Office of Enterprise Assessments
Assessment of the
Y-12 National Security Complex
Criticality Accident Alarm System

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Acronyms

ANS	American National Standard
ANSI	American National Standards Institute
CAAS	Criticality Accident Alarm System
CCB	Change Control Board
CFR	Code of Federal Regulations
CGD	Commercial Grade Dedication
CNS	Consolidated Nuclear Security, LLC
CRAD	Criteria and Review Approach Document
CSE	Cognizant System Engineer
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
ENS	Emergency Notification System
FY	Fiscal Year
IMPRB	Issues Management Prioritization and Risk Board
LCO	Limiting Condition for Operation
MAC	Minimum Accident of Concern
M&TE	Measuring and Testing Equipment
MOU	Memorandum of Understanding
mR	milli-Roentgen
NMC	Nuclear Measurements Corporation
NNSA	National Nuclear Security Administration
NPO	NNSA Production Office
OFI	Opportunity for Improvement
PISA	Potential Inadequacy of the Documented Safety Analysis
PM	Photomultiplier
QA	Quality Assurance
R	Roentgen
RAD	Radiation Absorbed Dose
RP	Report
S&TR	Safety and Technical Review
SD	Supplemental Directive
SO	Standing Order
SSC	Structures, Systems, and Components
SSO	Safety System Oversight
STA	Shift Technical Advisor
SWSAR	Y-12 Site Wide Safety Analysis Report
TE&AP	Technical Evaluation and Acceptance Plan
TSR	Technical Safety Requirement
UPS	Uninterruptable Power Supply
VSS	Vital Safety System
Y-12	Y-12 National Security Complex

Office of Enterprise Assessments
Assessment of the Y-12 National Security Complex
Criticality Accident Alarm System

EXECUTIVE SUMMARY

The U.S. Department of Energy Office of Nuclear Safety and Environmental Assessments, within the Office of Enterprise Assessments (EA), conducted an independent assessment of the Y-12 National Security Complex (Y-12) Criticality Accident Alarm System (CAAS) in Buildings 9204-2E, 9212, 9215, and 9720-5. Consolidated Nuclear Security, LLC (CNS) is the management and operating contractor for Y-12. This independent assessment was conducted February 29 through March 4, 2016, and March 21-31, 2016.

A CAAS was first installed at Y-12 in 1957 using expert-based processes for design and installation. The installation was accomplished long before standards were developed for a CAAS design and operational testing. Up to the early 1990s, Y-12 evaluated and tested the CAAS to ensure that the system remained viable and consistent with the latest standards and previous expert-based assumptions. The current population of CAAS detectors being used at Y-12 were purchased in the 1990s and were supplemented with additional detectors purchased in the mid-2000s. Y-12 currently has 51 CAAS detector systems in inventory; 36 are deployed in the field, and 15 are maintained in the CAAS calibration lab in various stages of readiness for field deployment.

The CAAS detectors purchased in the 1990s were well characterized through extensive reactor testing of all detectors to confirm criticality detection capability and to demonstrate the impact of intervening shielding by materials comparable to the construction of the Y-12 buildings. Y-12 utilized the information gained from reactor testing to demonstrate that the CAAS met the applicable American National Standards Institute/American National Standard 8.3, *Criticality Accident Alarm System*, design requirements. In addition, the information was useful in establishing the safety basis functional requirements for the CAAS. Establishing the design and functional requirements for the CAAS allowed the Y-12 contractor to bridge the gap between the older expert-based installation of the CAAS prior to the 1990s and the current standards-based approach for safety systems established through formal safety basis documentation.

Overall, the operability of CAAS is adequately being maintained and is verified through routine completion of surveillance testing requirements defined in the Technical Safety Requirements document. Y-12 has established effective surveillance procedures and processes to support surveillance testing.

However, EA identified two deficiencies that indicate that there is some amount of uncertainty in the CAAS detectors' ability to fully perform its functional requirements specified in the safety basis. The uncertainty was introduced when the CAAS detector design was not adequately controlled following the implementation of multiple CAAS modifications since initial testing. Also, the intervening shielding in some buildings is greater than the assumptions of the technical basis referenced in the safety basis that establishes the CAAS detector area of coverage. Specifically, the two deficiencies are the following:

- The coverage area chosen for the installed 9212 CAAS detectors is not in compliance with the assumptions of the referenced engineering evaluation in the DSA and the applicable Limiting Condition for Operation basis of the TSRs due to intervening shielding within Building 9212, and potentially the adjoining buildings.

- Some design requirements for certain CAAS detectors have not been fully verified, and component configuration control for all CAAS detectors has not been maintained to enable full verification of safety function performance.

EA identified other deficiencies with a lower level of significance. The most notable of these deficiencies was that CNS has not adequately responded to the contractor assurance system negative trend metric for the CAAS maintenance backlog. Since July 2015, the backlog of corrective maintenance for CAAS annunciation equipment has significantly exceeded the CNS target value for the number of overdue items, and the backlog is growing. Even though the CAAS annunciation is currently operable, the maintenance backlog affects the long term reliability of the annunciation equipment.

The National Nuclear Security Administration Production Office (NPO) is continuing to promote improvements in the CAAS and is working with CNS to finalize a strategy to replace the aging CAAS in some longer-lived facilities and upgrade CAAS components for use in other shorter-lived facilities. Although NPO did not identify all of the deficiencies noted in this assessment, NPO has been generally successful in monitoring CNS implementation of the elements of safety system management for the CAAS.

Office of Enterprise Assessments
Assessment of the Y-12 National Security Complex
Criticality Accident Alarm System

1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the Office of Enterprise Assessments (EA), conducted an independent assessment of the Y-12 National Security Complex (Y-12) Criticality Accident Alarm System (CAAS). The purpose of the EA assessment was to evaluate Consolidated Nuclear Security, LLC (CNS) implementation of the safety basis requirements pertaining to the CAAS. Four buildings were selected for evaluation the implementation of the safety basis requirements for the CAAS. The activities being conducted in the four buildings provided a good representation of the fissile material activities across Y-12 (e.g., solutions, metal, storage) and the complexity of intervening shielding between the detectors and the associated fissile material activities. The onsite portions of this EA assessment were conducted February 29 through March 4, 2016, and March 21-31, 2016.

2.0 SCOPE

This assessment evaluated the implementation of safety basis requirements for the CAAS in Buildings 9204-2E, 9212, 9215, and 9720-5. Specifically, at the request of the National Nuclear Security Administration (NNSA) Production Office (NPO), EA selected the safety significant CAAS for the assessment. EA's assessment consisted of evaluating the procedures and processes used to demonstrate the ongoing operability and reliability of the system, and specifically evaluating the implementation of those procedures and processes for CAAS within the buildings selected. The assessment focused on the implementation of the safety basis as it relates to the selected system, but did not evaluate the adequacy of the documented safety analysis (DSA). Key observations and results from this assessment are presented in Section 5.0, Results.

3.0 BACKGROUND

NPO is responsible for nuclear safety oversight at Y-12 and maintains a cadre of staff at Y-12 to provide oversight of safety system management implementation, which includes the CAAS. CNS manages and operates both Y-12 and the Pantex Plant. CNS member companies include Bechtel National, Inc., Lockheed Martin, Orbital ATK, and SOC, with Booz Allen Hamilton as a subcontractor.

Operations involving some fissile materials handled at Y-12 introduce a non-trivial risk of a criticality accident that could result in a release of radiation and significant exposure to facility personnel in the nearby area if not promptly evacuated. The purpose of a CAAS is to detect a criticality accident and immediately notify personnel to evacuate the affected area to prescribed muster stations that are away from the high radiation hazards. Once at the muster stations, the site's emergency management processes control the evacuation of personnel. It is important to note that the CAAS is not a control to prevent a criticality accident, it is a control to reduce the radiation exposure to personnel nearby a criticality accident by initiating an immediate evacuation.

Y/FSD-17, Y-12 Site Wide Safety Analysis Report (SWSAR), states that the CAAS consists of four basic component groups, including radiation detectors, relay control circuitry, power supply, and annunciation devices. The main two CAAS components are the radiation detectors and relay control circuitry; these components detect the criticality accident and provide a signal to initiate the annunciation devices to notify personnel to immediately evacuate. Together, these two components make what is normally referred to as a CAAS detector. Furthermore, a CAAS station is comprised of two CAAS detectors that are electronically connected to initiate the annunciation devices when both CAAS detectors radiation alarm setpoints are reached.

The SWSAR states that fissile material activities have been under CAAS detector coverage since 1957, and that CAAS detector placement was determined via an expert-based process that applied rule-of-thumb principles, along with familiarity of the Y-12 plant design (i.e., physical plant layout). The expert-based approach to CAAS detector installation was validated in 1958, when some of the CAAS detectors proved their functionality during the 1958 criticality accident at Y-12. The CAAS detected the criticality accident and provided the required alarm notification for prompt evacuation of personnel in the nearby area. A DOE publication prepared by the Los Alamos National Laboratory, LA-13638, *A Review of Criticality Accidents*, stated for the Y-12 1958 accident "that at least one person owes their life to the fact that prompt and orderly evacuation plans were followed." The CAAS is one of the main initiators for prompt evacuation.

In the early 1990s, Y-12 purchased new CAAS detectors and the components were tested at DOE research reactors that could produce radiation conditions representative of a criticality accident. The results of the reactor tests were used to fulfill the expectations of American National Standards Institute (ANSI)/American National Standard (ANS) 8.3, *Criticality Accident Alarm Systems*, initial testing requirements to ensure that fabrication met the criteria for system design specified in Section 5 of ANSI/ANS 8.3. All of the earlier CAAS detectors were replaced with the new and tested CAAS detectors. However, even though the CAAS detectors were replaced, the technical justification for the CAAS coverage area was not updated, and the earlier heuristic basis remained in effect. The CAAS detectors were simply swapped out and installed in the same locations vacated by the removal of the older CAAS detectors.

