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| U.S. Department of Energy<br><br>Office of Safety and Emergency Management Evaluations<br><br>Criteria Review and Approach Document | Subject: Safety Systems Inspection Criteria, Approach, and Lines of Inquiry<br><br>Acting Director, Office of Safety and Emergency Management Evaluations<br><br>Date: 12/17/12<br><br>Criteria Lead, William Miller<br><br>Date: 12/17/12 | HS: HSS CRAD 45-11<br>Rev: 3<br>Eff. Date: December 17, 2012<br><br>Page 1 of 18 |

## 1.0 PURPOSE

Within the Office of Health, Safety and Security (HSS), the Office of Enforcement and Oversight, Office of Safety and Emergency Management Evaluations (HS-45) mission is to assess the effectiveness of those environment, safety, health and emergency management systems and practices used by line and contractor organizations in implementing Integrated Safety Management; and to provide clear, concise, and independent evaluations of performance in protecting our workers, the public, and the environment from the hazards associated with Department of Energy (DOE) activities and sites.

A key to success is the rigor and comprehensiveness of our process; and, as with any process, we continually strive to improve and provide additional value and insight to field operations. Integral to this is our commitment to enhance our program. We continue to make Criteria, Review and Approach Documents (CRAD) available for use by DOE line and contractor assessment personnel in developing effective DOE oversight, contractor self-assessment and corrective action processes; the current revision is available at http://www.hss.doe.gov/indepoversight/safety_emergencymgt/guidance.html.

This CRAD supersedes HSS CRAD 64-11, revision 2 and reflects updates to referenced DOE directives. This CRAD focuses on a broad range of functional areas related to safety system functionality and reliability.

## 2.0 APPLICABILITY

The following Inspection Criteria document is approved for use by the Office of Safety and Emergency Management Evaluations.

## 3.0 FEEDBACK

Comments and suggestions for improvements on these Inspection Criteria, Approach, and Lines of Inquiry can be directed to the Acting Director of the Office of Safety and Emergency Management Evaluations on (301) 903-5392.

# Safety Systems
# Inspection Criteria, Approach, and Lines of Inquiry

**Scope:** The review of Safety Systems will evaluate the effectiveness of programs and processes for engineering design and safety basis, construction and installation, configuration management, surveillance testing, maintenance, operations, cognizant system engineer (CSE) and safety system oversight (SSO), and feedback and improvement of selected safety systems. The review will also evaluate the effectiveness in maintaining the functionality and reliability of these safety systems. The review of Safety Systems will be performed in the context of integrated safety management (ISM), although the inspection criteria, approach, and lines of inquiry are organized by functional areas rather than ISM principles and core functions. The following functional areas are designed as stand-alone sections to be used in any combination based on the need of the specific appraisal.

## I. Engineering Design and Safety Basis

**Objective: 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.**

**Inspection Criteria:**

- Within the scope of the review, the safety authorization basis demonstrates the adequacy of controls provided by the system to eliminate, limit, or mitigate identified hazards, and defines the process for maintaining the controls current at all times and controlling their use.
- Technical, functional, and performance requirements for the system are specified in (or referenced in) the facility authorization basis documents. Safety/authorization basis documents identify and describe the system safety functions, and the functional and performance criteria are translated into design calculations and procedures.
- Items and processes are designed using sound engineering/scientific principles and appropriate standards.
- The adequacy of design products are verified or validated by individuals or groups other than those who performed the work. Verification and validation work is completed before approval and implementation of the design.
- All the key design documents, including design basis and supporting documents, are identified and consolidated to support facility safety basis development and implementation, as required in DOE O 420.1B.

**Inspection Activity:** Review the appropriate safety basis documents, system design description and supporting documents (e.g., system diagrams, pipe and instrumentation drawings, calculations).

