor relationships and provides assurance that critical components will be available to SRTE as needed.

SRTE maintains spare parts in three facilities: N-Area (main receiving and storage facility – up to Level A), MAC (Material Acquisition Center – a large Level B warehouse on the TF site for larger parts), and mini-MAC (a smaller Level B facility on the TF site for smaller parts). The MAC and mini-MAC's storage capability was intended to ensure that SRTE will have immediate access to critical spare parts when access to the N-Area storage is not available. EA walked down each of these facilities and confirmed that they meet specified designated facility storage levels.

At the time of this EA review, SRTE had moved nearly all spare parts from a previously used SRTE facility, and the SRNS procurement organization was implementing a new inventory control system (a PeopleSoft SRTE module to upgrade the older Field Material Tracking System). SRTE does not have current procedures or desktop instructions to control critical spare parts inventory management and intends to rely on an "expert-based" system until the new systems are in place. This practice is contrary to DOE Order 414.1D, Attachment 2, 5.a, "Perform work consistent with technical standards, administrative controls, and other hazard controls adopted to meet regulatory or contract requirements using approved instructions, procedures, or other appropriate means" (**Deficiency**).

The MAC and mini-MAC rely on the use of manual "reorder cards" placed in the storage bin with each spare part item to alert the inventory specialist when to reorder items. The reorder cards include handwritten "min/max" levels. EA sampled seven critical spare part items specified on the CSEs' spare parts lists. Of those seven, two items at the mini-MAC did not have the associated reorder cards, and two other items were due for reorder but no reorders were in process. Hence, critical spare parts assumed to be stored at the TF may not be readily available as expected. All sampled spare parts were properly labeled to ensure traceability to their QA records. A walkdown of the N-Area stores for the sampled spare part items found the specified number of parts available in proper storage and appropriate purchase orders in process for items that had been "triggered" for reorder based on the minimum value specified in PeopleSoft.

Quality Verification of Item Installations

Maintenance personnel obtain replacement items out of Stores for use in approved work orders (WOs). For example, EA examined the most recently completed work order, WO #01502451-01, *Receipt Inspection for Rosemount per J-CGD-H-00284 PO258232*. The WO provided procedures to accept the new Rosemount replacement oxygen monitors and appropriately included independent QA verification of acceptance parameters. Verification that the analyzer was "within .2% volume of the stated calibration gas concentration" and that the alarm trip indication was "within .2% volume of the stated calibration gas concentration" was appropriately signed and dated on the attached CGD inspection plan (J-CGD-H-00284).

During walkdowns, EA traced back material certification records for two "span" gas cylinders (gases of known concentrations) required to perform monthly functional checks and annual calibrations of GBO_2M sensors. EA confirmed SRNS procurement records appropriately maintain the certification of analysis indicating the proper certified gas concentrations.

Quality Assurance Conclusions

Overall, the TAMs and GBO_2Ms (systems and components) are designed, procured, installed, operated, maintained, modified, and tested in accordance with the DOE-approved SRNS QAMP. Daily operability checks and maintenance quality verification steps ensure that these safety systems are fit for use and capable of performing their intended safety functions. Quality procurement acceptance parameters are consistent among most technical baseline documents, despite some discrepancies that do not impact the systems' ability to perform their safety functions. Sampled CGD packages conformed to procedural requirements, include appropriate technically based equivalency determinations where required, and addressed critical characteristics and verification methods consistent with the most important performance characteristics. Receipt inspection is fully compliant with contract requirements and uses qualified inspectors.

The CSEs specify critical spare part requirements for maintenance through the procurement automated ordering system. Storage facilities meet specified designated facility storage levels. However, critical spare parts stores are in the midst of location changes and improvements in the inventory control system that have resulted in an expert-based system without procedural instructions, contrary to DOE requirements.

5.3 Configuration Management

This section discusses EA's assessment of the SRTE configuration management (CMGT) program based on the requirements of DOE-STD-1073-2003, *Configuration Management Program*. TF is committed to meeting the requirements of that standard through contractual commitment to DOE Order 413.3B.

Objective: Configuration management programs and processes are adequate to ensure safety systems continue to meet safety basis requirements and changes are properly controlled. (DOE Order 413.3B Attachment 2, DOE Order 420.1B Chapter V (or DOE Order 420.1C as applicable to the facility), and DOE-STD-1073-2003 if applicable).

Criteria:

1. *The configuration management process adequately integrates the elements of system requirements and performance criteria, system assessments, change control, work control, and documentation control. (DOE Order 413.3B Attachment 2, DOE Order 420.1B Chapter V (or DOE Order 420.1C as applicable to the facility), and DOE-STD-1073-2003 if applicable)*
2. *Configuration management is used to develop and maintain consistency among system requirements and performance criteria, documentation, and physical configuration for the SSCs within the scope of the program. (DOE Order 420.1B Chapter V)*
3. *System design basis documentation and supporting documents are kept current using formal change control and work control processes. (DOE Order 420.1B Chapter V)*
4. *Applicable requirements and design bases are incorporated in design work and design changes. (10 CFR 830.122 Criterion 6)*
5. *Changes to system requirements, documents, and installed components are formally designed, reviewed, approved, implemented, tested, and documented.*
6. *System piping and instrumentation diagrams (P&IDs) have been prepared, are maintained, and reflect the installed configuration of the associated safety system. (DOE-STD-1073-2003 Section 6.4)*

DOE-STD-1073-2003 establishes five essential elements of a successful CMGT program. Those elements, addressed individually below, are implemented at TF through a combination of SRS sitewide processes and facility-specific processes. This approach enhances flexibility in personnel assignments across the many facilities at SRS but, at the same time, results in a more loosely defined program, lacking specifics and permitting multiple methodologies to accomplish required functions.

SRS has no overall CMGT program description. Manual 1-01, Management Policy 5.39, *Configuration Management*, defines very high-level expectations and broad responsibilities but is not specific to the TF. The SRNS standards/requirements identification document (S/RID), SRNS-RP-2008-00086-003-M&O, lists 20 sitewide procedures that implement portions of the overall CMGT program. It asserts that the program is in compliance with the requirements of DOE Order 420.1C, but does not mention DOE-STD-1073-2003. EA found that most aspects of a CMGT program as defined in both the Order and the standard were adequately implemented at TF as described in more detail below. WSRC-RP-H-00005, *Tritium Facilities Configuration Management Implementation Plan*, states that it defines the current SRTE CMGT program, but does not define a program that complies with DOE-STD-1073-2003. Only one of the five essential areas defined in the standard (Technical Baseline) is addressed. It states that SDDs will be maintained for SS systems but does not define whether the SDDs are technical baseline documents or design output documents (**Deficiency**).

Technical Baseline

The design and QA reviews discussed in Sections 5.1 and 5.2 of this report confirmed that the technical baseline is well-established in issued design output documents and supporting analyses and calculations. TAM and GBO_2M system functions and attributes are consistent with DSA and TSR requirements.

Design Change Control

The processes for design change control defined in procedures (E7 2.05, *Modification Traveler*; E7 2.37, *Design Change Form*; and E7 2.38, *Design Change Package*) are well-constructed and in compliance with DOE requirements. Preparers (normally the CSEs) are required to identify both design input documents and other related documents that might be impacted by the planned change. Implementation processes are structured to establish and maintain configuration control through package closure. Requirements documents may also be prepared for large modifications. The CSEs are involved in every stage of the preparation process and again at closure.

EA reviewed design change packages for three GBO_2M replacements and found them to be of good quality and compliant with DOE requirements related to design change control. The package for replacement of the HANM Secondary Stripper GBO_2M (MT-TRI-2012-00001) included design change form E-DCF-H-08492, which included calculation SRNS-H8352-2014-00015-SM, *Evaluation of Alarm Annunciator Support As Part Of E-DCF-H-08492.* This calculation contains design input data for concrete wall strength that had no confirmed basis. (The basis was provided informally when this issue was presented to SRTE engineering personnel.)

Work Control

Work control aspects of CMGT are addressed in Section 5.4, below. Implementation of changes to the facility configuration is controlled by maintenance processes and procedures.

Document Control

A single document control process is in use throughout SRNS. SRTE uses SPF to process revisions to engineering documents and site-specific procedures. SPF has fields where the preparer can enter metadata on design input documents as well as references, although such entries are voluntary. Once approved, document revisions go to central document control and are entered into the Document Control Registry, which is being replaced by the Engineering Plant & Facilities Management database (EPFM), a sitewide records management repository for record copies of engineering documents and procedures. Maintenance information is kept on a third system, Asset Suite. Correspondence, USQs, reports, and other non-engineering documents go to yet another system, the Electronic Document Workflow System (EDWS), which receives daily updates from EPFM. This configuration represents a possible error-likely situation in that, in effect, the record copy of a drawing, calculation, procedure, etc., is available from both EPFM and EDWS and a non-record copy is available from SPF. EPFM and EDWS are based on a Documentum platform and conform to DOE-STD-1073-2003 minimum requirements for records control. However, use of these sitewide document control processes prevents facility-specific use of Documentum capabilities to track relationships between documents, such as predecessor-successor relationships between upper tier and lower tier records (e.g., P&IDs and calculations). This is a systemic problem that hinders identification of all documents affected by a planned change and can result in situations like that described in Section 5.1 of this report, where differing values of an instrument setpoint were found in separate documents.

Assessments

The assessment process in the area of CMGT is limited, based on the schedule provided by SRTE. The CMGT process is divided into five areas, each of which is assessed on a 48-month re-visit cycle. The entire program has not been comprehensively assessed by SRTE. The two self-assessments that EA reviewed were disparate in depth and effectiveness. One examined change control and included reviews of several issued design change forms. The other was limited to review of the applicable procedure. While the first assessment examined the technical baseline change process effectively, the second had very little discernable value; it concluded that the procedure adequately addressed temporary modification requirements but did not assess implementation. An effective assessment program meeting the requirements of 10 CFR 830 Subpart A is a requirement of DOE-STD-1073-2003 Section 1 (**Deficiency**).

Configuration Management Conclusions

The CMGT process for the TF is functional and adequate to control the physical configuration of the facility, although requirements are dispersed over 20 sitewide procedures, and there is no governing CMGT program document. Modifications are controlled, and documents identified as impacted by a change are updated prior to return to service. Document control measures are sufficient to ensure that affected documents are revised as necessary. However, the CMGT implementation plan does not adequately address CMGT program specifics for the TF in any area except the technical baseline. The assessment program is inadequate to provide assurance that the CMGT program is functioning as intended.

5.4 Maintenance

EA evaluated the SRTE's performance in maintaining safety systems so that the systems can reliably perform when required.

Objective: Maintenance activities are properly planned, scheduled, and performed to ensure that safety systems can reliably perform intended safety functions when required. (DOE Order 433.1B)

Criteria:

1. *The safety system is included in the nuclear facility maintenance management program and the DOE approved Nuclear Maintenance Management Plan required by DOE Order 433.1B.*
2. *Maintenance processes for the system are in place for corrective, preventive, and predictive maintenance and to manage the maintenance backlog; and the processes are consistent with the system's safety classification. (DOE Order 433.1B Attachment 2)*
3. *The system is periodically inspected in accordance with preventive maintenance requirements.*
4. *The reliability of the SSC is maintained through performance of vendor recommended preventive maintenance requirements.*
5. *Maintenance activities associated with the system, including work control, post-maintenance testing, material procurement and handling, and control and calibration of test equipment, are formally controlled to ensure that changes are not inadvertently introduced, that the system fulfills its requirements, and that system performance is not compromised. (DOE Order 420.1B, Chapter V and DOE Order 433.1B Attachment 2)*

EA assessed selected elements of the SRNS maintenance program implemented at the SRTE, including plans and programs; corrective maintenance (CM) and preventive maintenance (PM); periodic inspections; maintenance performance measures and conduct; training; and processes for precluding introduction of S/CI. Assessment activities also included detailed walkthroughs of the TAM and GBO_2M systems; review of a sample of CM and PM records from the previous two years for the selected systems;

interviews with key Maintenance organization management and staff; review of the Occurrence Reporting and Processing System reports from the last three years; observation of maintenance and calibration activities performed during the onsite planning and data collection periods; and attendance at routine daily SRTE Maintenance meetings.