Between the early 1990s and the present, the development of DSA and technical safety requirement (TSR) documentation increased the expectations for the formality of a documented design basis and performance criteria to ensure that a safety system could meet its credited safety function (i.e., perform credited action(s) specified in the DSA). As a result, the 1958 basis for the CAAS coverage area was updated, and the current basis provided in the DSAs and TSRs is a combination of the assumptions from the older expert-based process, supplemented with an engineering calculation documented in Y/DD-598, *Y-12 Plant Criticality Accident Alarm System Radius of Coverage*. The coverage area of the CAAS detectors is reported as an area bounded by a circle (e.g., a crop circle) with a given radius based on assumed thicknesses of intervening shielding.

This safety system management assessment was being conducted because NPO requested that EA conduct the assessment to obtain additional insight on the implementation of the safety basis requirements for the CAAS.

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 implementation of the safety basis requirements for the CAAS. EA used the following sections of Criteria and Review Approach Document (CRAD) 31-15, *Safety System Management*, for the assessment:

- SS.1: *Engineering design and safety basis activities are conducted in a manner that demonstrates adequate protection of the public, the workers, and the environment from facility hazards.*
- SS.2: *Quality assurance practices are implemented in a manner that ensures safety systems will conform to required standards and perform as designed.*
- SS.3: *Configuration management programs and processes are adequate to ensure safety systems continue to meet safety basis requirements and changes are properly controlled.*
- SS.4: *Maintenance activities are properly planned, scheduled, and performed to ensure that safety systems can reliably perform intended safety functions when required.*
- SS.5: *Surveillance and testing activities are properly performed in accordance with TSR Surveillance Requirements and Specific Administrative Controls.*
- SS.8: *Federal Safety System Oversight Programs are established and effective in ensuring safety systems can reliably perform as intended.*

EA examined key documents, such as system descriptions, work packages, procedures, manuals, analyses, policies, training and qualification records, and numerous other documents. EA also conducted interviews of key personnel responsible for developing and executing the associated programs; observed TSR surveillance activities, which included a CAAS calibration, functional testing of the evacuation alarm, and daily system status check; and walked down significant portions of selected CAAS components in the 9204-2E, 9212, 9215, and 9720-5 Buildings, focusing on the CAAS detectors, relay modules, annunciation (i.e., horns) and intervening shielding between the fissile material activities, and detector stations.

EA's predecessor organization conducted a previous assessment of the environment, safety, and health programs at Y-12 in June 2008, and this assessment examined the completion and effectiveness of corrective actions from two of the findings described in the previous assessment that were applicable to this 2016 assessment. EA used applicable criteria adapted from EA CRAD 30-01, *Contractor Assurance System*, for the corrective action evaluation. Results of the corrective action assessments are included in Section 5.0, Results, of this report.

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 CAAS Design and Functional Requirements

This section discusses EA's assessment of the:

- Functional requirements and performance criteria for the CAAS that are contained in the approved safety analyses
- Engineering and scientific principles and standards used for the CAAS design
- Incorporation of the applicable requirements and design bases into the safety basis to ensure that accidental criticalities would be detected at Y-12 and that workers would be notified to immediately evacuate the area to reduce their exposure.

Criteria:

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 TSRs. (DOE-STD-3009-1994 CN 3 Chapter 4)

Key design documents, including design basis and supporting documents, are identified and consolidated to support facility safety basis development and implementation. (DOE Order 420.1C Chapter 5)

Engineered systems, structures, and components and processes are designed using sound engineering/scientific principles and appropriate standards. (10 CFR 830.122 Criterion 6)

The DSAs for each of the buildings evaluated specify the following design requirements from ANSI/ANS 8.3 as functional requirements to ensure that the CAAS provides its safety function:

- Detection of the minimum accident of concern (MAC) defined in ANSI/ANS 8.3 including short duration (i.e., 1 millisecond pulse) criticality accidents
- Continued operation in the maximum radiation field defined in ANSI/ANS 8.3 and the annunciation of the evacuation alarm within half a second
- Generation of a uniform alarm throughout the area with the option for supplemental visual signals in areas with high ambient noise
- Continued annunciation of the evacuation alarm until it is manually reset
- Continued operation in areas requiring occupation during a power outage or the utilization of portable instruments (no processes or areas require continued operation at Y-12 during an outage and can be left "as-is" based on the safety analyses)
- Consideration to the avoidance of false alarms.

EA's assessment of the functional requirements listed in the DSAs found the listing to contain all of the functional requirements necessary to ensure that the CAAS fulfills its assigned safety function of detecting a criticality accident and immediately notifying personnel for prompt evacuation. However, some of the functional requirements listed were ANSI/ANS 8.3 design requirements for the CAAS and should not be listed as functional requirements. An example would be the functional requirement to detect a MAC. Detecting a MAC would normally be established as a design requirement and would require specialized testing at a pulse reactor facility to certify the CAAS detector design. The reactor testing would not be conducted as a TSR surveillance requirement, but could be required on an as-needed basis to recertify the CAAS detector following modification if deemed appropriate. **(Deficiency)**

The SWSAR states that the CAAS design has been qualitatively determined to meet the requirements of ANSI/ANS 8.3. The SWSAR provides a description of the CAAS in Chapter 2, Facility Description, and a description of the CAAS instrumentation in Chapter 6, Prevention of Inadvertent Criticality. Both chapters reference appropriate requirements from ANSI/ANS 8.3. Chapter 6 references Y/DD-1233, *ANSI/ANS Series 8 Standards Matrix for Nuclear Criticality Safety*, to further explain how the requirements in the ANSI/ANS 8.3 standard are implemented at Y-12. With regard to the coverage area provided by the CAAS detectors, Y/DD-1233 identifies Y/DD-598 as the justification on the adequacy of the CAAS to detect a criticality accident in facilities except 9720-5. Building 9720-5 has a building-specific analysis.

The SWSAR states that all fissile material processing areas are provided overlapping coverage by a minimum of two CAAS stations, typically separated by at least 100 feet. The radius of detector coverage for each station is at least 400 feet for nominally shielded areas and 100 feet for more heavily shielded areas. Y-12 has used this 400-feet radius for detector coverage, for all but a few detector stations in areas with massive concrete shielding.

The TSR limiting condition for operation (LCO) for the buildings reviewed states that a CAAS capable of detecting a criticality accident within the coverage area specified on the applicable coverage area drawing shall be operable. In addition, the bases statement for the TSR LCO states that the technical basis for designating the detector coverage area is specified in Y/DD-598. EA's review of the coverage area drawings referenced in the TSRs for the buildings evaluated found that the coverage radius specified in the SWSAR (e.g., 400 feet) is annotated on the drawings correctly.

The Y/DD-598 report uses a gamma ray attenuation calculation, including buildup factors, to estimate the gamma radiation dose rate at various distances from a MAC with various thicknesses of intervening shielding. The Y/DD-598 report did not include gamma rays from neutron capture or radiation streaming pathways around the shielding. The report concludes with a set of graphs that allow the user to determine the radius of coverage for a CAAS detector, based on the thickness of intervening shielding from walls. The Y/DD-598 report states that the results are conservative estimates and may be used along with the physical plant layout to estimate the CAAS detector coverage for specific locations.

To determine whether the radius of coverage assigned to the CAAS detectors met the area of coverage supported by the Y/DD-598 report, the EA review team toured the buildings with a specific focus on the amount of intervening shielding present. The tour of the buildings indicated that the assumed detector coverage was appropriate based on the amount of intervening shielding witnessed, except for Building 9212 and potentially adjacent buildings that rely on the CAAS detectors within Building 9212; these buildings had more intervening shielding in the physical plant layout than assumed in the Y/DD-598 report for the 400-feet radius of detector coverage. In addition to the building tour of 9212, EA reviewed the facility layout drawings and interviewed Building 9212 staff, and both indicated that the intervening shielding was greater than what was assumed in Y/DD-598 by a factor of 1.5 to 4 depending on the type of criticality excursion. Since the intervening shielding thickness is greater than the assumptions of the safety basis (which are established by the referenced Y/DD-598 report) for the installed CAAS detectors in 9212, the assumptions of the safety basis are not being met. **(Deficiency)**

EA discussed with CNS and NPO the question regarding the intervening shielding exceeding the thickness assumed in Y/DD-598 for a 400-foot radius of CAAS detector coverage. CNS evaluated the question to determine whether a PISA existed on the shielding thickness being greater than that assumed by Y/DD-598 for the 400-foot radius of coverage, and documented its evaluation on the Y74-809, *Unreviewed Safety Questions Determination*, Appendix F, PISA Process and Disposition Form. CNS concluded that since no reliance is made on any single facet for CAAS detector coverage (e.g., overlapping coverage, setpoint, intervening shielding assumptions), no PISA exists based on the question.

EA reviewed the PISA form, and EA concluded that since Y/DD-598 is cited as the basis for CAAS detector coverage in the safety basis, the conflict between the Building 9212 physical plant configuration and the assumptions of the Y/DD-598 should be considered as an appropriate entry condition to declare a PISA. Therefore, the CNS evaluation of the question regarding too much intervening shielding for PISA applicability is incomplete, because not all safety basis documents were considered, as required by Y74-809. **(Deficiency)**

The SWSAR specifies that the CAAS annunciation zone is the area where an excessive dose can be realized and is referred to as an annunciation boundary. For many of the buildings at Y-12 with a CAAS, the dose used to define the boundary is 12 rad in free air, and unless a building-specific evaluation has been conducted, the area requiring CAAS annunciation has been determined equivalent to the affected facility, plus 200 feet beyond the facility. Following the 1958 accidental criticality, Y-12 prepared a documented justification that provides the basis for the annunciation boundary being 200 feet beyond the facility. EA's review of the justification found the basis to be extremely conservative and that it establishes an annunciation boundary that is larger than what would be required by the current ANSI/ANS 8.3 and ANSI/ANS 8.23, *Nuclear Criticality Accident Emergency Planning and Response*, standards.