**Inspection Lines of Inquiry:**

- Within the scope of the review, does the documented safety analysis (DSA) provide the basis for safety requirements and functions of the system, which is consistent with the logic and assumptions presented in the hazard and accident analyses?
- Does the documented safety analysis (DSA) identify the appropriate performance criteria necessary to provide reasonable assurance that selected system functional requirements will be met?
- Do authorization basis documents identify and describe the system safety functions?
- Does the definition/description of the safety functions of the system include:
  - Specific role of the system in detecting, preventing, or mitigating analyzed events?
  - The associated conditions and assumptions concerning system performance?
  - System requirements and performance criteria for the system and active components, including essential supporting systems for normal, abnormal, and accident conditions relied upon in the hazard or accident analysis?
- Are applicable regulations, DOE directives, and industry standards (such as applicable National Fire Protection Association and American National Standards Institute standards) incorporated into the program?
- Are the system design basis and supporting documents identified and consolidated in documentation consistent with DOE-STD-3024 on system design descriptions?
- Has the completed design been recorded in design output documents, such as drawings, specifications, test/inspection plans, maintenance requirements, and reports?
- When design basis information is not available, does the documentation include system requirements, basis for the system requirements, essential performance criteria, and a description of how the current system configuration satisfies the specified requirements and performance criteria?
- Do the bases for technical safety requirements (TSRs) for the system appropriately reflect assumptions of facility configuration and performance of safety functions, operational parameters, and key programmatic elements?
- Have technical and administrative design interfaces been identified and methods been established for their control?
- Is the safety classification of the system (or credited structures and components of the system) commensurate with the level of consequence and consistent with DOE guidance?
- Have the design bases and design assumptions identified in the safety analysis been appropriately translated into design calculations and procedures?
- Are acceptance criteria for tested parameters supported by calculations or other engineering documents to ensure that design bases assumptions are met?
- Verify, by walkdown or other means, that system installed configuration will support system function under accident/event conditions.
- Are operation and system alignments consistent with design basis assumptions?
- Verify that all energy sources (e.g., electric power, diesel fuel, compressed air, etc.) relied on for accident mitigation, including those used for control functions, will be available and adequate during accident/event conditions.
- Verify that potential/actual system degradation is monitored and/or prevented to ensure continued system functionality/operability.
- Verify that equipment is qualified for the environment expected under all conditions.
- Verify equipment is adequately protected from natural external events.

- Verify that safety margins have been maintained.
- Did the responsible DOE line management organization perform an effective review of the safety basis document with appropriately qualified personnel?

## II. Construction and Installation

**Objective: Construction and installation activities are conducted in a manner that ensures safety systems will conform to required standards and perform as designed.**

**Inspection Criteria**

- The nuclear facility structures, systems, and components (or modifications thereto) are constructed and installed in a manner that ensures adequate protection of the health and safety of the public, workers, and the environment from the effects of accidents involving radioactive materials release. Their construction and installation meets the requirements of, and considers the industry standards, set forth in DOE Order 420.1B, *Facility Safety.*
- Construction and installation activities that may affect the safety of DOE nuclear facilities are conducted in accordance with a DOE-approved quality assurance program meeting the quality assurance criteria specified in 10 Code of Federal Regulations (CFR) 830.122.
- Appropriate consensus standards, such as ASME NQA-1-2000, *Quality Assurance Requirements for Nuclear Facility Applications,* and other applicable quality or management system requirements are clearly identified, integrated, and implemented for nuclear-related work activities, as required by DOE Order 414.1D, *Quality Assurance.*

**Inspection Activity**

- Inspect safety structures systems and components to determine if they have been constructed in accordance with applicable drawings and specifications.
- Observe ongoing construction and installation work to determine if the qualifications of workers and the quality of work meet the requirements of applicable procedures, drawings, specifications, and industry standards.
- Observe quality control (QC) inspection activities and inspect construction work products previously accepted by QC inspectors to assess the effectiveness of the QC program.

**Inspection Lines of Inquiry**

- Have construction worker qualification requirements been established in accordance with applicable industry standards and have these requirements been met?
- Have safety structures, systems, and components been constructed and installed in accordance with applicable drawings and specifications?
- Do construction materials, such as concrete, metals, fasteners and wire, meet design specifications? Has a program been established and implemented for control of suspect/counterfeit materials in accordance with DOE O 414.1D?
- Has completed construction or installation work been inspected as required by applicable quality control procedures, and were these inspections effective in identifying construction deficiencies?