At the beginning of the onsite assessment, the SRTE Maintenance manager stated that the maintenance process at the tritium facilities was working well. The manager further stated that maintenance backlogs were high due in part to loss of funding and personnel for maintenance. Although 22 new maintenance craft and planners have been hired during the last year, obtaining security clearances for these new hires has hampered progress.

Nuclear Maintenance Management Plan and Program

Maintenance of safety system SSCs is acceptably addressed in the nuclear maintenance management program (NMMP) for SRTE facilities, as required by DOE Order 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*. The NMMP also complies with DOE Order 430.1B, *Real Property Asset Management*, as it relates to maintenance of those assets. The NMMP is further implemented by a sitewide NMMP Description Document, which includes a matrix of NMMP requirements and corresponding implementing SRNS procedures. The NMMP and NMMP Description Document acceptably meet the order requirements and have been approved by the NNSA SRFO.

The PM program, as described in SRNS Manual 1Y, Procedure 5.02, *Preventive Maintenance Program*, requires PMs to be scheduled and performed prior to the prescribed PM due date. For example, 5.02, Sections 4.9, 4.10, and 4.11, include responsibilities for facility managers and maintenance management personnel to ensure that facility systems and resources are available so that PMs can be performed before the established due date. On the other hand, procedure responsibilities for the SRTE maintenance manager include ensuring that PMs are performed before the end of the grace period that follows the due date. According to the SRTE Maintenance manager, it is routine practice for PMs not to be performed by the established due dates. There are no required management approvals or justifications for PMs to enter the grace period (typically 25 percent of the interval) following the PM due date and many PMs even exceed the grace period. If a PM will exceed the grace period, a deferral form is prepared and approved and a justification for continued use of the SSC is prepared by engineering. There have been more than 850 PM deferrals for SRTE for FY 2016 as of the end of August 2016. Management's practice of allowing PMs to routinely enter the PM grace period contributes to the large PM backlog and limits the effectiveness of the site's PM program, discussed later in this section (see **OFI-SRTE-2**).

The TAM and GBO_2M system PM activities are limited to TSR surveillance tests (typically monthly functional checks and annual calibrations). Since SRTE has a good performance record of TSR compliance over the last three years, the completion of these TSR-related PM activities for these systems has generally not been an issue during this same timeframe.

Maintenance scheduling personnel stated that when PMs are performed, the maintenance program generally resets the due date to the date of performance. Therefore, over a period of time, required PMs are not performed at the frequency prescribed in the SRTE maintenance program. For example, PMs performed on other systems important to safety, such as the ventilation system, have exceeded the due dates and grace periods. Although this category of PMs includes a scheduling correction factor for exceeding due dates, which is designed to bring PM intervals into alignment, ventilation PMs are not routinely performed on the adjusted schedule due dates. This has resulted in fewer number of PMs performed over time. Since June 2009, 15 six-month PMs have been performed on Fan-10. Of those, 13 were performed after the due date and 2 of the 13 exceeded the grace period. If the PMs had been performed on or before their assigned due dates, 17 PMs would have been performed. Similarly, the six-month PM performed on April 30, 2016, for air handling unit (AHU) 3001, which provides conditioned air to the TEF control room, was last performed approximately eight months earlier (August 20, 2015). These conditions illustrate where the execution of the SRTE PM program does not meet the requirements of DOE Order 433.1B, Section 2.e to ensure that types of maintenance (i.e., PM) provide for safe, efficient and reliable operation of safety basis SSCs (**Deficiency**).

Delaying the performance of scheduled PMs beyond their defined period should require escalating approval. Because SRNS routinely allows use of the grace period, without justification and approval from such organizations as systems engineering, operations, and facility management, the PMs are not being performed as intended (see **OFI SRTE-2**).

The maintenance program is appropriately identified as a safety management program and receives self-assessments on a three-year cycle. Each year the facility maintenance manager performs self-assessments on multiple maintenance topics so that all areas of the maintenance program are assessed every three years. EA reviewed the assessments performed during the last three years, and no issues were identified from these collective assessments.

During onsite assessment activities, the TAM and GBO_2M monitoring systems were observed to be in an acceptable condition, with only a few SSCs out of service or in an alarm condition. However, these systems are experiencing performance functional failures on a regular basis (e.g., TAM and GBO_2M SSC failures for the last three years have been approximately 350 and 60, respectively), including failures of oxygen cells, flow switches and indicating devices, sensors, booster pumps, and system monitors and displays. Given the large number of sensors for TAMs (74) and GBO_2Ms (44) and the availability of replacement parts for most components, the contractor keeps the overall functioning of the system within TSR LCOs. However, most equipment is allowed to run to failure instead of having planned component replacement before failure (based on typical failure rates). This practice contributes to work week schedule impacts, increases in PM backlogs, and adverse impacts on safety system reliability (see **OFI-SRTE-2**).

EA reviewed a sample of approximately 40 completed maintenance work packages (both CM and PM) out of a total of 1714 work packages performed on the TAM and GBO_2M systems during the last three years. Isolated deficiencies were noted, including work scope errors, inconsistent use of placekeeping, and unclear documentation of work completion. However, in general, the work documentation was thorough and in good order.

Three areas of the SRTE maintenance program are contributing to adverse trends in maintenance performance. First, the management process for preparing and implementing the work week schedule allows work activities to be merged into the work week schedule without a requirement to justify the need for impacting the existing schedule. This practice removes other pre-planned activities, such as PMs, from the work week schedule, so they must be rescheduled for another work week. Second, the practice of locking in the work week schedule only one work day before the work week starts also allows the displacement of PMs coming due, because operations requests are placed before other work including PMs. Finally, as previously stated, the practice of allowing most TAM and GBO_2M SSCs to run to failure results in a significant number of performance functional failures of SS components. As these failures occur and LCOs are entered, pre-planned PMs are frequently displaced from the work week schedule (see **OFI-SRTE-2**).

Corrective, Preventive, and Predictive Maintenance

SRNS has implemented acceptable CM and PM processes at the TF for the TAMs and GBO_2Ms, except as noted above. Predictive maintenance is performed on certain SSCs for other facility systems, such as vibration monitoring and bearing temperature trending on ventilation fans. EA reviewed a sample of predictive maintenance work orders performed at the TF and found no issues.

Maintenance processes are consistent with the system SS designations. Maintenance processes, including provisions for CMs and PMs covering TAM and GBO_2M monitoring systems at the SRS TF, are addressed in SRNS sitewide procedures. The work control process acceptably identifies the hazards, associated controls, and work steps for each activity (i.e., CM or PM), and a work package is generated specifically for that scope of work. However, weaknesses exist in the tritium work planning and scheduling process, as previously noted. SRTE management is aware of the problem, but management actions to date have not been effective in improving work week schedule management performance, as evidenced by adverse trends reflected in maintenance performance measures (discussed below).

PM activities for TF safety systems are performed by maintenance mechanics dedicated to the SRTE facilities and are developed for certain types of facility equipment. The maintenance activities associated with the TAMs and GBO_2Ms are discussed in associated SDDs and are generally consistent with industry practice for these systems.

Periodic Inspections

In addition to PM activities on the TAM and GBO_2M systems, CSEs perform annual evaluations of the system through a system health report. These evaluations are supported by detailed system walkdowns. System availability, maintenance, and configuration attributes are analyzed for each safety system. The reports evaluate data relating to the system, such as the number of hours of availability during the period, the maintenance backlog for the system, and any system concerns. The evaluations are an acceptable means of periodic evaluations. (See Section 5.6.)

Performance Measures

The SRTE maintenance program uses a number of metrics to track maintenance performance, including CM backlog, deferred PM items, PM total hours worked, locked-in schedule completion, and actual versus estimated maintenance work hours. While the performance measures represent an acceptable set of metrics that are designed to identify maintenance issues needing corrective action, management actions identified in the individual measures have not been effective in sustaining maintenance improvements. For example, since October 2012, the *CM Backlog* has steadily increased, averaging 16 man-weeks of backlog as of July 2016. The action for this metric refers to 11 recent maintenance hires but does not include additional specific actions to improve the performance of the PM program at SRTE. Similarly, *Deferred PM Maintenance Items* indicates an adverse trend over the last three years, and for July 2016, 75 PMs exceeded their due dates and associated grace periods and therefore received deferrals. The stated action for the metric to correct the adverse trend is "The facility is working to schedule outage windows and to realign PMs into these windows." However, most of the backlog and deferred items do not need a system outage to perform the PM.

The goal for *PM vs Total Hours Worked* is 75% PMs over other maintenance activities, but SRTE has not met this goal in the last three years, standing at 59.4% for July 2016. *Locked-in Schedule Completion* evaluates work week schedule performance against the locked-in schedule. The goal for this metric is an average of 94% or greater. As discussed earlier in this section, the work week schedule is locked in only one work day before the start of the next work week, so TF maintenance performance against the schedule should be very high. Nevertheless, the 94% goal has not been met during the last three years and was 72.9% for July 2016. Actions listed on the performance measure charts against these adverse performance trends have not effectively reversed these trends.

On a more positive note, maintenance planning is adequate in estimating man-hours needed to perform a particular maintenance activity, as evidenced by the *Actual vs Estimated Maintenance Work Hours*. In July 2016, the number of actual man-hours performed versus the estimated man-hours was a healthy ratio of only 1.16 to 1.

Conduct of Maintenance

EA observed pre-job maintenance walkdowns of the job sites, pre-job briefings, and performance of numerous work activities. Workers effectively integrated human performance error reduction tools into the performance of the work. During pre-job briefings, supervisors and workers discussed specific human performance error reduction tools related to the job activity and subsequently implemented them as work was conducted. These tools included three-way communication, procedure placekeeping, and peer checks. EA considers the integration of human performance error reduction tools into work performance to be a **Best Practice**.

EA also observed five CMs and seven PMs during this assessment. Maintenance personnel were knowledgeable of the procedure and the associated tasks were acceptably performed for these maintenance activities. However, EA observed the following issues in two of the PM activities:

- Step 6.2.5 of the calibration procedure (PP T-782521) for a TSR-required annual PM calibration for a TAM in Building 233-H directs the technician to "adjust the picoammeter source output to obtain picoammeter input value listed on Attachment 1." However, the test instrument will not accept some of the values listed in the table. For example, the table value of -4.0 E-13 amps cannot be entered, so the technician entered -0.4 E-12. The technician similarly adjusted the input for each of eight input values. This is an error-likely situation. After EA discussed the procedure inadequacy with the technicians, they agreed that it was an issue and stated that they had used an established process (e.g., verbal notification to first line supervisor) to request that their management change the procedure on several occasions. Contrary to SRNS Manual 1Y Procedure 8.20, *Work Control Procedure*, management did not address this worker feedback.
- The second PM issue involved one of the two ventilation system PMs that EA observed. These defense-in-depth ventilation system PMs were observed to assess the performance of more typical vendor-recommended PMs instead of the functional tests and calibrations performed on the selected safety systems discussed earlier. One of the vendor-recommended PMs was the semiannual PM for the TEF control room air handling unit (AHU-3001). During performance of the PM, EA observed a personnel safety issue. The AHU fan access door used to reach the fan motor is narrow (approximately 18 inches wide) and the fan motor is just inside the access door. However, to access the fan belts, sheaves and lubricating points behind the motor, the maintenance mechanic had to get into an at-risk body position. Therefore, this six-month PM, which has been performed twice a year on each of two AHUs, poses a risk to personnel performing the PM. Maintenance mechanics stated that they had raised this issue to management, but no action was taken to provide better access to perform the PM. Follow-up by EA determined that the SRTE safety engineer had submitted an Engineering Assistance Request over six months ago, but no engineer had been assigned to evaluate the request as of September 21, 2016. This is the second example of worker feedback not being properly addressed as required by SRNS Manual 1Y Procedure 8.20, discussed above (**Deficiency**).