Additional EA review of the Y/DD-598 report identified several instances where the analysis lacked the rigor of a formal engineering calculation that would normally be used to support the DSA and TSRs, as specified in formal engineering calculation, to verify that the design meets assigned function requirements per Y-12 program document Y17-002PPD, *Conduct of Engineering Program*. **(Deficiency)**

The following are examples of identified weaknesses in Y/DD-598:

- The Y/DD-598 report was issued as a study but is being cited as a technical basis document, despite not meeting the definition of a technical basis document in Y-12 Procedure, Y17-009, *Establishing and Maintaining the Technical Basis*. For example, the Y/DD-598 report was inappropriately cited in the Y-12 Technical Basis Index Summary as the technical basis for the map of the 400-feet nominal coverage areas for CAAS detectors, despite exceeding the assumed amount of intervening shielding in Building 9212. The Y/DD-598 report itself stated that its results "together with details of the physical plant layout may be used to estimate CAAS coverage for specific locations." Per the Y-12 procedure Y-17-69-307, *Design Analyses and Calculations*, assumptions, such as the amount of intervening shielding, are required to be verified before the results of an analysis or calculation can be used.
- The graph of allowable wall thickness versus distance from different types of criticality accidents (metal, solutions, etc.) misrepresented the conclusions of the analysis by assuming each wall to be the same thickness. All walls are not the same thickness throughout the buildings.
- The effect of the floors, roofing materials, and process equipment (e.g., a heavy walled furnace) along the line of sight between an accidental criticality and the detection stations providing coverage for Building 9212 is not factored into the Y/DD-598 report.
- The Y/DD-598 report assumed or calculated exposure rates for different criticality excursions without providing how they were determined or how they relate to the ANSI/ANS 8.3 MAC. The calculation in Y/DD-598 used simplistic approximations for predicting the interactions of gamma radiation with intervening shielding (e.g., concrete and air), without bounding the associated inaccuracy of the technique or discussing why the technique is conservative.
- A large collection of experimental reports and point papers have been prepared over the past 60 years discussing the capability of the CAAS relative to its function requirements; however, most of these reports have not been considered as part of the basis for Y/DD-598 conclusions and assumptions.

- Experimental results from past reactor tests demonstrated that detector performance is not as optimistic as asserted in the Y/DD-598 for a radius of coverage greater than 400 feet.

CAAS Design and Safety Basis Summary

EA's review of the safety basis documents for the buildings evaluated found that the functional requirements are adequate to ensure that the CAAS provides its safety function. The Y/DD-598 report referenced in the DSA and TSRs is part of the basis for the CAAS detector radius of coverage, and all CAAS detectors except those in Building 9212 met the basis provided by Y/DD-598. Due to the complexity of the physical layout of Building 9212, the intervening shielding assumptions for selecting a 400-foot radius of detections were not met because there is more intervening shielding then assumed in Y/DD-598. EA found the PISA evaluation by CNS on the question of additional shielding in Building 9212 to be incomplete. The CNS PISA evaluation did not consider all impacts to the safety basis, specifically the non-compliance with the referenced basis for CAAS detector coverage provided by Y/DD-598.

5.2 CAAS Configuration Management

This section discusses EA's assessment of the management of changes to CAAS requirements, documentation, and installed component configuration.

Criteria:

System design basis documentation and supporting documents are kept current using formal change control and work control processes. (DOE Order 420.1C Chapter V)

Changes to system requirements, documents, and installed components are formally designed, reviewed, approved, implemented, tested, and documented.

As discussed in Section 5.1 of this report, the DSAs specify the functional requirements for the CAAS. Chapter 5 of the facility-specific DSAs states, "...features of the CAAS required to meet the functional requirements are based on the designed and installed configuration and are appropriately controlled by the Configuration Management Program." The SWSAR also cites Y/SMS-80, *System Design Description for the Y-12 Criticality Accident Alarm System Excluding 9720-82*, which states, "…a maintenance history data sheet is prepared for each detector." Accordingly, the DSAs flow down the requirements for the CAAS to provide its safety function, citing the configuration management program as the means to continue to meet these requirements and capturing the expectation for CAAS detector maintenance histories in the system design description to maintain configuration management.

EA interviewed the CAAS design authority representative (who also serves as the design engineer) and the CAAS system engineer, and found that they were knowledgeable of the Y-12 configuration program described in Y15-004PD, *Configuration Management Program*. Furthermore, the personnel understood their roles and responsibilities for CAAS configuration management. For example, the CAAS design authority representative and the system engineer recognized the need for consistency between the SWSAR, facility-specific DSAs, surveillance procedures, system description document, and system drawings.

The CAAS design authority representative confirmed that configuration management for the layout of the installed CAAS, including the portions of the Emergency Notification System (ENS) used to automatically assist in the annunciation of a CAAS alarm, was implemented in the 1990s. He also confirmed that periodic system assessments per DOE Order 420.1C, *Facility Safety*, were used to identify differences between the installed systems and CAAS and ENS drawings in each facility, rather than verifying the alignment of the as-built condition of all of the installed equipment in all of the buildings and the system drawings at the same time.

EA found after a review of Y-12 walkdown reports that the previous system engineers were not performing the walkdowns every three years as required by Y-12 Program Description Y17-017PD, *Vital Safety Systems System Engineer Program*. The walkdowns of three buildings are more than two years overdue, and a walkdown report has not been issued for Building 9215. The current CAAS system engineer, assigned early in 2015, recognized that walkdowns were not being performed as required. To verify that as-built conditions are properly documented, walkdowns were completed in half of the nuclear facilities in 2015, and the remainder are scheduled for 2016 (including a walkdown of Building 9215 scheduled for October 2016). The CAAS system manager also created a periodic maintenance item in the CNS work management system (SAP) to automatically prompt performance and tracking of the CAAS walkdowns.

The CAAS system engineer also stated that differences in the installed configuration and CAAS and ENS drawings were noted in fall 2014, but that formal change requests had not been submitted. Specifically, the differences included correcting a drawing of the conduits for the ENS speakers and developing a drawing for a portion of the ENS distribution system. None of the deficiencies appear to reduce the CAAS detection or annunciation capabilities, as annunciation capabilities are demonstrated annually during surveillances. Following discussions with EA, the CAAS system engineer submitted formal change requests for these differences.

Initial Qualification Testing

The basis for acceptable CAAS detection performance was confirmed through experimental reactor tests in the early 1990s. The Y-12 CAAS detectors were not purchased as a CAAS but as radiation detectors, that were then qualified by reactor testing to confirm that the radiation detectors could meet the design requirements specified for a CAAS in ANSI/ANS 8.3. A Y-12 memo, dated October 1, 1992, entitled, "*Release of Radiation Monitors*," contained a Sandia National Laboratories Data Packet that summarized the testing results of 43 new Nuclear Measurements Corporation (NMC) GA-6 detectors by serial number. A summary of the test results concludes, "…we believe that most of the radiation monitors passed the acceptance testing and can be approved for use in the Y-12 Plant criticality accident alarm system. More studies will need to be conducted before the remaining monitors can be approved." This statement is followed by, "For the following monitors: 122, 126, 128, 131, 133, 136, 140, and 151 the data are inconclusive at this time." A list of the remaining serial numbers [35 GA-6 detectors] indicates that they "are approved for use within the CAAS for the Y-12 Plant."

In 2004-2005, 15 NMC GA-6 detectors were purchased from NMC. A Configuration Control Equipment Data Sheet (DS-CAAS-10) used in a 2004 purchase of detector(s) indicates that the detector(s) were required to be tested by NMC up to 50 milli-Roentgen (mR)/hour (hr) and again by Y-12 using its procedure for calibrating detectors. The procurement records of the 15 detectors purchased in 2004-2005 did not specify or verify the design requirements that the detectors survive the maximum radiation expected and detect the minimum duration transient, as required by the DSA; in addition, the detectors were not required to conform to the previously tested design. **(Deficiency)**

During observation of the CAAS calibration evolution, EA examined 15 CAAS detectors present in the calibration lab. The 15 CAAS detectors consisted of 14 recently calibrated detectors awaiting return to the field and one detector undergoing calibration. Two of these CAAS detectors had serial numbers that corresponded to the units that were not initially accepted and that were found to be inconclusive for use as calibrated CAAS detectors: unit 128 (Serial # 91-2064-29-128 which was being calibrated) and unit 133

(Serial # 91-2064-29-133 which was calibrated and ready for field deployment). Three detectors in the calibration lab were the CAAS detector units from the 2004-2005 purchases that were not fully tested: Serial #s 04-2062-9-26, 04-2062-9-27, and 04-2062-9-28. CNS does not know whether other CAAS units that were not initially accepted in 1992 or that were not fully tested (2004-2005) are currently deployed in Y-12 buildings, if any. **(Deficiency)**

CAAS Detector Changes

Y/SMS-80 references *Gamma Alarm System, Model GA-6-4-2-3-3-1-1S-05, Instruction Manual*, Nuclear Measurements Corporation, October 18, 1991. This vendor manual includes drawings and specifications for the 1992 purchased CAAS detectors, which establish a configuration baseline. However, CNS could not identify the applicable vendor manual for the 15 2004-2005 purchased CAAS detectors.