## III. Configuration Management

**Objective: Configuration management programs and processes are adequate to ensure safety systems continue to meet safety basis requirements and changes are properly controlled.**

**Inspection Criteria:**

- Configuration management process adequately integrates the elements of system requirements and performance criteria, system assessments, change control, work control, and documentation control, as required by DOE Order 420.1B.
- Configuration management is used to develop and maintain consistency among system requirements and performance criteria, documentation, and physical configuration for the systems, structures, and components (SSCs) within the scope of the program.
- System design basis documentation and supporting documents are kept current using formal change control and work control processes.
- Changes to system requirements, documents, and installed components are formally designed, reviewed, approved, implemented, tested, and documented.
- An unreviewed safety question (USQ) process has been established in accordance with 10 CFR 830 and is being appropriately implemented to control changes to safety systems including documents governing work on the systems.

**Inspection Activity:** Selectively walk-down system equipment and components and compare the actual physical installation of the system to documentation of the system design and safety basis; review safety component and services procurement programs (including the quality assurance program) and sample procurement packages.

**Inspection Lines of Inquiry:**

- Have as-built drawings and shop drawings been maintained after production to show actual configuration?
- Are materials and installation of system components consistent with the requirements and performance criteria for the system, including quality controls and quality assurance and as appropriate software quality assurance?
- Does the site quality assurance/control program govern the specification, purchase, inspection, acceptance testing, and maintenance of components, and does the program comply with DOE quality assurance requirements?
- Did the CSE prepare/approve a formal equivalency determination for commercial procurement of a safety component?
- Does the site quality assurance program include controls to prevent the introduction of suspect or counterfeit items into essential safety systems?
- Are system components properly labeled to assure proper configuration and operation?
- Do identified discrepancies (i.e., system changes) potentially impact (1) the operability or reliability of the system; or (2) the adequacy of the change control or document control processes applied to the system (e.g., presence of unauthorized changes or failure to properly document authorized changes)?

**Inspection Activity:** Review documentation related to selected design modifications, configuration changes, and interview individuals responsible for processing selected changes made to the system requirements, installed equipment, and associated documents.

**Inspection Lines of Inquiry:**

- Are documents affected by the changes appropriately identified?
- Are changes accurately described and reviewed and approved, as appropriate?
- Are systems, structures, and components affected by the changes identified by facility management, users, operators or others affected by the changes?
- Do facility procedures ensure that changes to the system requirements, documents, and installed components are adequately integrated and coordinated with those organizations affected by the change?
- Are changes to the system reviewed to ensure that system requirements and performance criteria are not affected in a manner that adversely impacts the ability of the system to perform its intended safety function?
- Are installation instructions and post-modification testing instructions and acceptance criteria appropriately specified?
- Are safety basis and design documents affected by the change revised and kept current using formal change control and work control processes?
- Are new design calculations, tests, or procedures required to support the change?
- Is there adequate evidence that the CSE has reviewed and concurred with design changes and the associated system modification work package?
- Are engineering (including the design authority and technical disciplines), operations, and maintenance organizations made aware of system changes that affect them and appropriately involved in the change process?
- Are other organizations affected by the change such as training, document control, hazard analysis/safety basis, fire protection, etc., integrated into the change process?

**Inspection Activity:** Review the USQ process procedure(s) and the results of USQ evaluations.

**Inspection Lines of Inquiry:**

- Has the contractor defined the USQ process in a procedure and has DOE line management approved the procedure?
- Does the process conform to the requirements of 10 CFR 830.203 and is it consistent with DOE guidance?
- Have design changes been appropriately evaluated using the USQ process?
- Has a USQ determination been made on identified potential inadequacies of the documented safety analysis?