The observed CM activities were performed adequately and safely, with the following exception. During the pre-job briefing for replacement of a failed solenoid valve for a Building 233-H TAM, management instructed the mechanics to maintain visual contact with the location in the cabinet where the solenoid was to be replaced. However, after the solenoid was removed from the nitrogen header, the mechanics stated that they were going to another area to remove fittings from the existing solenoid. EA questioned the mechanics about the information from the pre-job briefing (i.e., to maintain visual contact with the valve removal location until the new valve was installed). Subsequently, the technicians decided to remain at the location as previously instructed by management.

Based on limited-scope system walkdowns, EA found the configuration of the TAM and GBO_2M systems to be consistent with as-built drawings and system alignment procedures. Overall, maintenance of the TAMs and GBO_2Ms is conducted such that system configuration is properly managed throughout the maintenance process.

Maintenance Training

SRTE has implemented a training program for maintenance workers (i.e., electrical and instrumentation mechanics, maintenance mechanics). The training program consists of maintenance task training and site access training. *Tritium Maintenance Organization Training Program Description* (XTMMPD01 PDES 0001 03) governs implementation of the maintenance training program for SRTE facilities. DOE Order 426.2, *Personnel Selection, Training, Qualification and Certification Requirements for DOE Nuclear Facilities*, which is in the SRNS contract for SRTE facilities, establishes requirements for DOE contractor training including technicians and maintenance personnel. Section b(3)(b) of the Order states the following:

> "Personnel who perform work on engineered safety features as identified in the facility Documented Safety Analysis must be trained on those system/components. Included in this category are systems having a direct impact on the safe operation of the facility. System training must, at a minimum, include the following elements:
>
> 1 Purpose of the system;
> 2 General description of the system including major components, relationship to other systems, and all safety implications associated with working on the system; and
> 3 Related industry and facility-specific experience."

Contrary to these requirements, the training program for SRTE mechanics (who perform work on systems having a direct impact on safe operation of the facility) does not include systems training and related industry and facility-specific experience (**Deficiency**). The SRTE training program description mentioned above is also out of date and refers to the previous version of the DOE training order (DOE Order 5480.20A).

Procurement, Receipt Acceptance, and Suspect/Counterfeit Items

SRNS has established an acceptable process for procurement of SS spare parts through a group of engineering and QA procedures. EA sampled spare parts procurement and storage for the TAM and GBO_2M systems and determined that the parts were properly procured and stored. Section 5.2 of this report provides additional details on procurement and spare parts.

SRTE has implemented an acceptable process to guard against S/CI. Manual 1B, procedure 5.19, *Suspect and Counterfeit Item Program*, describes the prevention, identification, evaluation, notification, and disposition of S/CI. In addition, engineers and maintenance personnel receive initial and periodic training on the identification and disposition of S/CI found in the facilities, so that as work is performed and systems are walked down, they can identify and disposition any existing S/CI. EA sampled training records for the required S/CI training and found no issues.

Maintenance Conclusions

In summary, SRTE has established a maintenance program that generally meets DOE Order 433.1B. The contractor has addressed the requirements through the NMMP and its implementing documents. Procedures for conducting CM are effective in restoring the functionality of safety systems equipment following equipment failure. The observed work activities were performed in accordance with established controls, work hazards were properly identified and controlled, and maintenance workers exhibited good questioning attitudes, use of human performance error reduction tools and conduct of operations behavior. However, management attention is needed to improve the scheduling and implementation of PMs to reduce the likelihood of equipment failure and increase safety system reliability. Management attention is also needed to ensure that worker feedback is appropriately addressed and that maintenance training includes all the requirements of DOE Order 426.2.

5.5 Surveillance and Testing

EA assessed the SRTE surveillance testing program for the TAM and GBO_2M systems to maintain compliance with the approved TSRs. Many of the surveillance requirements are met through the PM program; those are discussed in more detail in Section 5.4 of this report.

Objective: Surveillance and testing activities are properly performed in accordance with TSR Surveillance Requirements and Specific Administrative Controls.

Criteria:

1. *Requirements relating to test, calibration, or inspection assure: that the necessary operability and quality of safety structures, systems, and components is maintained; that facility operation is within safety limits; and that limiting control settings and limiting conditions for operation are met. (10 CFR 830.3 and Table 4)*
2. *Instrumentation and measurement and test equipment for the system are calibrated and maintained. (10 CFR 830.122 Criterion 8)*

The SRTE DSA identifies the need for TAMs and GBO_2Ms for protection of the co-located worker. The DSA requirements have been properly flowed down to the TSRs and implementing procedures (see also Section 5.1 above). EA reviewed a sample of surveillance testing packages completed during the last three years, including calibrations of TSR equipment and functional tests. All of the reviewed packages were properly completed and met established acceptance criteria.

EA observed multiple daily operational TSR surveillance checks and monthly functional checks of TAMs and GBO_2Ms. The operations and maintenance personnel performing these surveillance activities were knowledgeable of the procedures and performed them properly. One of the daily operational checks, the HANM TAM check, is required by TSR SR 4.3.4.1 every 72 hours, but SRTE performs the check every day. The performance of these operability checks more often than required is commendable and reinforces the importance of these items to safety.

EA observed performance of the *233-H Room Kanne Picoammeter Loop Check* (PP T-782521) for TAM K-35. This procedure is an annual calibration check of the electronic loop for the TAM performed with a picoammeter. Technicians properly followed the calibration check procedure, which is thorough and effective for verifying the electronic operation of the TAM. After the TAM calibration check, EA also observed the functional check of the TAM's ion chamber (using a calibrated radiological source). The calibration check and functional check of the ion chamber adequately demonstrated continued operability of the TAM to perform its intended function.

Measuring and Test Equipment Calibration Program

SRTE has a single tool room that provides measuring and test equipment (M&TE) and maintains the equipment in proper calibration. Manual 1Q, Procedure 12-1, *Control of Measuring and Test Equipment*, acceptably defines the requirements and responsibilities for control of standards and M&TE used to support calibration of TAMs and GBO_2Ms. The M&TE observed during the onsite portion of the assessment was properly calibrated and maintained.

Surveillance and Testing Conclusions

Surveillance testing, calibration, and inspection programs adequately maintain the SSCs in a condition that ensures the TSRs are satisfied. The M&TE maintenance and calibration program is well organized and effective. The observed TAM and GBO_2M surveillance and testing activities for SRTE were generally performed properly and adequately translate the TSRs into useable procedures and programs.

5.6 Operations

EA assessed the Operations functions and activities related to the TAMs and GBO_2Ms in both HANM and TEF. Due to the nature of these systems, typical Operations activities are daily surveillances and periodic functional checks, as well as responses to alarms. The full spectrum of surveillance and testing is discussed in Section 5.5, above.

Objective: Operations are conducted in a manner that ensures the safety systems are available to perform intended safety functions when required. (DOE Order 422.1, Conduct of Operations)

Criteria:

1. *The operator must establish and implement operations practices to ensure that shift operators are alert, informed of conditions, and operate equipment properly. (DOE Order 422.1, Attachment 2)*
2. *The operator must establish and implement operations practices for developing and maintaining accurate, understandable written technical procedures that ensure safe and effective facility and equipment operation. (DOE Order 422.1, Attachment 2)*
3. *The operator must establish and implement operations practices for initial equipment lineups and subsequent changes to ensure facilities operate with known, proper configuration as designed. (DOE Order 422.1, Conduct of Operations, Attachment 2)*
4. *Operator training must be sufficiently comprehensive to cover areas which are fundamental to the candidate's assigned tasks to ensure that personnel are capable of safety performing their job duties. The training program must include a core of subjects, such as instrumentation and control and major facility systems, as applicable to the facility and position. (DOE Order 426.2, Attachment 1 Chapter II.6)*
5. *The training program must include on-the-job and classroom training to ensure personnel are familiar with all aspects of their positions, including but not limited to: normal and emergency procedures, administrative procedures, location and function of pertinent safety systems and equipment, and TSRs. (DOE Order 426.2 Attachment 1 Chapter II.6)*
6. *Formal processes have been established to control safety system equipment and system status to ensure proper operational configuration control is maintained. (DOE Order 422.1, Attachment 2)*

Conduct of Operations

This assessment of vital safety system operation examined the site conduct of operations as it relates to operation of the GBO_2Ms and the TAMs in HANM and TEF. The purpose was to ensure that facility operations support the safety systems in performing their intended function.

EA observed Operations personnel on multiple occasions, primarily to observe their performance of daily or monthly surveillance procedures associated with the TAMs and GBO_2Ms in HANM and TEF. This also allowed EA to observe shift turnovers, logkeeping, and control area activities.

SRTE shift turnovers are guided by a checklist, in accordance with SRS procedure 2S 4.1, *Shift Turnover*. EA observed turnovers being conducted by shift technical engineers, shift operations managers, first line managers, and control room operators. Turnovers were conducted in a professional manner, with a discussion of logbook entries, facility conditions, and status of work in progress. Electronic status boards depicting the state of the TAMs were reviewed by the incoming shift. EA found the observed turnovers to be satisfactory.

EA also observed logkeeping by the control room operators and first line managers. Log entries were chronological, with time entries in the left margin as required by SRNS procedure 2S 2.4, *Operating Logs*. The off-going watchstander noted the name of the on-coming watchstander who was relieving the position, and signed the log as required by 2S 2.4. Likewise, the on-coming watchstanders signed the log after noting that they had assumed the duties of the position. EA did not observe any corrections or late entries in the logs, although 2S 2.4 describes the acceptable method for both of these. EA found the logkeeping to be satisfactory.

Access to control areas in both TEF and HANM was in accordance with SRNS procedure 2S 5.3, *Control Area Activities*. The HANM control area is separated by a doorway, and the at-the-controls area has a different-colored carpet to distinguish its boundaries. The TEF control area has a barricade tape, and the at-the-controls area is also designated by its carpet. EA observed numerous occasions where personnel requested permission to enter in accordance with the requirements of 2S 5.3. On one occasion, the first line manager denied entry to some personnel because he was discussing an evolution with one of the control room operators and did not want the distraction of additional personnel in the control area. After completing his discussion, he allowed the additional personnel to enter so he could address their request. EA found the implementation of access control in the control area to be satisfactory.

EA observed both the control area and process areas for operator aids. Operator aids were logged and reviewed as required, and no unapproved operator aids were identified. Some handwritten or typed notes were attached to various computer monitors or similar items in the control area; however, the information on the notes (such as phone lists) did not meet the definition of an operator aid found in DOE Order 422.1, *Conduct of Operations,* Attachment 2, Section 3.i. No operator aids were used for either the TAMs or the GBO_2Ms in either TEF or HANM. EA found the use and control of operator aids to be satisfactory.