The original vendor for the CAAS detectors, NMC, has made changes to the detectors over the decades of use at Y-12. At least one of the changes made to the electronics of the CAAS detector in 1982 was verified through reactor testing to negatively affect the operability of the CAAS detector under maximum radiation conditions. Surviving maximum radiation conditions is currently a design and functional requirement for the CAAS detectors. Specifically, Y/DD-424 describes a change discovered during qualification testing of GA-6 detectors, which were purchased to replace older GA-2 detectors starting in 1982. The document states, “The initial tests revealed that one-half of the detectors did not respond to narrow-width bursts.” Y/DD-424 attributes the failures to the use of a different operational amplifier in a portion of the detection circuit. “Replacement with the originally specified operational amplifier solved the problem.” The 1982 testing results demonstrate how changes to detectors designed and qualified for use by a vendor to measure general area radiation could have unintended and unwanted impacts on its ability to detect an accidental criticality due to the environments the equipment could be subjected to. Therefore, all changes require thorough evaluation and, in some cases, may require further testing before being made for equipment being used in a CAAS.

Y/SMS-80 states that a maintenance history data sheet will be maintained for each detector. Since the baseline acceptance testing in 1992, component changes have occurred and have not been annotated on history data sheets. Evidence indicating that component changes have occurred can be found in DAC-SE9000034-A001, Appendix A, *Interval Analysis for 2001-2006 Data*, which shows that component replacements have been made in the CAAS detectors. Also, the SWSAR, Section 6.6, states, “Over the life of the system many modifications have been made, including detector replacements, detector setpoint changes, annunciation system upgrades, and relay circuitry upgrades.” CNS does not have documentation specifying the current configuration history of each CAAS detector being used.

As noted in Section 5.3 of this assessment report, replacement parts are procured through the proper quality assurance (QA) processes. NMC recently changed suppliers of the photomultiplier (PM) tubes from Photonis to ET Enterprises. Acceptance criteria included the capability to detect a nuclear criticality accident and actuate an audible and/or visible alarm, but not the ability of the PM tubes to survive the maximum radiation expected and detect the minimum duration transient. To gain industry perspective, EA contacted a reputable company that sells certified CAASs. The company engineering representative described a recent experience of having to replace a vendor for the radiation detector. Prior to releasing CAAS detectors for use, the new radiation detector was placed in test units and retested in accordance with ANS 8.3, Section 6.2, to requalify the design following the modification that had the potential to affect the maximum expected radiation tolerance and sensitivity to minimum duration transients of the CAAS. EA contacted Photonis and confirmed that the company no longer manufactures PM tubes. In addition when asked, Photonis could not identify any vendor with a PM tube that would be an exact replacement part to theirs.

In summary, EA's review of the application of configuration management since the 1990s for the CAAS detectors found the following:

- Eight of the 1992 CAAS detectors that were not initially approved for use have no documentation of final acceptance, and some of the detectors have been identified in use at Y-12.
- Maintenance history data sheets that show specific CAAS detector component changes and associated specifications were not maintained; therefore, no configuration baseline has been established.
- Key characteristics for product acceptance of recently purchased PM tubes did not address the ability of the PM tubes to survive the maximum radiation expected and detect the minimum duration transient.

Some design requirements for certain CAAS detectors have not been fully verified and the component configuration baseline for all CAAS detectors has not been established or maintained. Therefore, the current unknown and untested configuration of the CAAS detectors results in uncertainty that the CAAS will perform as expected and fulfill its assigned functional requirements as stated in the safety basis. **(Deficiency)**

CAAS Configuration Management Summary

The CAAS design authority representative and CAAS system engineer adequately demonstrated their knowledge of CNS configuration management processes and, in particular, their roles and responsibilities associated with maintaining system requirements and performance criteria. Since configuration management was implemented in the 1990s, CAAS system walkdowns have been used to identify and correct differences between the installed layout and the system drawings. Although walkdowns have not been completed as required, the current CNS system engineer and system manager have taken action to improve management of these walkdowns and accomplish overdue walkdowns by the end of 2016. Most importantly, significant weaknesses in CAAS detector and replacement component acceptance testing documentation and/or lack of engineering evaluations have resulted in CNS's inability to demonstrate the capability of the Y-12 CAAS to fulfill all functional requirements stated in the safety basis.

5.3 Quality Assurance of Replacement Parts

This section discusses EA's assessment of QA practices and implementation, to ensure safety systems will conform to required standards and perform as designed. EA focused on the procurement and verification of replacement CAAS detector components acquired since the 1992 purchase and testing of the complete CAAS detector replacement inventory.

Criterion:

Requirements are established for procurement and verification of items and services. (10 CFR 830.122 Criterion 7)

The 1992 purchase from NMC and subsequent reactor testing of the complete CAAS detector replacement inventory provided a firm foundation for demonstrating the performance capability of the new CAAS detectors. Y-12 subjected the equipment to radiation fields comparable to a criticality accident through experimental reactor testing to confirm that the equipment could function as a CAAS and meet the design requirements of ANSI/ANS 8.3. The reactor testing established the basis of the CAAS detector design from which all future changes could be evaluated.

CAAS detector spare part procurement records are scarce. Only one historical record was found relating to the purchase acceptance of PM tubes: DS-CAAS-10, *Configuration Control Equipment Data Sheet*, for a 2004 purchase of detectors (quantity not specified). This document specifies the component specifications and the acceptance methodology and criteria indicative of a commercial grade dedication (CGD) process; NMC was reportedly never designated as a 'qualified supplier' through the Y-12 QA program. The document specified the purchase of a "Detector Tube: XP2202B" from NMC, but which CAAS detector(s) received this part replacement is not known.

In accordance with the CNS engineering CAAS replacement/upgrade strategy (see Section 5.4 of this report), replacement components are being purchased. The only components purchased and received at this time are the PM tubes with associated matching socket, scintillator/crystal, and optical coupling fluid. These purchases were made in accordance with the current CNS procurement and verification processes. These CNS purchasing and receiving processes are considered satisfactory based on the requirements of 10 CFR 830.122 (Criterion 7), DOE Order 414.1D, and Nuclear Quality Assurance (NQA)-1:2008.

Y/SMS-80 identifies quality grading sheets for the CAAS system components for each building. Components that support the CAAS safety function are Grade 2 per the grading system in Y15-001, *Grading Criteria for Y-12 Facilities and Systems*; all other components are Grade 3 or 4. The procured components were identified as Grade 2, consistent with the quality grading sheets.

CNS did not qualify the vendor through its supplier qualification program. CNS purchased these parts as commercial grade items and relied upon the CGD process to establish the pedigree required for safety-significant structures, systems, and components (SSC). The requisite documentation was completed. The data sheet (specifies technical requirements for commercial items), Technical Evaluation and Acceptance Plan, or TE&AP (identifies the critical characteristics and associated acceptance criteria that must be met to accept the item), and equivalency evaluation (justifies the equivalency of a new component with the original) were developed by the assigned CGD engineer with required reviews and approvals. The CGD dedication process was followed in accordance with CNS procedures; however, implementation was less than adequate as explained below.

The Equivalency Evaluation Worksheet, dated December 15, 2015, justifies replacing the previously used "Photonis XP2202B" with "ET Enterprises 9266." EA noted that the AMPEREX XP2202B was originally specified in the vendor manual that accompanied the 1992 purchased CAAS detectors. EA contacted Photonis, and a Photonis engineer confirmed that AMPEREX was acquired by Photonis and that AMPEREX/ Photonis XP2202B was the exact same PM tube. The worksheet specifies purchase of ET Enterprises 9266 PM tubes to be supplied by the manufacturer (NMC). The worksheet also identified four attributes, three of which were indicated as not equivalent, but the document indicates that "The calibration of the CAAS detectors will compensate for the parameter difference." However, the calibration does not verify some key design requirements.

The data sheet (YAREA-ENS-0005 Rev1) and TE&AP (TEA YAREA-ENS-0005 Rev1) for the PM tubes specify the critical characteristics as "Radiation Detector Assembly – Calibration of high radiation alarm set point and High Radiation Alarm contact closure" and the acceptance criteria as "successful completion of Y52-45-ME-203 [*Preventive Maintenance and Surveillance of the NMC GA-6 Detector*]." This documentation addresses the PM tubes' capability to detect a gamma field and actuate an audible and/or visible alarm, but does not address the PM tubes' ability to survive the maximum radiation expected and detect the minimum duration transient, both required safety functions per the DSA. The 2004 PM tube procurement discussed above exhibited the same weakness. Y17-69-316, *Engineering Procurement Document Manual*, Section C.13 states, "Critical characteristics selected for acceptance shall consider, as applicable: …criteria addressing the most severe location criteria/design basis conditions…"

The selection of the critical characteristics for this commercial graded dedication did not address all of the most severe design basis conditions. Y-12's experience has shown that manufacturer recommended changes to the CAAS detectors electronics resulted in detector failures under certain conditions. In addition, industry practices demonstrate that when major components are changed, full testing is typically performed to requalify the design (see Section 5.2 of this report regarding CAAS detector changes). Not all key critical characteristics were identified for the CGD of CAAS replacement parts as required by Y17-69-316. **(Deficiency)**

Once the purchased materials were received, the CNS QA organization conducted the appropriate receiving inspection with appropriate tag placement, and completed requisite documentation. The shipment was transferred to the CAAS calibration lab, subsequently placed in the stores (in a Grade 2 segregation area), and controlled appropriately. As CAAS detector systems are routinely calibrated, replacement parts are removed from the stores and used in accordance with procedures. EA observations at the calibration lab and stores confirmed that CNS is following established procedures to effectively receive and control purchased items.

The current CAAS spare parts procurement and receiving is being accomplished by a team of professionals. The team includes the CAAS design engineer (who is also the design authority representative), a CGD engineer, the system engineer, a procurement planner, the QA receiving inspector, and the stores manager. The qualification cards and associated training records for each of these individuals involved in the recent replacement part procurements were examined. All individuals were found to have completed requisite QA training.