## IV. Maintenance

**Objective: Maintenance activities are properly planned, scheduled, and performed to ensure that safety systems can reliably perform intended safety functions when required.**

**Inspection Criteria:**

- The safety system is included in the nuclear facility maintenance management program and the DOE approved Nuclear Maintenance Management Plan required by DOE Order 433.1B, and is maintained in a condition that ensures its integrity, operability, and reliability. 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.
- The system is periodically inspected in accordance with maintenance requirements.
- Maintenance activities associated with the system, including work control, post-maintenance testing, material procurement and handling, and control and calibration of test equipment, are formally controlled to ensure that changes are not inadvertently introduced, the system fulfills its requirements, and that system performance is not compromised.
- Requirements are established for procurement and verification of items and services.
- Processes are established and implemented that ensure that approved suppliers continue to provide acceptable items and services.

**Inspection Activity:** Review maintenance records, plans, and schedules for aging system equipment and components.

**Inspection Lines of Inquiry:**

- Does maintenance for the system satisfy system requirements and performance criteria in safety basis documents or other site maintenance requirements?
- Does maintenance address age-related system degradation that could affect system reliability or performance?
- Are conditions that require component replacement identified?
- Is component aging incorporated into preventive maintenance?
- Has the system been evaluated for potential inclusion of suspect/counterfeit parts?
- Is there a DOE approved Maintenance Implementation Plan that addresses periodic inspection of components to determine whether degradation threatens performance?
- Has the responsible DOE line management ensured that sufficient resources are budgeted in a timely manner to accomplish the maintenance program's objective of providing DOE with the highest confidence in the reliable performance of mission-critical, safety systems through proactive maintenance practices?
- Does the nuclear facility maintenance program include condition assessments, prioritization of maintenance projects, management of deferred maintenance, analyses to determine optimal period for maintenance actions, and reporting results of condition assessments to DOE, as required by DOE O 430.1B?
- Has the responsible DOE line management ensured that the requirements and standards for maintenance of nuclear facilities are incorporated into contracts and subcontracts, including support services contracts, as appropriate?

**Inspection Activity:** Review work packages related to the system.

**Inspection Lines of Inquiry:**

- Are maintenance source documents such as vendor manuals, industry standards, DOE orders, and other requirements used as technical bases for development of system maintenance work packages?
- Is the system inspected periodically according to maintenance requirements and are deficient conditions evaluated and or corrected?
- Are acceptance criteria defined and used for system modification, repair, maintenance and test activities?

**Inspection Activity:** Review system or component history files for selected system components for the past 3 years.

**Inspection Lines of Inquiry:**

- Are excessive component failure rates identified?
- Are failure rates used in establishing priorities and schedules for maintenance or system improvement proposals?
- Has preventive maintenance been performed as prescribed?
- Has the corrective maintenance backlog been effectively managed?
- Is there an accurate maintenance history that compiles maintenance, resource, and cost data in a system which is retrievable and capable of entering required-maintenance costs, actual maintenance costs, and availability data and failure rates for mission-critical and safety systems into the DOE Facility Information Management System?

**Inspection Activity:** Review the procedure and process for performing inspections of the system, including interviews with personnel performing the inspections.

**Inspection Lines of Inquiry:**

- Do personnel performing inspections understand operational features, safety requirements, and performance criteria for the system?
- Are inspections sufficiently detailed to verify emergent conditions requiring corrective maintenance?
- Are conditions adequately evaluated to ensure the system is capable of performing its safety related functions?
- Do routine or special inspections look for suspect/counterfeit parts and are maintenance personnel trained in identifying suspect/counterfeit parts?

**Inspection Activity:** Review procurement processes and records for system components and services.

**Inspection Lines of Inquiry:**

- Are procurement processes defined within the site/facility quality assurance program and include provisions for supplier qualification, receipt inspection, and document management?

- Are components and services procured for the system obtained in accordance with the site/facility quality assurance program?
- Are critical or important acceptance parameters and other requirements, such as inspection/test equipment or qualified inspection/test personnel, specified in design documentation?
- Are installation instructions and post-modification testing instructions and acceptance criteria appropriately specified?
- Are inspections and tests performed to verify that physical and functional aspects of items, services, and processes meet requirements and are fit for use and acceptance?