EA reviewed the SRNS Conduct of Operations matrix to examine SRNS's assertion of full compliance with DOE Order 422.1. DOE Order 422.1, Admin Change 2, requires that implementation be "demonstrated by providing, at a minimum, a Conduct of Operations Matrix…The Conduct of Operations Matrix may be provided through direct use of Appendix A or by use of equivalent documents or electronic systems." SRNS has embedded the Conduct of Operations matrix in a larger document, the S/RID, which identifies program implementation documentation for numerous environment, safety, and health directives. Management Policies Manual 1-01, Procedure 4.20, *Conduct of Operations,* states that the S/RID "provides a listing of the implementing documents for the DOE Order to satisfy the requirement for a Conduct of Operations Matrix." This method is compliant with the order requirement. However, contrary to the requirements of the order and the assertion of the S/RID, SRNS was not in compliance with Attachment 2, Section 2.m addressing control of interrelated processes. SRNS had identified this non-compliance and initiated a draft implementing procedure to address the requirements of 2.m before EA's assessment, but that procedure remained unapproved during the assessment. SRNS deactivated 2S 5.8 on September 8, 2016.

EA has noted shortcomings in implementation of control of interrelated processes while performing assessments of vital safety systems at other locations, as noted in the Operations section of the EA report *Office of Enterprise Assessments Lessons Learned from Targeted Reviews of the Management of Safety Systems at U. S. Department of Energy Nuclear Facilities*. EA provided this report to the SRNS Environmental Management Conduct of Operations Advisor, who is coordinating the new procedure and implementation of the process. This manager also created a Site Tracking, Analysis, and Reporting (STAR) item (2016-CTS-008955) during the assessment in order to capture all aspects of the implementation, along with due dates.

The SRTE has a number of memoranda of understanding (MOUs) with other SRNS organizations. Two MOUs address provision of utilities, domestic water, fire water, and similar systems that are considered interrelated processes. Electric power is required for operation of both selected safety systems. The MOUs define the responsibilities for control of interrelated process and establish lines of communication. However, contrary to the requirements of Section 2.m.(2), the MOUs do not require operator training (for both SRTE operators and the provider of the interrelated process) to understand interrelated processes, to interpret instrument readings, and to provide timely corrective action for process-related problems (see **OFI-SRTE-3**). Instead, the MOUs require only that personnel be trained for their assigned tasks, and also complete facility entry training.

Operator Training and Qualification

TEF and HANM operators and supervisors are trained and qualified for the positions they hold. The training program consists of a mix of classroom and on-the-job training, with the specifics varying by the position. Qualification cards list the requirements for the position and document the completion dates. Qualified examiners administer oral boards in order to evaluate the individual's knowledge and understanding of various systems and processes. Training for all positions includes both *Defense Programs Conduct of Operations* and *Tritium Facility Safety Documentation*. The training material emphasizes the importance of safety systems for protection of the workers.

EA reviewed a sample of training material, including material pertaining to the selected safety systems, all of which was developed in a systematic manner in compliance with DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*. EA also examined completed written exams and records of oral boards. The completed documents showed evidence of an effective program, with a testing program that is sufficiently difficult to challenge the students' knowledge. Records of oral boards likewise demonstrate a healthy, functioning process that is challenging to both new and experienced staff. The training records also show evidence of remedial training for knowledge weaknesses revealed by oral boards.

Some control room operators are cross-trained for positions in both TEF and HANM control rooms. To prevent a cross-trained operator from losing proficiency in a position in which the operator does not frequently stand watch, SRNS has a proficiency requirement for watchstanders to have served in position for at least 24 hours in the last 90 days. Tritium Operations uses a computer-based tool, the Automated Qualification matrix, to compose the watchbill for each shift. This system ensures that the watchstander is current with the required proficiency hours, and updates the proficiency hour running total. Coupling the watchbill roster and the proficiency database is considered a **Best Practice**.

Operations staff also receive continuing training on a variety of topics, such as the new Rosemount GBO_2Ms that are being phased in to replace the obsolete Delta F systems. The tritium training organization develops a schedule of "cycle training," which is presented to operating staff over a period of weeks so that shift personnel all become trained on the same material. The cycle training includes scenarios to evaluate how the crew interacts as a team to solve problems.

Procedure Development, Use, and Adherence

The SRTE procedures group works with various other SRTE elements, such as Operations, Maintenance, and Engineering, to develop operating procedures, alarm response procedures, surveillance procedures, and other procedures that impact the SRTE mission. SRTE maintains a database of procedure "owners" in organizations such as Operations or Maintenance, while the procedure writers use standardized tools to ensure that the procedures are user-friendly and include techniques to minimize errors. Many DOE sites have procedure style guides to assist the procedure writers, and SRNS has created PS-TS-AP-4005, *Procedural Document Structure*. However, PS-TS-AP-4005 specifically exempts SRTE. Instead, SRTE formats procedures using PPA-AP-907-005, *Procedure Professionals Association – Procedure Writer's Manual*. The Procedure Professionals Association (PPA) is an industry working group with its roots in the Institute of Nuclear Power Operations. PPA is composed of subject matter experts from the U.S. commercial nuclear field, DOE, and other similar business interests. Use of PPA standards continues the trend of adopting consensus standards and abandoning "in-house" standards. The activities observed by EA were performed in accordance with procedures developed and formatted using the PPA standards, and were clear and easily followed by the SRTE personnel.

SRTE utilizes a pre-job brief process to ensure that work requiring multiple employees is adequately coordinated, and that all workers understand their roles in the evolution. EA observed several pre-job briefs for surveillance activities on the selected safety systems and found it to be a useful process. As work was performed, EA observed commendable use of human performance improvement/error reduction tools, including effective placekeeping and consistent three-way communications. Another useful SRTE tool for error reduction is the use of a tablet computer for daily rounds. EA observed daily rounds, pertaining to both TAMs and GBO_2Ms, using a tablet computer that automatically flags out-of-limits readings and also ensures that all required readings have been taken before allowing the operator to submit the completed procedure for supervisory review. In addition to recording the readings, the tablet version of the procedure allows the user to make explanatory comments, which can be particularly useful when an instrument is out of service or in a similar non-standard configuration. During the performance of the rounds for the GBO_2Ms in HANM, local alarm panels in the process rooms were included in the round sheets. At each local alarm panel, there was a copy of the associated alarm response procedure. The procedures were marked as controlled copies and were the current revision.

During one set of rounds for the GBO_2M system in TEF using the tablet computer, the operator encountered an unexpected condition related to the use of the explanatory comment tool. The operator appropriately contacted supervision, who in turn contacted the tablet computer subject matter expert to resolve the matter. The subject matter expert demonstrated an alternate method for comment entry. The operator's response to this unexpected condition was satisfactory, as was the supervisory response.

The TSRs specify the frequency for various SRs, as noted in Section 5.5. For the GBO_2Ms, the TSRs require an operability check every 24 hours. SRTE has elected to perform this check every shift. EA observed the daily checks using the tablet computer as noted above. For the TAMs, the TSRs require an operability check every 72 hours. SRTE has elected to perform this check every day. EA also observed these checks, which were also performed with the tablet computer. The performance of these operability checks more frequently than the minimum requirements is satisfactory and reinforces the importance of these items to safety.

EA observed performance of the monthly response check of the HANM TAMs on multiple occasions (also discussed in Section 5.5). During one particular evolution, the control room operator noted a typographical error in a section of the procedure and brought it to the attention of the supervisor, who followed the protocol for making non-intent changes. Later in the performance of this same surveillance, the operators discovered that one verification step referred to the incorrect room number. They again correctly engaged their supervision, who, in conjunction with the shift technical engineer, appropriately initiated a procedure change since it was not obvious that this would be a non-intent change. EA requested previous completed copies of the surveillance, which had been issued as a new version three months earlier. The two previous performances of the procedure did not uncover these errors, apparently demonstrating a lack of attention to detail.

System Lineups and Equipment Status Control

SRTE controls the lineup of the GBO_2Ms and the TAMs with initial system lineup procedures. Additionally, alternate airborne tritium monitoring can be provided in the event of problems with the primary monitoring system. SOP 233-29001, *Establishing Alternate Monitoring for Kanne Operations*, is used in HANM to establish alternate monitoring, while in TEF the procedure is SOP 264-H-2901, *Establishing Alternate Air Monitoring for TAM Operation*. Depending on the affected monitoring points, an LCO may be entered. The alternate monitoring adequately addresses ALARA (as low as reasonably achievable) concerns, while LCO entry adequately protects the safety basis assumptions.

Electronic status displays in both the TEF and HANM control rooms show the status of each individual air monitor. Control room operators use the distributed control system to manipulate air monitor function, such as manually controlling the monitoring sequence, which is then depicted on the status display. If one of the monitors is in alarm, out of service, or in another non-standard configuration, the status display shows the monitor in an alternate color corresponding to the condition. EA observed the use of this board during a monthly functional check of the TEF TAM system, when sequencing of the TAM under surveillance was switched from automatic to manual. The use of the alternate color on the status board satisfactorily highlighted the condition for the operators. As noted above, the air monitors serve an ALARA function and are set several orders of magnitude lower than what their credited safety function would require.

Operations Conclusions

The GBO_2Ms and TAMs in TEF and HANM are operated in a manner that ensures the systems will be able to perform their intended function when required. Operators are well trained and informed on the importance of the systems. The systems' lineup and status are adequately controlled. A non-compliance with DOE Order 422.1 concerning the implementation of interrelated processes operation, self-identified by SRNS, is being addressed. EA identified a best practice for the process used to automatically credit operator proficiency hours based on watchstanding hours.

5.7 Cognizant System Engineer Program

Within the CSE objective, EA reviewed the CSE program, CSE training and qualifications, CSE roles and responsibilities, and operations and maintenance technical support. The scope also included interviews with the four CSEs assigned to the selected systems.

Objective: Cognizant System Engineer Program implementation is effective in ensuring that safety systems can reliably perform as intended.

Criteria:

1. *The DOE contractor has established a system engineer program to ensure continued operational readiness of systems within the program scope. (DOE Order 420.1B Chapter V)*
2. *The System Engineer Program must be applied to active safety class and safety significant SSCs as defined in the facility's DOE approved safety basis, as well as to other active systems that perform*

important defense-in-depth functions, as designated by facility line management. (DOE Order 420.1B Chapter V.2)

3. *Hazard category 1, 2, and 3 nuclear facilities must have a System Engineer Program, as well as a qualified cognizant system engineer (CSE) assigned to each system within the scope of the Program. (DOE Order 420.1B Chapter V.3)*

DOE Order 420.1C requires that protocols for implementing the facility CSE program address the following elements:

- Identification of the systems covered by the CSE program and the systems assigned for coverage
- Configuration management
- Support for operations and maintenance
- Training and qualifications of CSEs.

SRNS's CSE program is briefly described in several manuals, as outlined in the S/RID. In brief, the CSEs are considered Design Authorities (DAs), per manuals E7 3.04, *SSC Performance Monitoring*, and 1.10, *Engineering Program Roles, Responsibilities, Accountabilities and Authorities*, with associated roles and responsibilities that, in aggregate, satisfy the order requirements. Additionally, WSRC-IM-2005-00019, *System Engineer Handbook Tool*, assists the CSE in gaining practical knowledge to perform assigned engineering responsibilities.

The CSE is the focal point for system documentation, with roles in the CMGT process (see Section 5.3), procurement of spare parts and replacement items, and maintenance of the system based on manufacturer guidance. EA reviewed aspects of the SRTE CSE program described in the documents noted above to assess the performance of the CSEs assigned to the selected systems in key areas.