QA training requirements for the CAAS calibration crew, which serves a critical function in the acceptance testing of CGD items, are limited to General Employee Training Quality, a basic course for all employees. When interviewed, these individuals did not understand the collection of procurement documents contained in the work package (i.e., data sheet, TE&AP), nor their roles in product acceptance, segregation, and item control beyond following instructions.

CAAS Quality Assurance Summary

Employees involved in the procurement process, with the exception of the CAAS calibration crew, were well trained in QA.

The 1992 purchase and subsequent reactor testing of the complete CAAS detector replacement inventory provided a firm foundation for demonstrating the performance capability of the new CAAS detectors. The accompanying vendor manual with drawings and specifications provided a component baseline from which changes could be managed. A single procurement acceptance record from 2004 of a PM tube(s) indicates Y-12's use of the baseline configuration, as the PM tube identification number was the same and the item was procured from the original vendor. Recent purchases and receiving of PM tubes have mostly been in accordance with Y-12 procedures. However, critical characteristics for acceptance testing did not address the PM tubes' ability to survive the maximum radiation expected and detect the minimum duration transient, both required safety functions per the DSA. Y-12's experience has shown that manufacturer recommended changes have not always performed as expected. In addition, industry practices demonstrate that when major components are changed, full testing is performed to requalify the design. Omitting key critical characteristics is not in compliance with applicable Y-12 procedures and precludes Y-12's ability to demonstrate the CAAS's ability to satisfy all required safety basis functional requirements.

5.4 Maintenance Activities to Ensure CAAS Reliability

This section discusses EA's assessment of maintenance activities (planning, scheduling, and performance), ensuring that the CAAS can reliably perform its safety function.

Criteria:

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)

The system is periodically inspected in accordance with preventative maintenance requirements.

The reliability of the SSC is maintained through performance of vendor recommended preventative maintenance requirements.

Maintenance Management

Management requirements of CAAS corrective and preventive maintenance are established in the Y-12 Program Description, Y18-018PD, *Nuclear Maintenance Management Program*, to comply with the requirements of DOE Order 433.1B. CNS tracks the status of maintenance items with its work management system (SAP). CAAS detector preventive maintenance is performed adequately and is mostly comprised of surveillances required by the TSRs to verify CAAS operability. However, EA determined that CNS's management of CAAS corrective maintenance has not met the expectations and requirements of Y18-018PD to ensure system reliability based on the CAAS's classification as a safety significant system as discussed below. **(Deficiency)**

- Since July 2015, a CAAS system engineer has reported that the backlog of corrective maintenance for CAAS annunciation equipment has significantly exceeded the CNS target value for the number of overdue items, and this number is growing. The CNS target value for corrective maintenance backlog is two items. At the end of March 2016, 82 items were open, 65 of them were over 3 months old, 30 were over 6 months old, and the oldest was entered in January 2014. These items include requests to repair/replace non-functioning horns, speakers, lights, and corroded conduit used for CAAS annunciation.
- Contrary to the expectation documented in Y18-018PD that "[m]anagers at all levels assess the performance of maintenance activities and services to identify and correct problems," CNS personnel (i.e., the section manager for infrastructure maintenance, the CAAS and ENS manager, and the CAAS equipment owner) stated that they were aware of the maintenance backlog and were prioritizing maintenance, but that they did not have a formal plan to reverse the declining trend in the performance of corrective maintenance. The CAAS equipment owner entered the excessive maintenance backlog and rate of increase into the CNS issues management system (IMS # 31614667) based on discussions with EA.
- Contrary to the requirement in Y18-018PD for system engineers and reliability engineers to periodically "review the reliability of the equipment … to identify chronic reliability problems, including those that are the result of aging degradation," an analysis per Y-12 Procedure Y18-021, *Physical Asset Management Solution (PAMS)*, has not been performed for the CAAS (with portions of the CAAS being approximately 60 years old).
- In December 2015 and January and February 2016, the inventory of critical spare power supplies and hazardous location speakers was less than the minimum designated by the CAAS system engineer.

Periodic Inspections and Vendor Recommended Maintenance

CAAS detectors are inspected when calibrated every 13 months per technical procedure Y52-45-ME-203. The first section of the "Performance Activities" portion of the procedure is "Determining GA-6 Condition." The unit is inspected for physical damage prior to determining the "as-found" settings for the alarm relay and the detector response. The CAAS detector stations are also visually inspected during daily surveillances.

The detectors used in Y-12 legacy facilities have the optional battery backup feature from the vendor NMC. The battery backup is comprised of two individual 12 volt batteries connected in series. The batteries are checked during each performance of Y52-45-ME-203 and are replaced if either battery's voltage deviates too far from the average, or if the batteries have been installed for over two years. The vendor did not specify a replacement interval, so the current practice exceeds the vendor's recommendation for battery preventive maintenance.

However, the PM tubes in the CAAS detectors were not being replaced every five years as recommended in the vendor's "Preventive Maintenance" section of *Instruction Manual [for NMC Gamma Alarm System GA-6]*. Appendices of DAC-SE-900034-A001, *Technical Evaluation of the GA-6 Radiation Detector Calibration for the Criticality Accident Alarm System at the Y-12 Plant*, showed that PM tubes have been occasionally replaced (e.g., when they no longer functioned satisfactorily) rather than on a proactive, periodic basis. For example, in 2015, CNS experienced a failure of an in-service CAAS detector and the vendor determined that the PM tube had failed due to its age. Prior to this EA assessment, CNS identified that this vendor recommended preventive maintenance was not being performed and initiated corrective action. CNS is now replacing the CAAS detector PM tubes over the next year, typically while calibrating the detectors. Daily surveillances will continue to verify performance of PM tubes (including those beyond the vendor's recommended replacement age) by ensuring that the 1 mR/hr artificial background light source is measured and indicated by each CAAS detector.

During this assessment, EA observed a successful PM tube replacement. The electricians performing the replacement exhibited the proper questioning attitude when they encountered an unexpected condition. Specifically, the detector had wiring with different colored insulation than that specified in the work instructions provided by the vendor for replacing the PM tube. The electricians suspended their work and contacted their supervision and the design engineer. Subsequently, the system engineer directed that the PM tube replacement be performed using another PM tube (PM tube and the associated circuit board) from another CAAS detector. The system engineer did not direct the workers to document the source of the scavenged parts, which is contrary to the requirements in the safety analysis to manage the configuration of the CAAS and the requirement in Y/SMS-80 that a maintenance history data sheet will be maintained for each detector. The electrician performing this work elected to record this information as a good work practice. The remaining steps in the PM tube replacement were accomplished without difficulty. Calibration of the unit is discussed further in Section 5.5, TSR Surveillance and Testing. The replacement of the PM tube was satisfactory, as was the response to the unexpected wire insulation coloring.

Long-term Maintenance Strategy

Report, RP YAREA-CAAS-0004, *Engineering Position and Recommendations for the Y-12 Criticality Accident Alarm System (Excluding 9720-82)*, documents an adequate strategy to replace the CAAS for select buildings and to replace CAAS components for some of the other buildings to improve the reliability of the system and avoid the potential need for criticality testing of replacement parts for the current CAAS. Specifically, the CAAS in Buildings 9204-2E, 9215, 9998, and 9720-5 is targeted for replacement from 2017 to 2021 since an enduring need for a CAAS is projected for these buildings. An enduring need for a CAAS in Buildings 9212 and 9995 is less certain, so select components are planned to be replaced to maintain the CAAS in these buildings until their decommissioning that CNS tentatively projects for 2035. As CAAS equipment is replaced or no longer needed, these components would be available for use as spare parts. RP YAREA-CAAS-0004 also discusses the option to replace CAAS detectors in Buildings 9212 and 9995, and using the new processing cabinets supporting Buildings 9204-2E, 9215, and 9998 if needed. For the remainder of the buildings (i.e., Buildings 9204-2 and 9206), CNS plans to continue to perform normal maintenance of the CAAS, since these buildings will likely not need a CAAS after 2020 and 2023, respectively.

NPO supports this strategy as evidenced by its Safety Evaluation Report Addendum for the Y-12 National Security Complex Safety Analysis Report (Y/FSD-17, Rev. 9), dated August 11, 2015, which states, "[g]iven the current life extension plans for several older Y-12 facilities and many follow-on discussions between the NPO and contractor technical staffs, it is apparent that CNS must seriously address the replacement of the legacy CAAS system with a more modern system." The 2015 NPO Performance Fee Evaluation Report also credits the CNS engineering CAAS replacement/upgrade strategy.

In discussions with the CNS CAAS upgrade project manager, EA confirmed that tangible efforts are underway to achieve this strategy. Funding has been authorized for fiscal year (FY) 2016. A project schedule and FY 2016 Spend Plan have been developed, and other required project documents are being prepared that demonstrate progress in the development of a CAAS replacement.

CAAS Maintenance Summary

Management requirements of CAAS corrective and preventive maintenance are established in Y-12 Program Description, Y18-018PD, to comply with the requirements of DOE Order 433.1B. CAAS preventive maintenance and surveillances are adequately performed to verify operation of the detectors and annunciation systems as required by the safety analyses. However, since July 2015, CNS has not adequately responded to the excessive and growing corrective maintenance backlog. Allowing an excessive maintenance backlog to continue to grow for an extended period is not consistent with the requirements and expectations documented in Y18-018PD to ensure system reliability based on the CAAS's classification as a safety significant system.

CNS has initiated a project to replace the CAAS to improve system reliability and avoid the need for criticality testing for replacement parts for the CAAS. The CNS strategy replaces the legacy CAAS by 2021 for facilities with an enduring need for a CAAS. The CNS strategy maintains the existing CAAS until 2035 in non-enduring facilities until their decommissioning.

5.5 TSR Surveillance and Testing

This section discusses EA's assessment of surveillance and testing activities, to ensure they are properly performed in accordance with TSR surveillance requirements. The surveillance requirements verify that the system is operable, as defined by the LCOs of the CAAS. Some surveillance requirements also satisfy testing requirements specified by ANSI/ANS 8.3.