## V. Surveillance and Testing

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

**Inspection Criteria:**
- Surveillance and testing of the system demonstrates that the system is capable of accomplishing its safety functions and continues to meet applicable system requirements and performance criteria.
- Surveillance and test procedures confirm that key operating parameters for the overall system and its major components remain within safety basis and operating limits.
- The acceptance criteria from the surveillance tests used to confirm system operability are consistent with the safety basis.
- Instrumentation and measurement and test equipment for the system are calibrated and maintained.

**Inspection Activity:** Review surveillance and/or testing procedures and the supporting DSA TSRs and bases for the system and major components and a sample of the test results, including a walk-through of the surveillance test procedure with appropriate facility personnel (e.g., test technicians, engineers, operations personnel).

**Inspection Lines of Inquiry:**
- Does the procedure contain instructions to perform the test successfully and assure validity of test results?
- Are key parameters used to verify that system performance meets system requirements and performance criteria appropriate for the current mission?
- Can parameters that demonstrate compliance with the safety basis be measured or physically verified?
- Does the system design include provisions necessary for conducting the tests?
- Are personnel knowledgeable and able to satisfactorily perform the test?
- Does the procedure cite applicable safety requirements?
- Are limits, precautions, system and test prerequisite conditions, data required, and acceptance criteria included?
- Are appropriate data recording provisions included or referenced and used to record results?
- Does the procedure include provisions for listing discrepancies?

- Does the procedure require timely notification to facility management about any failure or discrepancy that could impact operability?
- Did appropriate personnel review the test results and take appropriate action?
- Is there a clear linkage between the test acceptance criteria and the safety documentation, and are the acceptance criteria capable of confirming that safety/operability requirements are satisfied?
- Was the test equipment used for the surveillance calibrated?

## VI. Operations

**Objective: Operations are conducted in a manner that ensures the safety systems are available to perform intended safety functions when required.**

**Inspection Criteria:**
- Procedures are technically accurate to achieve required system performance for normal, abnormal, remote shutdown, and emergency conditions.
- Operations personnel are trained on procedure use, proper system response, failure modes, and required actions involved in credible accident scenarios in which the system is required to function.
- Operations personnel are knowledgeable of system design and performance requirements in accordance with the facilities safety basis.
- Formal processes have been established to control safety system equipment and system status to ensure proper operational configuration control is maintained in accordance with DOE O 422.1, *Conduct of Operations*.

**Inspection Activity:** Selectively review the technical adequacy and accuracy of system alarm response procedures and operating procedures for normal, abnormal, and emergency system operations.

**Inspection Lines of Inquiry:**
- Is the system operated in accordance with the system design?

**Inspection Activity:** Review operator training for the system, focusing on the technical completeness and accuracy of the training manual and lessons plans.

**Inspection Lines of Inquiry:**
- Are personnel trained and qualified to ensure they are capable of performing their assigned work? Are personnel provided continuing training to ensure that job proficiency is maintained?
- Does training reflect system modifications?
- Have operations personnel been trained on these modifications?

**Inspection Activity:** On a sampling basis, walk-through the system operating procedures and the system piping and instrumentation drawings with the operator(s). Conduct walk-throughs to validate the proper configuration of valve, breaker, and other safety system components.

**Inspection Lines of Inquiry:**

- Can the procedures be performed as written?
- Are components and equipment accessible for normal and emergency conditions?
- If special equipment is required to perform procedures or operations, is the equipment available and in good working order?
- Is the knowledge level of the operator(s) adequate concerning equipment location and operation?
- Are system operations associated with the system(s) selected consistent with the control of equipment and systems status requirements of the site's Conduct of Operations program and DOE O 422.1?
- Are shift routines and operation practices associated with the system(s) selected consistent with requirements of the site's Conduct of Operations program and DOE O 422.1?
- Are the Operator Aid and component label programs for the system's selected compliant with the site's Conduct of Operations program and DOE O 422.1?
- Is the operational configuration of safety system components including supporting systems and equipment properly maintained?