CSEs rely on frequent system walkdowns, extensive field presence, involvement in issue resolution, and system data analysis to meet system monitoring expectations and ensure adequate system performance. However, walkdown documentation is not specifically required; "walkdown notes" are only mentioned in the guidance attached to E7 3.04. EA found that the CSEs do not rigorously document walkdowns or other activities throughout the year, resulting in a vulnerability in that if a CSE cannot return to work for some reason, the CSE's system walkdown highlights, concerns, and important observations may be lost. This may also contribute to inadequacies found in the system health presentations as noted below.

System Notebooks

SRNS procedure E7 3.04 provides both guidance and requirements for CSEs in maintaining the system notebook to help manage and maintain their assigned system. A system notebook is required for all vital safety systems that require performance monitoring. The notebook is also an important tool for transitioning between engineers. Procedurally required contents of the system notebook broadly include system health assessments, performance monitoring trends, system walkdowns, engineering paths forward, list of applicable regulatory documents, system operations logs, NCRs, occurrence reports, spare parts list, open corrective maintenance, technical training related to the system for associated personnel, and record of system design changes. EA found the creation of system notebooks to be a positive aspect of the overall CSE program. The assigned CSEs for the TAM and GBO_2M systems are well informed on the status and physical conditions of their systems. Additionally, the CSEs are adept at accessing information on their system through the online system notebook platform.

System Health Presentations

With respect to system health reporting, E7 3.04 requires formal assessments to measure system health for vital safety systems every 12 to 15 months. Informal assessments through the course of that period culminate in a system health presentation (SHP) to SRTE management.

The SHPs of the four CSEs were staggered, and each covered a period of one year. EA examined the SHPs for all four CSEs for the period between 2014 and 2016. Each presentation starts with a standardized four-panel chart addressing maintenance cost, obsolescence/life issues, failures/ discrepancies, and concerns/issues/risks. Additional slides provide supporting detail. The intent of the presentations is to distill information down to essential messages for senior management. However, the most recent SHPs are too brief to effectively communicate important messages. EA also identified several problems with regard to reliability, operability and system trending:

- The SHPs for TEF TAM systems, documenting the period between 2013 and 2016, identified that 47 flow switches and 45 internal pump sample valves were replaced. According to the TAM trending charts, the life expectancy of the internal pumps that were replaced had declined, and the failure rate of the flow switches had increased significantly. Despite these issues, no effective analysis of the failure mechanisms was performed as required by E7 3.04, Sections 4.3 and 8.5. Likewise, the SHPs did not provide supporting analysis of flow switch and pump failure mechanisms, contrary to the requirements of E7 1.01, Section 4.4 and DOE Order 420.1C (**Deficiency**).
- The SHPs did not establish performance criteria against which system and component performance could be assessed as required in DOE Order 420.1C (**Deficiency**).
- The averaging process used to calculate and assess the availability of TAMs and GBO_2Ms is ineffective because averaging over all of the systems in total yields a high availability figure that conceals poor performance by individual units. Furthermore, the availability calculation is no longer used in system health reports, contrary to E7 3.04, Sections 3.0, 5.1, 8.5, and 8.8 (**Deficiency**).
- The 2016 HANM GBO_2M SHP stated that "component failures can go undetected rendering the system unable to perform its safety function." No further discussion was provided.
- Interviews with the CSE indicated that the continued availability of spare parts is a large vulnerability, but the presentation did not effectively communicate this vulnerability or the efforts needed to plan accordingly. The HANM TAM SHP obsolescence/life issues panel stated: "Forecast Life: Components are currently replaceable. Life based on availability of parts." The supporting detail section on future concerns stated: "Technology phasing out: PLC Modicon Series no longer available" and "Alarm light bulbs (incandescent) no longer produced at same specifications."
- The 2016 HANM GBO_2M SHP indicated a potential risk that Delta F sensor manufacturing will be discontinued. Thirty are planned to be replaced by new technology oxygen monitors (Rosemount) over the next ten years. Based on the failure rate and current inventory (including purchase orders in process), SRTE will expend the current inventory of spares by April 2018. If the manufacturer terminates this product line (SRTE is the only customer for this product), HANM may face a significant vulnerability that is not effectively communicated in the SHP.

The SHPs are also used to track corrective action commitments. EA followed up on selected issues, including those identified in several safety system oversight assessments performed by SRFO. All of the STAR items were adequately addressed and closed.

The document receipt process ensures that vendor manual submittals are put into the electronic records system before distribution. The CSE is the primary recipient of this information and also performs an important role in independently verifying that vendor manuals are retrievable through this system. EA found that performance in this area is adequate.

CSE Training and Qualifications

DOE Order 420.1C requires that CSEs be qualified as described in DOE Order 426.2. Procedure PROGPJCTPDES000104, *SRS Technical Staff Training Program Description*, establishes and documents the program that qualifies engineers to fill technical staff positions. Attachment 1 of this procedure establishes additional training and qualification requirements for engineers assigned as CSEs. EA noted that completion of several training courses and required reading assignments was not documented in the CSEs' training history. EA discussed training issues during a meeting with SRTE training personnel (both working level and supervisory) and was informed that the CSE training program was of "low rigor," "ad hoc," and based on a "graded approach." The following are some examples of training issues that EA observed:

- One CSE did not have S/CI training documented as complete.
- Procurement training differed among the four CSEs, and only one CSE had the training listed as required in PROGPJCTPDES000104.
- Specific required reading listed in PROGPJCTPDES000104 to provide the knowledge and skills necessary to qualify for the CSE positions was not documented or listed in the reviewed training histories. Examples of required reading not documented include:
    - *Conduct of Operations Manual* - Manual 2S
    - *Facility Safety Document Manual* - Manual 11Q
    - *Conduct of Engineering* - Manual E7
    - M&O Chief Engineer Desktop Instructions - M&O-2007-00081, M&O-2009-00005, and M&O-2009-00007.
- The facility training document, XTMTPD01 PDES 0001 18, *Savannah River Site Tritium Programs Engineering Training Program Description*, does not flow down the CSE training requirements listed in PROGPJCTPDES000104 for the DA positions.

Further, the GBO_2M CSE training histories were missing system-specific training qualification requirements for their assigned systems. EA brought this issue to the attention of the supervisor for those CSEs. The supervisor generated system-specific qualification requirements and added them to the training requirements for the CSEs before the end of the assessment.

EA also explored this issue with the design engineering group that supports SRTE, regarding their training program as it relates to the engineering staff positions and requisite responsibilities. The Design Engineering Manager stated that the electrical engineers and mechanical engineers receive the same training. EA also found that there is no task-to-training matrix or specific training based on engineering discipline. The interviewee noted that because all his engineers did the same tasks, there was no need to provide different training for the different engineering disciplines.

EA discussed these concerns with the Chief Engineer, who acknowledged that there were issues in the current training program and that SRNS was taking steps to correct them by engaging in the "Value Stream Analysis" process. However, the documentation for this process does not address issues in providing training as it relates to the engineering staff positions and requisite responsibilities. DOE Order 426.2 requires that there be a "systematic approach to training in order to ensure that personnel have requisite knowledge, skills, and abilities to perform their job." EA found several instances inside and outside the CSE program where this requirement was not met (see **Finding F-SRNS-1**).

CSE Conclusions

The CSEs assigned to the SS systems under review are knowledgeable of facility processes and their assigned systems, and the system notebooks are effective repositories of system information. However, EA noted significant shortfalls in the conformance of the CSE training program to DOE Order 420.1C and in the establishment of job-specific training and reading requirements for all technical staff using a systematic approach to training as required by DOE Order 426.2. In addition, the SHPs are ineffective in reporting system status and identifying system issues to senior management; they do not provide supporting analysis of component degradation/failures, do not assess system and component performance in comparison to established performance criteria, and use an ineffective methodology for calculating system availability.

5.8 Feedback and Improvement

EA assessed the effectiveness of feedback and improvement processes in addressing and preventing the recurrence of safety system issues. EA reviewed the SRTE management assurance system (MAS), management assessments, independent assessments, issues management, use of worker feedback and lessons learned, and contractor assurance system reporting to senior management and NNSA.

Objective: Feedback and improvement processes are effective in addressing and preventing the recurrence of safety system issues. (10 CFR 830 Subpart A)

Criteria:
1. *Identify the causes of problems and work to prevent recurrence as a part of correcting the problem. (10 CFR 830.122 Criterion 3)*
2. *Contractors must monitor and evaluate all work performed under their contracts to ensure that work performance meets the applicable requirements for environment, safety, and health, including quality assurance, integrated safety management, safeguards and security, cyber security, and emergency management. (DOE Order 226.1B Attachment 1 Section 1)*

The SRTE MAS, SRNS-RP-2008-00206, *Management Assurance System (MAS) Manual*, is a comprehensive, well-written, documented description that meets the requirements of DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*. The MAS describes an effective risk-based assessment planning process to acquire feedback information in functional areas indicating weak performance. The MAS also addresses other forms of feedback processes (i.e., from workers, lessons learned, and performance measures) that provide a complete approach to communicating important information to senior management and the SRSO.

Assessment Planning and Implementation

The SRTE MAS describes a comprehensive, graded approach to focus management assessment resources based on past performance information, including functional area performance indicators, prior assessment results, issues from the Issues Management System, significant issue occurrences for the functional area, and customer concerns. SRNS also developed well-structured and comprehensive "Assessment Performance Objectives & Criteria (APO&C)" that consist of functional areas, elements, performance objectives, and criteria for each functional area (e.g., engineering, configuration management, maintenance). For example, Functional Area <u>06</u> addresses safety documentation; Element <u>03</u> addresses administrative and engineering controls verification; and Performance Objective <u>03</u> addresses verification of safety basis controls and includes seven criteria, each with specified "lines of inquiry." The overall functional area described here, <u>06-03-03</u>, is the one most closely associated with the scope of this EA assessment. It specifies a three- to five-year assessment frequency goal, in the absence of a regulatory or contractually required frequency (U-PP-G-00005 Rev1, *FA-06 Assessment Bases, Criteria, and Suggested Lines of Inquiry*). This technique gives assessors definitive assessment planning direction, which ensures consistent oversight performance over time.

Each year, SRTE compiles past performance information for each functional area into a complex spreadsheet. SRTE effectively calculates a risk value for each APO&C to identify the highest priority assessment areas for the upcoming year. EA reviewed the FY 2016 SRTE assessment schedule. SRNS-T0000-2016-00018, *Transmittal of Savannah River Tritium Enterprise (SRTE) Programs Management Risk Based Assessment and Audit Schedule- 2016*, identifies the planned self-assessments for FY 2016 by assessment number. No FY 2016 assessments are planned for functional area 06-03-03.

SRTE provided EA with reports of self-assessments completed over the past two years that specifically addressed functional area 06-03-03. Some problems were evident:

- An FY 2016 assessment of "sufficient numbers of qualified personnel to support the safe implementation of the controls established through the safety basis" resulted in the examination of the SRTE minimum staffing level table, the list of qualified workers available, and documentation of required LCOs completed within eight hours. There were no interviews or investigation into expended overtime; overall, this was a very limited review. EA noted that SRNS-T0000-2016-00018 did not identify this assessment as an FY 2016 planned assessment.
- A stated assessment scope of safety basis controls and requirements implies that it addresses all safety systems, but the report only addressed the fire suppression system.
- Assessment results to "ascertain effective TSR implementation and compliance with applicable requirements" communicated only the status of safety basis update implementation tasks and independent implementation verification reviews, without any performance-based evaluation.
- An assessment of facility personnel's knowledge of safety basis controls and requirements resulted in a three-sentence discussion that appears very limited and superficial.