Criteria:

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 Subpart B Appendix A, G.6, Table 4, (5)) *Instrumentation and measurement and test equipment for the system are calibrated and maintained. (10 CFR 830.122 Criterion 8)*

Surveillance Requirements Overview

Each of the facilities examined during this EA assessment had its own TSRs, and for the CAAS, five surveillance requirements are implemented to demonstrate that the system is capable of accomplishing its function of detecting a criticality accident and initiating annunciation for prompt evacuation. The surveillance requirements ensure that the CAAS LCO is met, which also satisfy testing requirements specified in ANSI/ANS 8.3.

The five surveillance requirements include periodic calibration of the CAAS detectors in a dedicated calibration facility, as well as daily, weekly, quarterly, and annual surveillances of various portions of the CAAS. EA observed performance of all of the surveillance procedures. Performance was generally satisfactory, with the following positive observations:

- While performing the weekly surveillance of ENS power, the shift technical advisor (STA) used a calibrated proximity meter, verified the calibration was current, and recorded the information on the data sheet, demonstrating appropriate use of measurement and test equipment (M&TE).
- During performance of the quarterly functional test of the detectors, EA noted good "as low as reasonably achievable" practices in handling of the radioactive source.

However, EA noted procedure issues during the annual surveillance. The TSRs require an annual functional test of the detector relay matrix, alarm signal components, and actuation relays. This functional testing addresses the requirement for periodic testing of the entire alarm system, as described in Section 6.4, *Periodic Tests*, of ANSI/ANS 8.3. EA observed performance of this surveillance for five detector stations (each having two detectors, with a single relay matrix per station) in 9720-5. EA noted two issues with the procedure:

- The check-off form lacked a specific box to mark associated with the reset light being initiated and cleared for detector D1.
- The engineering drawing referenced for a portion of the annunciation area uses a different identifier for the area than the identifier the procedure uses.

EA also reviewed completed surveillance documentation for the daily CAAS detector surveillance and the weekly ENS power surveillance for several months for each of the four facilities. For the most part, the records were complete and satisfactory; however, CNS had previously identified that an incorrect version of the weekly surveillance in 9215 had been used for seven weeks. When this was discovered, the STA verified that use of the incorrect version did not compromise validity of the surveillance. The STA documented and retained this information with the surveillance records.

The weekly surveillance of ENS power is a "reference use" procedure, except in 9720-5. The daily surveillance for all facilities examined is also a "reference use" procedure. "Reference use" procedures allow the authorized performer to simply fill out the surveillance data sheet. However, in 9720-5, the weekly surveillance is a "continuous use" procedure, which requires the entire procedure to be in-hand and steps followed in sequential order. All other surveillances for CAAS were "continuous use" procedures. Y14-001, *Conduct of Operations Manual*, Chapter 16, *Technical Procedures*, requires sections or subsections of procedures that contain "hold points" or include independent verification shall be designated as "continuous use" procedures. Contrary to this requirement, Y52-07-9215-002, *Daily Surveillance of the Criticality Accident Alarm System (CAAS) for the 9215 Complex*, and Y52-07-9215-003, *Weekly Surveillance of the ENS Horns and Lights for the 9215 Complex*, both have a requirement for independent verification in a note in the performance section of the procedures, yet they are not designated “continuous use” procedures. Furthermore, having the requirement for independent verification contained in a note is contrary to the requirements for a note from DOE Order 422.1, *Conduct of Operations*, in Attachment 2, Appendix A, 2.p.(3)i. **(Deficiency)**

Detector Calibration

The TSRs require a calibration of the CAAS detectors to be performed every 13 months. The calibration is performed by an approved procedure Y52-45-ME-203 in a dedicated CAAS calibration facility. To fulfill the TSR 13-month calibration requirement, CAAS detectors in operating facilities are removed from the facility and immediately replaced with previously calibrated CAAS detectors from the calibration facility. Removed units are calibrated and remain as spares in the CAAS calibration facility until needed to replace the next CAAS detector in an operating facility that needs calibration. Field observations of selected deployed detectors found all to be within the required 13-month calibration time frame.

Observation of the calibration activities found the electricians demonstrated the appropriate formality of operations through verbatim compliance with the calibration procedure. When the electricians encountered errors with the numbering for various steps in Appendix A, the electricians recognized the discrepancy, suspended calibration activities, and contacted their manager and the procedure subject matter expert. After confirming that correcting the procedure steps numbering was a “non-intent” change, the supervisor noted the correct step references, then initialed and dated the changes in accordance with Y15-232, *Technical Procedure Process*. Also, the calibration procedure uses several pieces of M&TE consisting of a calibrated 50 mR/hr radiation source, a calibrated pulse generator, and a calibrated multimeter. The procedure has steps to record the calibration expiration date and the M&TE identification number. The electricians verified and recorded the M&TE calibration information as required. Furthermore, review of the calibration procedure and the performance of the calibration activities indicate the calibration process results in a calibrated CAAS detector that would fulfil the TSR surveillance requirement for a 13 month calibration.

CNS has evaluated the overall CAAS detector measurement errors associated with the detector calibration and documented the evaluation in DAC IYAREA-CAAS-0001, *CAAS Gamma Monitor Setpoint Uncertainty Calculation*. The results of the evaluation found the error to be much larger than stated in the safety basis. CNS appropriately declared a PISA on December 17, 2014, and issued Y12-CAAS-001, *Evaluation of Safety for the Potential Inadequacy in the Documented Safety Analysis Associated with CAAS Detector Calibration Uncertainty for Nuclear Facilities*, on January 26, 2015. To resolve the PISA and determine if the CAAS detectors would experience a radiation field from an accidental criticality sufficient enough to initiate an alarm given the greater instrument error, CNS performed an engineering calculation and documented it in RP YAREA-CAAS-0003, *CAAS Detector Alarm Trip Point to Support the Current Radius of Coverage*. The engineering calculation built on the base analysis provided by Y/DD-598 (See Section 5.1, above.), and added secondary photon production from neutron activation in the intervening materials. The neutron activation results in additional secondary gamma radiation and provides an increased radiation field at the CAAS detectors. The radiation field calculated from the addition of neutron activation is slightly above the alarm setpoint (0.6 mR/hr) including the calibration error.

An assessment by an independent group within CNS (RP 000Y12-CAAS-0001, *Y-12 Site-Wide Criticality Accident Alarm System Calibration,* January 6, 2016) previously identified findings and weaknesses associated with the calibration procedure and process associated with the CAAS detectors. CNS has not formally responded to the report or taken the necessary compensatory actions in the past five months. **(Deficiency)** However, the calibration procedure is being rewritten to reduce or eliminate the sources of the identified calibration error.

TSR Surveillance and Testing Summary

Existing surveillance and testing procedures adequately demonstrate compliance with TSR surveillance requirements and testing requirements of ANS/ANSI 8.3. CNS is revising the detector calibration procedure to reduce uncertainty and correct errors with the procedure.

5.6 CNS Issues Management Processes

This section discusses EA's assessment of CNS corrective actions to drive performance improvement. EA focused on three categories of past issues: CNS CAAS issues over the past three years, two previous issues identified by the former DOE/EA organization (DOE/Health, Safety, and Security, HS-64) in 2008, and any recent CAAS-related issues identified by NPO. Corrective actions were examined with regard to documentation, evaluation, and implementation to permanently resolve identified issues adverse to quality.

Criteria:

The issues management system captures program and performance issues from many sources, and issues are appropriately categorized to ensure problems are evaluated, reported, and corrected (including compensatory actions when needed) on a timely basis (DOE O 226.1B CRD 2.b(3)).

For higher significance findings a documented casual factor analysis/evaluation, timely actions and plans to correct and prevent reoccurrence, tracking plans and actions to closure, and performing effectiveness reviews must be completed (DOE O 226.1B CRD 2.b(3)(b)).

Objective evidence shall demonstrate satisfactory implementation of corrective actions and performance improvement. (NQA-1, Requirement 16; DOE Order 414.1D; DOE Order 226.1B)

The Y-12 contractor issue management process (IMP) was effective in resolving the past issues evaluated during this review. CNS has implemented an issues management system through Y15-312, *Issues Management Process*. Review of Y15-312 found that it addressed the essential elements of a satisfactory IMP including: issue opening/closing/tracking, ownership assignment, significance level determination, issue screening, issue analysis, corrective actions, verification reviews, feedback and improvement, and trending. The process provides four Significance Levels (A-D with A being the highest significance).

Y-12 CAAS Issues - Past Three Years

The CAAS-related issues recorded in the IMP over the past three years include 28 Level B and Level C issues. Y-12 "rolled up" 14 issues into one Level B (open) issue. Combining 14 issues into one issue was inappropriate because such a practice skews performance measures and trend analyses, and conceals owner accountability. Of the four open Level B issues and eight open Level C issues, all are in various stages of completion in accordance with the IMP. It is noted that three Level B and three Level C issues have been given multiple due date extensions.

The following issues were reviewed and the corrective actions appropriately addressed the associated issue:

Issue Number 31377957, Level B, 9720-5 Implementation of Standing Order (SO). NPO identified this finding after a CNS Shift Manager delayed reading an important standing order. An extent of condition and causal analysis was completed and resulted in the issuance of Y14-02-011, *Conduct of Operation Supplement*, dated October 8, 2015. The issue was closed on June 24, 2015. EA reviewed Y14-02-011, which imposed a requirement for the issuing manager/timely order administrator to send an email and an "alpha page" to all managers responsible for implementing the SO. EA interviewed three shift managers and found that each were well aware of the expectations of Y14-02-011, were able to describe their responsibilities for timely response, and could provide evidence of past responses using the email voting mechanism provided by Outlook. The notification process is in place and being effectively implemented to ensure that shift managers read timely orders as soon as possible. This procedure was an example of demonstrated performance improvement.