Overall, self-assessment reports directly related to verification of safety basis controls contained some incomplete scope descriptions. The assessments were shallow, involved minimal effort, and lacked sufficient rigor, contrary to DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, Contractor Requirements Document (CRD), 2.b.(2): "The contractor assurance system, at a minimum, must include the following: Rigorous, risk-informed, and credible self-assessment and feedback and improvement activities" (**Deficiency**). SRNS Manual 12Q also provides for assessments at management's discretion. SRTE Design Engineering, for example, issued SRNS-E3300-2015-00004, *Design Assessment Plan and Schedule*, October 31, 2015, to define its self- assessment topics for FY 2016. Design Engineering identified seven important engineering topics, including change control, drawings/redlines, and design verification. Design Engineering assesses these topics once a year, demonstrating a positive management culture to examine internal processes to drive continuous improvement. EA reviewed reports of 34 Design Engineering self-assessments conducted since January 2015, with no issues identified.

The SRTE MAS identifies an Independent Evaluation Board responsible for the performance of internal independent assessments of selected topics throughout the SRTE organization, with a focus on safety and operational excellence. The implementing directive 12Q FEB-1, *Facility Evaluation Board*, provides an adequate independent assessment process. Over the past three years, the SRTE Independent Evaluation Board has not performed any assessments that specifically included examination of SRTE's TAMs, GBO_2Ms, or the CSE program; this conforms to SRTE's three- to five-year assessment frequency goal for these items.

Satisfactory processes are in place to identify and analyze problems and issues, including operational events; track, monitor, and close corrective actions; and verify the effectiveness of corrective actions. Manual 1B, Procedure 4.23, *Corrective Action Program*, implements the SRNS Issues Management System. The STAR system records issue data and analyses, and it provides for data reporting. CSEs were knowledgeable of the SRNS issues management program and understood the issues management process using the STAR system. Interviews with CSEs and workers confirmed management's support and encouragement to identify issues.

The STAR system implements a satisfactory graded approach using Significance Categories 1 through 4 (with 1 being the most significant). Significance Categories 1 through 3 address graded impact on "safe/secure facility operations, worker or public safety and health, regulatory compliance, or public/business interests." Significance Category 4 addresses "errors that have inconsequential impact" and "do not warrant further corrective action." SRTE designates a fifth Significance Category, T, assigned to issues for "tracking that are necessary and/or appropriate to address and manage." Per Procedure 4.23, Significance Category T does not require a causal determination or full application of corrective action program elements.

EA found that some significant safety system performance issues were not appropriately categorized in accordance with the Manual 1B, Procedure 4.23 graded approach (**Deficiency**). This miscategorization skews issue data category frequency and adversely affects the SRTE assessment prioritization process discussed above. Some examples follow:

- The TEF/TAM CSE recognized a recent increased failure rate of system booster flow switches due to sluggish performance. SRTE shared this information with the SRFO in late CY 2015. SRFO then included the issue in assessment report as an OFI. Based on the OFI, SRTE created STAR record 2016-CTS-000101, *NNSA-SRFO Assessment Report*, *2016-SA-000214*, December 18, 2015, and assigned a Significance Category T. The SRFO report specified two corrective actions: increase the minimum inventory and replenish the stock. SRTE did not perform any further causal analysis. This issue, which should have been documented in STAR when discovered but was not, resulted in increased cost of components, purchasing, receiving/ inspection, storage, handling, work planning and execution, records management, etc., which has a business impact and should have been assigned a Significance Category of 2 or 3.
- The CSE indicated the annual GBO_2 Monitors sensor replacement rate has increased from seven (2005) to about twenty-nine (presently) as previously discussed. SRTE studied the cause of these failures in 2009. SRTE has since elected to implement a replacement technology and has taken appropriate actions to perform a technical evaluation, test proposed replacement oxygen sensors, develop a ten-year funding strategy (nearly $30+ million), and begin acquisitions and installments. However, SRTE did not enter a STAR system record to identify the problem and track/manage the corrective actions. Based on the large business impact, SRTE should have recorded this issue as Significance Category 1 in the STAR system.
- In June 2016, SRTE found the inventory of GBO_2M sensor spare parts unexpectedly depleted. This condition came as a surprise to the CSE, because a spare part minimum level had been established and previous auto-processing was normally successful. An immediate investigation into back orders identified the problem, and the N-Area receiving facility organization initiated STAR record 2016-CTS-008647, *PeopleSoft Staging Table Issue*, August 22, 2016, categorized as Significance Category T. No cause analysis was completed, but closure actions are ongoing. This issue resulted in a special study, a software modification, increased interaction with the supplier, and other consequential actions. Based on the minor to moderate business impact, SRTE should have recorded a Significance Category 2 or 3 issue in the STAR system. (This example indicates that mis-categorization using the T category may be pervasive throughout SRNS.)

- STAR record 2013-CTS-012935, *Mechanics working on the wrong oxygen monitor*, October 25, 2013, was categorized as Significance Category T. A cause analysis was completed, and 19 corrective actions were taken. Based on the minor to moderate business impact indicative of the response activities, this issue should have been recorded in the STAR system as Significance Category 2 or 3.
- A TEF/oxygen monitor QA verification issue resulted in an NCR. SRTE recorded 2015-NCR-14-0041, *Failed QA inspection and accept the wrong model 3001 Insta-Trans analyzer*, November 4, 2015. The inadequate receipt inspection resulted in two of the three incorrect replacement items being placed in a glovebox and sequentially failing the calibration check before SRTE recognized they were the incorrect parts. The final engineering disposition was to dispose of the two items placed in the glovebox and return the other item to the supplier. The 2015-NCR-14-0041 record indicates that a STAR report is not required, but in fact, SRTE entered two STAR system issues, 2016-CTS-1468 and 2016-CTS-1469. Both were categorized as Significance Category T. The CSE reported that a new CGD package was developed and a testing apparatus configured that now requires the item to be tested before placement in a glovebox. No causal analysis was completed for this issue. Based on the minor to moderate business impact – e.g., the disposed items (about $7K), revised CGD, repurchasing, receiving/inspection, storage, handling, work planning and execution, and records management – this issue should have been recorded in the STAR system as Significance Category 2 or 3.

SRNS-RB-2011-00265 Rev9, *SRTE Review Board Charter*, establishes the SRTE Review Board as a senior management mechanism to review, monitor, and assess performance to drive improvement, and reflects positive involvement of senior leaders in issues management. The board is required to review all Significance Category 1 and 2 issues, as well as a sample of Significance Category 3 issues. The most recent SRTE Review Board meeting presentation, August 22, 2016, indicated that SRTE is satisfactorily implementing the Review Board charter. However, the charter assigns the Issues Analyst, instead of a Review Board sub-team, to sample Significance Category T issues quarterly and evaluate the significance category selection. This places the Issues Analysist, a staff-level administrative individual, in the position of “challenging” system experts, i.e., CSEs. Since the annual risk-ranking algorithm for assessment planning only uses STAR issues with Significance Categories 1, 2, and 3, incorrectly categorizing issues as T (exemplified above) eliminates their contribution to the prioritization process.

Worker Feedback and Lessons Learned Use

All interviewed employees expressed their willingness to raise issues, their satisfaction with management’s response to their concerns, and support for identification of lessons learned. SRTE is implementing the TOPS program (Tritium Operating Production System), which is a good tool for encouraging management and employee engagement. As an example, the initial rollout of TOPS within SRTE has been an effective way to streamline morning staff meetings and to prioritize and push responsibility and accountability down to lower levels. SRTE attributes a 38% reduction in product cycle time directly to this initiative.

The most recent official lesson learned relevant to the TAMs and GBO_2Ms was 2006-LL-0066, *Expired Calibration Gas Used to Calibrate Oxygen Monitoring Equipment (SRS)*, September 13, 2006. Current procedures require workers to record the span gas cylinder lot number and expiration date to keep this issue from recurring, indicating that the 2006 lesson learned was effectively institutionalized. The TEF TAM CSE reported recent outreach to the DOE Thomas Jefferson National Accelerator Facility regarding tritium air monitoring, indicating a willingness to reach out to other organizations.

Contractor Assurance System Reporting

SRTE provides a monthly NNSA Operations & Programs Report of Performance, which constitutes the required contractor assurance system reporting to SRFO. The intent of this monthly report is to maintain transparency and inform SRFO of important aspects of contract performance. EA reviewed the four most recent monthly reports and found that they were effective in communicating the HANM GBO_2M sensor replacement issue and status, indicating that these monthly reports inform senior management of the most significant TAM and GBO_2M issues. The SRTE Trending Report of SRTE issues identified over the past 12 months indicates that about 50% of the total issues were equally distributed between conduct of operations and occupational safety and health. SRTE satisfactorily addressed both of these topics in each of the past four NNSA Operations & Programs Report of Performance reports, indicating effective use of issues management data.

Feedback and Improvement Conclusions

Overall, the SRTE feedback and improvement processes are mostly effective in addressing and preventing the recurrence of safety system issues. The SRTE MAS Manual is a comprehensive, well-written document that meets DOE Order 226.1 requirements. The MAS provides an effective risk-based management assessment planning tool. Some discretionary management assessments, conducted by Design Engineering, for example, demonstrate a positive management culture actively examining internal processes and driving continuous improvement. SRTE has not performed any independent assessment reports directly related to these safety systems or the CSE program over the past three years, but this is consistent with SRTE's planned frequency goals. SRTE has also implemented a satisfactory issues management program that provides for graded causal analysis and issue recurrence prevention. SRTE has effectively involved senior management in the monthly review of SRTE issues. The collective analysis of all feedback information is effectively analyzed and communicated in SRTE's monthly NNSA Operations & Programs Report of Performance.

However, TAM and GBO_2M management assessment reports directly related to verification of safety basis controls have some incomplete scope descriptions, and some assessments are shallow and lack sufficient rigor. Also, some significant safety system performance issues were not appropriately categorized, which eliminates their contribution to the assessment prioritization process.

5.9 Federal Oversight Program

EA evaluated the establishment and implementation of SRFO programs and processes for conducting oversight of the management and operation of nuclear safety systems. Specifically, EA reviewed program and process documents, interviewed responsible managers and staff, and evaluated samples of process outputs, such as assessment schedules, assessment/surveillance reports, issues management data, and contract performance-based evaluations.

Objective: Federal safety oversight programs are established and effective in ensuring safety systems can reliably perform as intended.

Criteria:

1. *All applicable DOE organizations must: (1) Establish and implement an effective oversight program consistent with DOE Policy 226.1B and the requirements of this Order, and (2) Maintain sufficient technical capability and knowledge of site and contractor activities to make informed decisions about hazards, risks, and resource allocation; provide work direction to contractors; and evaluate contractor performance. (DOE Order 226.1B Section 4)*

2. *The DOE site office has established and implemented an effective Safety System Oversight (SSO) program for qualifying staff to apply engineering expertise in its oversight of the assigned safety systems and to monitor performance of the contractor's CSE program. (DOE Order 426.1 Appendix D)*

Procedure SV-PRO-008, *Vital Safety System Assessments*, details the overall approach, responsibilities, and requirements for the SRFO vital safety system assessment program. The procedure directs the SSO engineer to: monitor appropriate systems and programs in order to ascertain status and condition in facilities; determine the effectiveness of the contractor's System Engineering staff and program; determine the effectiveness of implementation of a vital safety system program; and evaluate the quality of a contractor's self-assessment program.