Issue Number 31360967, Level B, ENS Uninterruptable Power Supply (UPS) Cooling Fan Motor Issue. The shift manager for 9204-2E was notified of an alarm condition of a safety significant UPS for the ENS. The alarm was caused by the failure of the cooling fan for the UPS. The failure of the cooling fan was determined to be a performance degradation of the safety significant UPS for the ENS; therefore, the failure required an issue to be placed into the IMP. Due to the safety significance designation of the UPS, an extent of condition and causal analysis was performed as required by the IMP. Review of the causal analysis found that the system engineer adequately evaluated the reliability of the cooling fan against the vendor recommended preventive maintenance expectations and no unique cause could be identified. The fan replacement was adequately accomplished under a corrective maintenance work order. EA observed the unit to be in full operation during this assessment. EA found that all appropriate corrective actions were taken and the issue was properly closed.

Issue Number 31433685, Level C, Impact to CAAS Detector Not Included. A Y-12 assessment of the nuclear criticality safety program included an evaluation of the Y-12 change control process implemented through Y15-187, *Integrated Safety and Change Control Process*. The assessment identified an observation which stated that Appendix C of Y15-187, *Change Review Checklist*, does include changes in shielding as a potential impact to the CAAS detector coverage. The observation was captured as an issue in the IMP. The CNS issue owner determined that Appendix C of Y15-187 is only a recommended checklist and is intended to be generic. No corrective actions were required, and the issue was closed. EA review of Y15-187, found that the Appendix C checklist had sufficient criteria to identify the appropriate configuration control participants if a change involving shielding occurred in a nuclear facility with a CAAS detector. The criteria listed in Appendix C directs the user of Y15-187 to determine the impact of the change on credited safety SSC's and associated trip point settings. EA found that all appropriate corrective actions were taken and the issue was properly closed.

Applicable 2008 Independent Oversight Issues

The 2008 Independent Oversight review was conducted by EA's predecessor organization. That report identified ten contractor findings. In response, the contractor identified 122 corrective actions. Closure effectiveness for issues E-3 and E-4 from that report was examined as part of this assessment based on the issues' applicability to safety system management.

Finding E-3 (IMS Issue 30174056) addressed weaknesses in the contractor's configuration management of the Webber Environmental Chambers safety system components. The contractor's corrective actions included re-evaluating all vital safety systems (VSSs) to "determine if there is a lack of clarity/accuracy in the identification/ description of the VSS in the safety analysis documents…" The CNS effectiveness review concluded that the review was thorough and it was only an isolated instance of a VSS component grading inconsistency, which was corrected. EA determined that this issue was effectively closed by CNS.

Finding E-4 (IMS Issue 30173518) addressed weaknesses in the contractor's QA documentation of measurement and test instrument use during surveillances of the safety systems. The CNS effectiveness review, sampled 26 surveillance procedures and confirmed M&TE use was being appropriately documented. EA observed two surveillances and the CAAS detector calibration evolution. CNS demonstrated effective performance in accordance with procedures and proper recording of M&TE information. In addition, the documentation of five past surveillances were reviewed. Each surveillance was found to have properly recorded the calibration data for the instruments used in the work performance. Accordingly, EA found this issue has been effectively resolved.

Recent NPO Oversight Issues

NPO provided a list of all NPO-identified issues for January 1, 2012, to present. Of 293 total issues, only one was associated with the CAAS. This issue identified a change made to the 9215 CAAS annunciation area without the requisite evaluation of the impact on the 9204-2 annunciation area and unclear interfaces of the CAAS annunciation equipment in the DSAs for both facilities. One of two corrective actions are complete. EA confirmed Y15-87 was modified to address interaction between nuclear facilities when changes may impact adjacent nuclear facilities. The remaining corrective actions involves revision to safety basis documents to correct a CAAS annunciation inconsistency in the 9204-2E DSA [Y/SAR-003] and TSR [Y/TSR- 003]. EA confirmed planned compensatory measures are adequately established until the safety basis changes are implemented. Corrective actions to revise the DSA/TSR are appropriately being tracked in the CNS IMP.

Previous Issue Follow-up Summary

For the most part, Y-12's issues management processes for issues related to the CAAS have been effectively implemented. Y-12 adequately analyzed the issues and developed appropriate corrective actions. Only one weakness was noted regarding the inappropriate rollup of 14 issues associated with the CAAS calibration facility into one issue, a practice that skews performance measures and trend analyses, and conceals owner accountability. Overall, Y-12 satisfactorily implemented the appropriate corrective actions that have led to performance improvement.

5.7 NPO CAAS Safety System Oversight

This section discusses EA's assessment of the NPO Federal safety system oversight (SSO) program's staffing of qualified personnel and the adequacy of the oversight being performed to ensure that the CAAS can reliably perform as intended.

Criterion:

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. (CRAD 31-15)

The previously qualified CAAS SSO engineer retired in late 2015. Two engineers have been officially designated to become qualified CAAS SSO staff, with one of the engineers providing backup duties. Each engineer has begun working towards completion of the Qualification Standard. The expected lead SSO just finished with the qualification, and the backup is just beginning the qualification process.

NPO-3.1.3.2 requires the contractor's CSE program to be assessed every five years and safety-significant SSCs also to be assessed every five years. Operational awareness activities complement the assessment program, which is consistent with NNSA Supplemental Directive (SD) 226.1. The last NPO assessment of the contractor's CSE program was conducted in 2010, *YSO Assessment of Site Engineering Program*, dated August 26, 2010. This major assessment did not identify any deficiencies. The assessment scope included a review of the safety system physical configuration. However, the reviewer performed only a document review with supporting interviews to assess safety system configuration. This is noted as a missed opportunity for NPO to critically examine the CAAS design basis and sample CAAS detector physical configurations. During this EA assessment, NPO was simultaneously conducting a self-assessment in preparation for a Chief of Defense Nuclear Safety review. The latest NPO review identified a finding that the required assessment of the contractor's CSE program is nearly two years overdue per the requirements of NNSA SD 226.1 and NPO-3.1.3.2.

The last NPO CAAS safety-significant SSC assessment was performed in July 2015 at the 9215 complex and January 2016 at the 9720-5 complex. The July 2015 assessment included a review to ensure the recommended manufacturer preventative maintenance for the *Nuclear Measurements Corporation Gamma Alarm System Model GA-6-4-2-3-3-1 -1 S*-05 was being correctly performed. The assessment did not identify that the recommended PM tube replacement frequency was not being performed. The report indicates that walkdowns of selected components and surveillance activities were performed and found "physical configuration of the system was consistent with the documented design and safety basis documents." The report noted that the CAAS walkdowns were "intermittently being performed and not meeting the frequency/documentation requirements of Y17-019." The January 2016 NPO assessment of Building 9215 found that field conditions were consistent with the documented design and safety basis documents, after examining two drawings and a field CAAS station. The report also indicates that system health reports were being prepared by the system engineer.

EA found issues with the inadequate CAAS PM tube replacement frequency, configuration management deficiencies, and the delinquent issuance of CAAS system engineer walkdown reports (required every three years and a walkdown report has not been issued for Building 9215 – see Section 5.2). The content of these NPO assessment reports indicates that the NPO CAAS oversight is not of sufficient depth to ensure adequate contractor compliance/performance with the safety basis.

The November 2, 2015 NPO Site Integrated Assessment Plan indicates that the next CAAS safety-significant SSC assessment is planned to be completed March 31, 2016. The planned assessment has been delayed until the summer (2016) to allow NPO time to make use of the results of this EA assessment to improve assessment planning. The next NPO assessment of the CNS CSE program is planned to be completed June 30, 2016. Due to the limited nature of the past two CSE program assessments completion of the review will be important.

Federal Safety System Oversight Summary

Overall, the NPO SSO program related to the CAAS is adequate. The NPO SSO program implements the requirements of NNSA SD 226.1. Since the qualified CAAS SSO program lead has recently retired, a new CAAS SSO program lead has been identified by the NPO Assistant Manager for Nuclear Safety and Engineering. Both the CAAS SSO lead and backup are working towards completing qualifications. NPO staff are performing operational awareness and required assessments with the exception that the required five-year assessment of the contractor's CSE program is overdue. The completed NPO CAAS-related assessments lack the needed level of detailed performance-based oversight. The NPO is adequately scheduling and planning CAAS and CNS CSE program reviews in the Site Integrated Assessment Plan.

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.

EA identified no Findings during this assessment.

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified no opportunities for improvement during this assessment.

Appendix A
Supplemental Information

Dates of Assessment

Onsite Assessment: March 21-31, 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
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
Patricia Williams
Michael A. Kilpatrick

EA Site Lead for Y-12 National Security Complex

Jimmy Dyke

EA Assessors

Jimmy Dyke – Lead
Joseph Probst
Michael Marelli
Greg Teese

Appendix B
Key Documents Reviewed, Interviews, and Observations

Documents Reviewed

- Y/SAR-003-Rev11, Safety Analysis Report for 9204-2E Facility, April 27, 2015
- Y/SAR-10-Rev10, Safety Analysis Report for 9720-5 Facility, July 15, 2015
- Y/MA-7886-Rev10, Safety Analysis Report for 9215 Complex, September 22, 2014
- Y/MA-003-Rev5, Safety Analysis Report for 9212 Complex, September 20, 2012
- Y/MA-7925, *Technical Safety Requirements for the 9212 Complex*, Revision 10, March 2015
- Y/MA-7925 DCN-02, *Removal of Building 9828-2 from the Technical Safety Requirements for the 9212 Complex,* January 29, 2014
- Y/MA-7887, *Technical Safety Requirements for the 9215 Complex*, Revision 10, September 22, 2014
- Y/TSR-003, *Technical Safety Requirements for the 9204-2E Facility*, Revision 11, April 27, 2015
- Y/TSR-10, *Technical Safety Requirements for the 9720-5*, Revision 10, April 2015
- JCO 972005-F-0003, *Justification for Continued Operation an Evaluation of Safety for Building 9720-5 PISA for CAAS Detector Uncertainty*, Revision 0, March 9 2015
- Y/SMS-80, *System Design Description for the Y-12 Criticality Accident Alarm System Excluding 9720-82*, Revision 3, March 2015
- Y12-CAAS-001, *Evaluation of Safety for the Potential Inadequacy in the Documented Safety Analysis Associated with CAAS Detector Calibration Uncertainty for Nuclear Facilities*, Revision 0, January 26, 2015
- Presentation: *Y-12 Criticality Accident Alarm System - Status and Future Plans*, August 2015
- Presentation: *Highly Enriched Uranium Processing at the Y-12 National Security Complex*, March 2012
- *Bases for Y-12 Policy Regarding Radiation Evacuation*, April 8, 1959
- *Criticality Safety Support Group Response to Tasking 2007-07 (OS-QSD-07-126)*, September 25, 2007
- *CSSG Tasking 2007-07*, July 2, 2007
- *Instruction Manual [for NMC Gamma Alarm System GA-6]*
- *NMC GD-6B 3 Cycle – 5 Cycle Conversion Kit [Instructions]*
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- E2E137609, *Emerg Notification Sys Speaker & Conduit Layout First Floor Plan*, Revision D, June 11, 2012
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- E2E137611, *Emerg Notification Sys Speaker and Cond Layout Second Fl Mezz Plan*, Revision C,

November 5, 2008

- E2E137612, *Speaker and Conduit Layout Third Floor Plan*, Revision H, May 31, 2005
- E2E137613, *Speaker and Conduit Layout Roof Plan Bldgs 9204-2E & 9949-AS*, Revision D, August 6, 2012
- E2E137614, *Riser Diagram RTU 5-2 Speakers, Warning Lights & Horns*, Revision G, August 6, 2012
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- E2E137616, *Emerg Notification Sys Spkr Warning Lgt & Horn Riser Diagram*, Revision C, September 9, 2003
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- E2E137618, *Emerg. Notification Sys. Evacuation Alm Test Pnl Test Procedure & Schem*, Revision C, November 1994
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- EE YAREA-CAAS-0001, *Equivalency Evaluation Worksheet CAAS/Criticality Accident Alarm System*, January 25, 2016
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- GWS-PSS-CAAS-92042, *Grading Worksheet for Building 9215 Criticality Accident Alarm System*, Revision A, May 16, 2003
- GWS-PSS-CAAS-9212, *Grading Worksheet for Building 9212 Criticality Accident Alarm System*, Revision B, August 17, 2006
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- GWS-PSS-CAAS-9995, *Grading Worksheet for Building 9995 Criticality Accident Alarm System*, Revision A, May 16, 2003
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- GWS-PSS-CAAS-92042E, *Grading Worksheet for Building 9204-2E Criticality Accident Alarm System*, Revision A, May 19, 2003
- GWS-PSS-CAAS-97205, *Grading Worksheet for Building 9720-5 Criticality Accident Alarm System (including ENS)*, Revision 2, May 24, 2012
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- RP-920402E-CAAS-0004, *CAAS Memorandum of Advisement No. 96-02 – CAAS Annunciation for areas north of 9204-2E, south of 9204-2E, north of 9204-2 and east of 9204-2*, February 26, 1996
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- Y/DD-1180, *Technical Basis for CAAS Annunciation Coverage within Occupied Areas at the Y-12 NSC*, Revision 1, April 2006
- Y/DD-1218, *Basis for Areas Requiring Criticality Accident Alarm System Audible/Visual Signal Coverage at the Y-12 National Security Complex*, April 2006
- Y/DD-1233, *ANSI/ANS Series 8 Standards Matrix for NCS*, Revision 3, January 2016
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- Y15-004PD, Configuration Management Program, October 23, 2014
- Y15-009, *Criteria for Application of the Y-12 Configuration Management*, November 11, 2014
- Y15-101, *Records and Controlled Documents*, Revision 09/16/2014, September 30, 2014
- Y15-187, *Integrated Safety and Change Control Process*, May 20, 2015
- Y15-232, *Technical Procedure Process*, Revision 4.1, February 29, 2016
- Y15-312, *Issues Management Process*, March 5, 2014
- Y17-002PPD, Conduct of Engineering Program, February 4, 2015
- Y17-009, Establishing and Maintaining the Technical Basis, November 11, 2014
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- Y52-07-50-004, *Daily Surveillance of the Criticality Accident Alarm System (CAAS) for Building 9720-5*, Revision 0.3, June 22, 2015
- Y52-07-9215-002, *Daily Surveillance of the Criticality Accident Alarm System (CAAS) for the 9215 Complex*, Revision 0.3, September 22, 2014
- Y52-07-9215-003, *Weekly Surveillance of the ENS Horns and Lights for the 9215 Complex*, Revision 0.3, August 19, 2015
- Y52-07-B2E-006, *Weekly Surveillance of the ENS Horns and Lights for the 9204-2E Facility*, Revision 0.4, December 23, 2014
- Y52-07-B2E-007, *Daily Surveillance of the Criticality Accident Alarm System (CAAS) for the 9204-2E Facility*, Revision 0.3, December 30, 2014
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- Y52-53-ESSO-035, *Annual Surveillance and Testing of the Criticality Accident Alarm System (CAAS) in Buildings 9212, 9215, 9995, and 9998*, Revision 0.1, April 29, 2015
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- Y60-015, *Integrated Quality Manual*, November 10, 2015
- Y70-150, *Nuclear Criticality Safety Program*, Revision 10/28/2015, November 12, 2015
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- Y-F-9212-GBEQ, *General Building Equipment*, October 28, 2015
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- REP-AB-9/26/2011-2808, *Shadow Assessment of Engineering System Requirements Documents*, September 26, 2011
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Interviews
- CAAS System Engineer
- CAAS System Engineer-in-training
- CAAS Design Engineer and Design Authority Representative
- CAAS System Owner
- CAAS Electricians (3)
- Building 9215 Facility Safety Representative
- Reliability Assurance Engineer

- Chief Nuclear Criticality Safety Engineer
- Chief Facility Safety Engineer
- CAAS Upgrade and Replacement Project Manager
- CNS ESO CAAS Lead Technical Advisor
- CNS CAAS Calibration Crew (3)
- CNS Chief Engineer
- CNS CAAS Design Engineer/Commercial Grade Dedication Engineer
- CNS Stores – Control Technician
- CNS Issues Management Lead
- CNS 9998 Shift Manager
- CNS 9212 Balance of Complex Shift Manager
- CNS 9215 Shift Manager (2 – one in training)
- CNS 9204-2E Shift Manager
- NPO Safety System Oversight Engineer Lead – CAAS
- NPO Safety System Oversight Engineer Backup – CAAS
- NPO Safety System Oversight Engineer Lead – Webber Environmental Chambers

Observations

- Performance of Y52-07-B2E-006, *Weekly Surveillance of the ENS Horns and Lights for the 9204-2E Facility*
- Performance of Y52-53-ESSO-040, *Quarterly Surveillance and Testing of the CAAS in Buildings 9212, 9215, 9995, and 9998*
- Performance of Y52-53-ESSO-036, *Annual Surveillance and Testing of the Criticality Accident Alarm System (CAAS) for Building 9720-5*
- Performance of Y52-45-ME-203, *Preventive Maintenance and Surveillance of the NMC GA-6 Detector*
- Replacement of a photomultiplier tube in a GA-6 detector
- Walk down of 9215 with CAAS System Engineer
- Walk down of 9204-2E with CAAS System Engineer
- Walk down of Building 9212 CAAS and fissile material activities
- Walk down of Building 9720-5 CAAS and fissile material activities

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.

- Some design requirements for certain CAAS detectors have not been fully verified, and component configuration control for all CAAS detectors has not been maintained to enable full verification of performance to meet the safety function. The implementation of configuration control is not consistent with the expectations of Design and Procurement Criteria of the Y-12 Quality Assurance Program.

- Due to intervening shielding within Building 9212, and potentially the adjoining buildings, the coverage area chosen for the installed 9212 CAAS detectors is not in compliance with the assumptions of the referenced engineering evaluation in the DSA and the applicable Limiting Condition for Operation bases of the TSRs.

- The DSA listing of functional requirements for the CAAS includes statements that have more applicability as design requirements and would not normally result in performance criteria that would be verified through a TSR surveillance requirement. This approach to defining functional requirements is contrary to the expectations of DOE-STD-3009.

- The evaluation for the PISA applicability for the question on excessive intervening shielding in Building 9212 for the chosen radius of coverage for the CAAS detectors did not consider all applicable information in the safety basis; therefore, the evaluation is incomplete. This approach is contrary to the expectations of Y74-809.

- The Y/DD-598 report, which provides the basis for the CAAS detector radius of coverage, lacked the rigor of a formal engineering calculation that would normally be used to support the DSA and TSR. This approach is contrary to the expectations of Y17-002PPD.

- CNS's management of CAAS corrective maintenance has not met the expectations and requirements of Y18-018PD to ensure system reliability. Specifically, there has been a growing corrective maintenance backlog since July 2015 and no periodic system reliability reviews have been conducted.

- Some procedures for the TSR surveillance requirements requiring independent verification are not designated as "Continuous Use," and this is contrary to the requirements of Y14-001, *Conduct of Operations Manual*, Chapter 16, *Technical Procedures*.

- A January 2016 internal independent assessment by CNS on the closure of corrective actions from a previous CAAS detector calibration assessment, identified findings and weaknesses in the calibration procedure and process; however, CNS has not taken any corrective actions in the past five months since the assessment to address the findings.