Overall, the SRFO SSO engineer is very knowledgeable of the selected systems and the current system status. The SSO engineer performed scheduled independent assessments of system performance, equipment configuration, and material condition of assigned systems and safety management programs, as identified in SRFO procedure SV-PRO-011, *Assessment Oversight Program*. The procedure also addresses the qualifications of assessors; the training and qualifications of the SSO engineer were complete and adequate. In addition, the SSO engineer conducts system walkdowns and program/ document reviews, such as corrective actions, maintenance, surveillance, design change packages, modification packages, and safety basis revisions.

The assessment schedule is developed with a goal to assess each safety system on a rolling three-year schedule. Vital safety system assessments are primarily guided by typical lines of inquiry approved by the Assistant Manager for Mission Assurance. Results of the assessment are briefed to the responsible contractor personnel and formally transmitted to the SRFO Manager. Deficiencies are tracked in the STAR system for closure.

EA reviewed the SSO vital safety system assessments from years 2011 to the present and verified that they were done triennially for the TEF and HANM TAMs and GBO_2Ms. The SSO assessments focused on monitoring the performance of the safety systems in accordance with the DSA; the change control process; system physical configuration; and CSE performance. One assessment in October 2015 identified an "observation" that the lack of spare parts in inventory that forced the facility to take operating TAMs out of service to return LCO-related TAMs to service when multiple failures occurred in TAM flow switches. The assessment also stated that "the booster pump flow switches, until recently, have been reliable and trouble free;" however, 38 internal pumps were replaced from 2014 to 2015, and 27 flow switches were also replaced during that time. Additionally, the assessment noted that no issues were identified in the SHPs, even though EA identified a concern about the computation of system availability. According to DOE Order 426.1, the SSO engineer "performs evaluations of contractor troubleshooting, investigations and root cause analysis." SSC performance issues identified elsewhere in this report were not captured in the SSO assessment, perhaps because the lines of inquiry selected from SV-PRO-008 for the planned assessment scope did not include several that focused on this area (i.e., lines of inquiry 8a, 8b, and 19) (see **OFI-SRFO-1**).

Facility Representative Program

The responsibilities and requirements for managing and implementing the Facility Representative (FR) program are delineated in SV-PRO-010, *SRFO Facility Representative Program*. The procedure describes the duties, responsibilities, and authorities of FRs; FR qualification/requalification; the FR assessment program; FR staffing and coverage; emergency event response and occurrence reporting activities; and FR program performance assessment and feedback. Attachment A of SV-PRO-010 provides the minimum routine FR assessment activities, including determining current facility status, facility conditions, activity observation, safety-related system walkdown/surveillance requirements, and specific administrative controls. SRFO currently has two fully qualified FRs assigned to the TF. Both FRs' training records are complete and adequate.

Oversight and feedback are documented in several ways. The FRs provide immediate feedback as appropriate during their daily walkthroughs, and they meet with the contractor weekly to discuss issues. Minor issues identified in the FRs' weekly facility status and tour assessments (OP-1/OP-2) are entered in the STAR system and are provided to the contractor. Findings from assessments are transmitted formally to the contractor for resolution. Monthly operational surveillances (OP-03/05) are provided to the contractor on performance in this area and are included in the subjective evaluation of operations for the year-end Performance Evaluation Report. EA reviewed three weekly operational awareness activity/issue reports and ten monthly status/trend reports. EA identified no concerns about the reviewed documentation and communication provided by the reports. Overall, communication of oversight results to the contractor is effective.

Federal Oversight Conclusions

DOE field element oversight of SRTE is provided by SRFO, which uses appropriately documented plans and schedules for planned assessments and focus areas for operational oversight. The SSO engineer demonstrated a sound understanding of the facilities and systems to which he was assigned. In addition, safety system assessments performed by the SSO and reviewed by EA were in-depth and of good quality for the areas assessed. However, the SRFO SSO assessments had some problems. System reviews were not sufficiently critical to drive the contractor organization to create and maintain system performance metrics that adequately gauge system status (i.e., availability). In addition, assessments did not address the declining performance of the TEF TAMS, which exhibit increasing component failure rates and decreasing component operating life expectancy. Recent assessments also did not address component reliability.

In interviews, the FRs demonstrated knowledge of DOE requirements and facility-specific knowledge of their respective facilities, and they are active in monitoring facility work activities and conditions.

6.0 FINDINGS

Findings are deficiencies that warrant a high level of attention from management. If left uncorrected, findings could adversely affect the DOE mission, the environment, the safety or health of workers and the public, or national security. DOE line management and/or contractor organizations must develop and implement corrective action plans for EA appraisal findings. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE Order 227.1A to manage these corrective action plans and track them to completion. In addition to the findings, deficiencies that did not meet the criteria for a finding are listed in Appendix C, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

Savannah River Nuclear Solutions, LLC

Finding F-SRNS-1: Contrary to the requirements of DOE Order 426.2, the SRNS training program does not exhibit a systematic approach to training, with analyses to determine required training needs based on job functions.

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.

Savannah River Tritium Enterprise

OFI-SRTE-1 Consider revising HANM SS TAM alarm setpoint documentation for consistency.

OFI-SRTE-2 Consider improving work week schedule management by setting the schedule at an appropriate point before the actual start of the work week (e.g., 2 weeks before the start of work) and establishing schedule adherence controls to limit merging of work activities into the schedule after the schedule has been set, such as the controls prescribed in Institute of Nuclear Power Operations Guideline AP-928, *Work Management Process Description*. In addition, consider developing frequencies for pre-planned replacement of TAM and GBO_2M components based on failure rates to reduce maintenance backlog and improve TAM and GBO_2M system reliability.

OFI-SRTE-3 Consider updating MOUs with interrelated process providers to include training for both SRTE personnel and the interrelated process personnel to understand the nature of the interrelated processes, to interpret instrument readings, and to provide timely corrective action for process-related problems. Consider expanding the existing STAR item on interrelated processes to track completion of the updating of MOUs between SRTE and interrelated process suppliers.

NNSA Savannah River Field Office

OFI-SRFO-1 Consider expanding the scope of future vital safety system assessments to include lines of inquiry specifically related to equipment performance issues.

Appendix A
Supplemental Information

Dates of Assessment

Onsite Assessment: August 22-25 and September 20-29, 2016

Office of Enterprise Assessments (EA) Management

Glenn S. Podonsky, Director, Office of Enterprise Assessments
William A. Eckroade, Deputy Director, Office of Enterprise Assessments
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments
William E. Miller, Deputy Director, Office of Environment, Safety and Health Assessments
C.E. (Gene) Carpenter, Director, Office of Nuclear Safety and Environmental Assessments
Patricia Williams, Director, Office of Worker Safety and Health Assessments
Gerald M. McAteer, Director, Office of Emergency Management Assessments

Quality Review Board

William A. Eckroade
John S. Boulden III
Thomas R. Staker
William E. Miller
C.E. (Gene) Carpenter
Patricia Williams
Gerald M. McAteer
Michael A. Kilpatrick

EA Site Lead for Savannah River Site

Jeff Snook

EA Assessors

Charles Allen – Lead
Mike Marelli
Tim Martin
Glenn Morris
Samina Shaikh
Greg Teese

Appendix B
Key Documents Reviewed, Interviews, and Observations

Documents Reviewed

1-01 4.20, Revision 5, 6/29/2011, *Conduct of Operations*
2006-LL-0066, *Expired Calibration Gas Used to Calibrate Oxygen Monitoring Equipment (SRS)*, September 13, 2006
2013-SA-003862, 8/5/2014, *Management Directed 233-H Tritium Air Monitors - Assessment of TSR Surveillance; LCO 3.3.2*
2013-SA-003863, 5/13/2014, *Management Directed 234-7H Tritium Air Monitors Assessment of TSR Surveillance; LCO 3.3.4*
2013-SA-003866, 11/12/2013, *Management Directed 233-H EC Enclosure Oxygen Monitoring System Assessment of TSR Surveillance; LCO 3.4.2*
2013-SA-003873, 12/23/2013, *TEF Tritium Air Monitors Assessment of TSR Surveillance; LCO 3.3.5*
2013-SA-003875, 3/10/2014, *TEF Glovebox Oxygen Monitoring System Assessment of TSR Surveillance; LCO 3.4.6*
2013-SA-005926, 7/9/2014, *National Nuclear Security Administration-Savannah River Field Office (NNSA-SRFO) Assessment Report, 2014 AAP – Quarterly Safety System Oversight (SSO) Assessment/Nuclear and Process Safety*
2014-SA-001319, 12/8/2015, *CY14 Management Assessment Schedule: FA-09 – Change Control – Element 5.3 (FAPM)*
2014-SA-002627, 4/1/2014, *National Nuclear Security Administration-Savannah River Field Office (NNSA-SRFO) Assessment Report, 2014 AAP – Quarterly SSO Assessment- Safety System Assessment of the 233-H Glovebox Oxygen Monitors*
2014-SA-005877, *National Nuclear Security Administration-Savannah River Field Office Assessment Report – FY 2015 AAP- Engineering Program*
2014-SA-005896, *Savannah River Field Office FY 2015 AAP - Nuclear and Process Safety (1Q15)*
2014-SA-005901, 10/2/2015, *National Nuclear Security Administration-Savannah River Field Office Assessment Report, FY 2015 AAP-Nuclear and Process Safety*
2015-NCR-14-0041, *Failed QA inspection and accept the wrong model 3001 Insta-Trans analyzer*, November 4, 2015
2015-SA-000138, 12/8/2015, *FY15 Management Assessment Schedule: Configuration Management*
2015-SA-006686, *CY15 FAPM Schedule: Periodic Assessment of Limiting Conditions for Operations*, 1/7/2016
2015-SA-006712, *CY15 FAPM Schedule: 2015 FA-06 Tritium Facility Self-Assessment 2*, 1/5/2016
2015-SA-006690, *CY15 FAPM Schedule: 2015 FA-06 Facility Self-Assessment 3 Template*, December 22, 2015
2015-VAR-18-0009, *Canberra Industries*, March 9, 2016
2016-SUR-34-0009, *SRTE Independent Evaluation Board Final Report*, April 13 - 26, 2016
2016-SA-000214, 12/18/2015, *National Nuclear Security Administration-Savannah River Field Office Assessment Report, FY 2016 AAP - Nuclear and Process Safety – SSO (1Q15)*
2016-SA-004313, *2016 FA-06 SRTE 1st Quarter Self-Assessment*, July 18, 2016
2S 1.1, Revision 18, 4/27/2016, *Procedure Administration*
2S 1.3, Revision 7, 4/19/2016, *Procedure Compliance*
2S 2.1, Revision 10, 7/28/2016, *Communications*
2S 2.4, Revision 8, 7/23/2015, *Operating Logs*
2S 3.2, Revision 4, 6/11/2015, *Control of On-Shift Training*
2S 3.3, Revision 9, 2/11/2016, *Facility Drills*
2S 4.1, Revision 5, 10/22/2015, *Shift Turnover*
2S 4.2, Revision 3, 10/22/2015, *Shift Briefings*

2S 4.3, Revision 7, 6/23/2016, *Watchbill Administration and Watchstanding Proficiency*
2S 4.4, Revision 6, 7/23/2015, *Shift Routines and Operating Practices*
2S 5.3, Revision 3, 3/28/2014, *Control Area Activities*
2S 5.4, Revision 4, 3/28/2014, *Round Sheet Preparation and Use*
2S 5.5, Revision 10, 4/30/2014, *Control of Equipment and System Status*
2S 5.8, Revision 1, 12/18/2003, *Operational Aspects of Facility Chemistry and Technical Processes*
2S 5.10, Revision 2, 6/29/2011, *Operator Aid Postings*
2S 6.1, Revision 6, 8/11/2016, *Alternate Implementation and Interpretation Process*
4B 1, Revision 2, 7/31/2013, *Training and Qualification Program*
4B 2, Revision 5, 12/5/2013, *Qualification/Certification Program Requirements*
4B 3, Revision 2, 9/28/2012, *Analysis, Design and Development of Training*
4B 5, Revision 2, 7/31/2013, *Training Processes, Records and Documentation*
AB81225A•377·A·MB8, Revision A, 12/18/1989, Picoammeter TA-102, *Operation and Maintenance Manual*
AC11412A-000138, Revision A, 12/2003, *Canberra Type Test Report for TAM-100D Response Time*
AC11412A-000165, 2/4/2004, *Canberra Factory Acceptance Test Report for TEF TAM Monitors with Certificate of Calibration*
AC30738A-000006, TEF GBO2 H2 Monitor User Manual, Panametrics TMO2-TC, *Thermal Conductivity Transmitter*
AC30738A-000007, TEF GB02 Monitor Manual, Teledyne Electronics Technologies Analytical Instruments, *INSTA-TRANS Trace and Percent Oxygen Transmitter*
ADM TRIT-1118, Revision 4, 10/13/2009, *Setpoint Control*
ADM TRIT-1155, Revision 4, 8/3/2010, *Tritium Facilities Watchbill Administration and Watchstanding Proficiency Requirements (U)*
ADM TRIT-1167, Revision 11, 2/25/2016, *Installed Process Instrumentation (IPI) Program*
ADM TRIT-6317, Revision 8, 12/19/2015, *Controlled Step Identifiers in Procedures (U)*
ADM TRIT-6324, Revision 22, 4/6/2016, *Tritium Operational Guidelines and Instructions (U)*
ADM TRIT 6417, Revision 0, 8/8/2012, *Tritium Procedure Format Standardization (U)*
ANSI/ISA-84.00.01-2004, 09/02/2004, *Functional Safety: Safety Instrumented Systems for the Process Industry Sector – Part 1*
ARP-233-H-DCS-GBM-XX-O2FA, Revision 1, 8/10/2016, *XX-O2 Low Flow Rosemount*
ARP-233-H-DCS-GBM-XX-O2HH, Revision 1, 8/10/2016, *XX-O2 Hi Hi O2 Rosemount*
ARP-233-H-DCS-GBM-XX-O2UA, Revision 1, 8/10/2016, *XX-O2 Trouble Rosemount*
ARP-264-H-DCS-AM-RAH-XXXX, Revision 8, 2/22/2016, *Hi Activity*
ARP-264-H-DCS-AM-SM-XXXX, Revision 7, 2/22/2016, *AM-XXXX Seq Malf Alarm*
ARP-264-H-DCS-AM-UA-XXXX, Revision 7, 2/22/2016, *General Trouble*
ARP-264-H-DCS-CMT-AAHHXXXX, Revision 5, 4/29/2014,*GB O2 Hi-Hi*
ARP-264-H-DCS-CMT-FAL-XXXX, Revision 4, 1/28/2015, *GB O2 Low Flow*
ARP-264-H-DCS-CMT-UA-XXXX, Revision 4, 1/28/2015, *GB O2 Trouble*
ARP-264-H-DCS-WPS-MFLTXXXX, Revision 5, 4/29/2014, *Multiple Fault Failure*
ARP-264-H-DCS-WPS-TAH-PROC, Revision 3, 4/29/2014, *WPS Procssr High Temp*
ARP-233000-DCS-GBM-SS-O2BFS, Revision 2, 6/14/2016, *SS-O2B Low Flow*
ARP-233000-DCS-GBM-SS-O2BH, Revision 1, 6/14/2016, *SS-O2B High O2*
ARP-233000-DCS-GBM-SS-O2BHH, Revision 2, 6/14/2016, *SS-O2B Hi Hi O2*
ARP-233000-DCS-GBM-SS-O2BUA, Revision 2, 6/14/2016, *SS-O2B Trouble*
ARP-233000-DCS-GBM-XX-O2FS, Revision 3, 8/10/2016, *Low Flow*
ARP-233000-DCS-GBM-XX-O2H, Revision 2, 8/10/2016, *Hi O2*
ARP-233000-DCS-GBM-XX-O2HH1, Revision 3, 8/10/2016, *Hi O2*
ARP-233000-DCS-GBM-XX-O2HH2, Revision 3, 8/10/2016, *HiHi O2*
ARP-233000-DCS-GBM-XX-O2PWRL, Revision 3, 8/10/2016, *PwrLoss*
ARP-233000-DCS-GBM-XXX-O2HH, Revision 0, 4/23/12, *FTS or SAS O2 Alarm*

ARP-233000-H-DCS-AM-BLW-XFL, Revision 3, 1/19/2016, *Air Monitor Blower Failure*
ARP-233000-H-DCS-AM-CPU-PRIF, Revision 2, 1/19/2016, *Primary HP-PLC Failure*
ARP-233000-H-DCS-AM-CPU-SECF, Revision 2, 1/19/2016, *Secondary HP-PLC Failure*
ARP-233000-H-DCS-AM-KX-HA, Revision 6, 1/5/2016, *High Activity or More than one Valve Open: High Activity*
ARP-233000-H-DCS-AM-KX-IF, Revision 3, 1/5/2016, *Kanne Instrument Failure*
ARP-233000-H-DCS-AM-KX-LF, Revision 3, 1/5/2016, *Kanne Low Flow*
ARP-233000-H-DCS-AM-KX-SM, Revision 3, 1/5/2016, *Kanne Sequence Malfunction*
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Interviews

- Cognizant System Engineer for TEF tritium air monitors
- Cognizant System Engineer for TEF glovebox oxygen monitors
- Cognizant System Engineer for HANM tritium air monitors
- Cognizant System Engineer for HANM glovebox oxygen monitors
- SRTE Electrical and Fire Protection Engineering Manager
- Engineers (2)
- HANM Facility Manager
- SRTE Mechanical and Environmental Systems/Engineering Programs Manager
- Operators (2)
- Procedures Manager
- Project Design Authority Manager
- Safety Basis Project Manager
- Shift Operations Managers (2)

- Shift Supervisors (2)
- Shift Technical Engineer
- SRNS Sitewide Configuration Management Subject Matter Expert
- SRTE Chief Engineer
- SRTE Integrated Supply Chain Director
- SRTE Maintenance Manager
- SRTE Operations Manager
- SRTE Training Manager
- SRTE Training, Procedures and Emergency Preparedness Manager
- TEF Facility Manager
- SRTE Procurement Buyer
- SRTE Contractor Assurance System Managers (2)
- SRTE Supplier Quality Manager
- SRNS N-Area Receiving Area Manager
- SRTE Receiving/ Stores Manager
- SRTE Receipt Inspector
- SRTE Quality Inspectors (2)
- SRTE Issues Analysist/ Assessment Coordinator
- SRTE Independent Evaluation Board Manager
- Day Maintenance Manager
- Work Management Center Manager
- Maintenance Training Coordinator
- Maintenance Planner (2)
- Maintenance First Line Supervisors (4)
- SRFO Facility Representatives (2)
- SRFO Safety System Oversight Engineer
- SRFO Assistant Manager for Mission Assurance
- SRFO Training Coordinator

Observations

- Multiple Performances of SURV-233-59116, *Functional Surveillance of 233-H Non-Effluent Kannes (U)*.
- Performance of DS-6-OS-001, *Glovebox Oxygen and Hydrogen Monitor Rounds (U)* in TEF using the tablet computer.
- Performance of DS-6-OS-005, *Daily Surveillance Datasheet for 264/264-2H Tritium Air Monitoring Systems (U)* using the tablet computer.
- Performance of DS-6-OS-008, *TEF Tritium Air Monitoring Systems Monthly Functional Surveillance Data Sheet (U)*.
- Performance of LCO-016, *Auxiliary Operator Glovebox Oxygen Log (U)* in HANM using the tablet computer.
- Multiple Shift Turnover meetings
- HANM/KANNEs and TEF GBO_2 Monitoring Stations Walkdown
- TF/ HANM KANNE #K6 Monthly Functional Test
- SRTE TEF/O_2 Monitors Daily Check
- SNRS N-Area Receiving Warehouse
- Material Acquisition Center Walkdown
- Mini-MAC Walkdown

- Maintenance Morning Meeting (multiple)
- Performance of GBO_2 monthly functional test (2)
- Replacement of GBO_2 display
- Annual Calibration of Building 233-H Kanne K-35
- Replacement of Building 233-H Kanne solenoid valve
- Repair of a TAM in TEF
- Rebuild of a TAM booster pump in TEF (2)
- 6-Month PM on TEF Exhaust Fan-10
- 6-Month PM on TEF control room AHU-3001

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.

- SRNS has not demonstrated a basis for how the HANM and TEF GBO_2M and $ECEO_2M$ system High-High alarm setpoints satisfy the safety margin requirements of NFPA-69, Section 7.7.2.4, while continuing to meet the requirements of Section 7.7.2.5.
- SRNS has not demonstrated the continued validity of the required SIL-1 qualifications of the SS GBO_2M and $ECEO_2M$ systems as required by DOE Order 420.1c, DOE-STD-1195-2011 and ANSI/ISA-84.00.01-2004 Part 1, in light of recent increases in component failure rates and the use of outdated 1998 SRS sitewide failure rate data.
- There is no well-defined method for tracking open items and unverified assumptions to closure in issued calculations. (10 CFR 830 Subpart A)
- The SRTE site critical spare parts inventory management process is mostly an "expert-based" process with no procedures/desk instructions, contrary to DOE Order 414.1D, *Quality Assurance*, Attachment 2, 5.a.
- The TF configuration management implementation plan does not address most aspects of a configuration management program compliant with DOE-STD-1073-2003.
- The assessment program does not adequately assess configuration management program implementation as required by DOE-STD-1073-2003.
- Contrary to DOE Order 433.1B, the SRNS NMMP, and site procedures, PMs are not performed at the frequency prescribed in the established maintenance program.
- Contrary to SRNS Manual 1Y, Procedure 8.20, *Work Control Procedure*, Section 5.6, the lead work group managers do not always evaluate worker feedback and take appropriate action.
- Contrary to DOE Order 426.2, the training program for SRTE electrical, instrumentation, and mechanical maintenance mechanics does not include systems training and related industry and facility-specific experience.
- No effective analysis of the failure mechanisms was performed for the TEF TAM internal pumps and flow switches as required by E7 3.04 Sections 4.3 and 8.5. Likewise, the SHPs did not provide supporting analysis of flow switch and pump failure mechanisms, contrary to the requirements of E7 1.10, Section 4.4 and DOE Order 420.1C.
- The SHPs do not establish performance criteria against which system and component performance can be assessed as required in DOE Order 420.1C.
- Contrary to E7 3.04, Sections 3.0, 5.1, 8.5, and 8.8, the availability calculation is no longer used in system health reports, and the methodology used to calculate and assess the availability of TAMs and GBO_2Ms is ineffective.
- Self-assessment reports directly related to verification of safety basis controls contain some incomplete scope descriptions, and self-assessment results are superficial and lack sufficient rigor, contrary to DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, CRD, 2.b.(2).
- Some significant safety system performance issues were not appropriately categorized in accordance with the graded approach of SRNS Manual 1B, Procedure 4.23, *Corrective Action Program*.