**Inspection Activity:** Conduct interviews with operators.

**Inspection Lines of Inquiry:**

- Are operators knowledgeable of the system procedures, operation, the system's role in accident mitigation, safety limits, and determinations of operability?

**Inspection Activity:** Verify the local operation of system equipment.

**Inspection Lines of Inquiry:**

- Is the indication available to operate the equipment in accordance with applicable operating procedures and instructions?
- For accident conditions, are the environmental condition assumptions adequate for remote operation of the equipment?
- Are support systems and procedures adequate to support the system during event sequences when the system is designed to initiate?

## VII. Cognizant System Engineer and Safety System Oversight

**Objective: Cognizant System Engineer and Safety System Oversight Programs and methods are effective in ensuring safety systems can reliably perform as intended.**

**Inspection Criteria:**
The DOE contractor has established an effective system engineer program as defined in DOE Order 420.1B to ensure continued operational readiness of identified systems to meet their safety functional requirements and performance criteria.

**Inspection Activity:** Review contractor's system engineering program description and procedures. Review CSE training and qualifications requirements. Review training and requalification records of CSEs. Review CSE system notebook/logs, system health reports, system assessment reports, and observations/findings from oversight activities. Review system modification, maintenance, and procurement work packages. Review sample database records of system deficiencies, problems, engineering issues, and corrective actions. Interview CSEs, design engineers, and engineering management.

**Inspection Lines of Inquiry:**

- Are CSE qualification and training requirements adequately defined and implemented?
- Does CSE training include knowledge of facility and system safety basis, applicable codes and standards for design and maintenance, failure modes and effects analysis, root-cause analysis, performing periodic system walk-down and reviews, and preparing system health reports?
- Is an appropriately qualified and experienced CSE assigned to each system within the scope of the program?
- Are CSE functions, responsibilities and authorities clearly defined?
- Are CSEs familiar with system's engineering documents (e.g., drawings, calculations, system design descriptions), maintenance and procurements activities, surveillance tests, and with existing system condition and performance?
- Do CSEs provide technical support for operations and maintenance through the activities described in DOE O 420.1B, including review of design changes, ensuring effective configuration management, identifying trends in key system parameters from operations and surveillances, determining operability, performing analysis of problems, and initiating corrective actions?
- Is system configuration formally controlled and managed to develop and maintain consistency among system requirements and performance criteria, documentation, and physical configuration of the system?
- Do system assessments include periodic reviews of system operability, reliability, and material condition?
- Are detailed and comprehensive safety system assessments performed and periodically scheduled?
- Do system assessments include appropriately qualified experts in the necessary engineering and other disciplines?

**Inspection Criteria:**
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.

**Inspection Activity:** Review the DOE site office's SSO program description and SSO training and qualification requirements. Review the previous and present oversight assessment plans and schedules of planned surveillance and assessment activities. Review surveillance and assessment reports prepared by SSO personnel. Follow-up on sample SSO findings to ascertain how they are tracked and resolved. Interview SSO personnel and walkdown assigned systems, as necessary.

**Inspection Lines of Inquiry:**

- Has the SSO program established appropriate training, qualification, and performance requirements for SSO personnel?
- Are safety system oversight personnel appropriately trained and qualified to perform their assigned duties?
- Is an appropriately qualified and experienced SSO staff assigned to each safety system?
- Has the site office developed an adequate plan and schedule for periodic assessments of all the safety systems at different nuclear facilities within its purview?
- Are the functions, roles, and responsibilities of SSO personnel clearly defined?
- Do SSO personnel perform periodic assessments of system performance, equipment configuration, and material condition of assigned systems?
- Are SSO findings adequately tracked and resolved?
- Do SSO personnel assess contractor's CSE program to ensure operability, reliability, material condition, and performance of the assigned safety systems?

## VIII. Safety System Feedback and Improvement

**Objective: Safety System Feedback and Improvement processes are effective in addressing and preventing the recurrence of safety system issues.**

**Inspection Criteria:**

- The contractor assurance system includes engineering, configuration management, maintenance, surveillance and testing and operations assessment activities and engineering performance indicators/measures.
- The contractor's assurance system monitors and evaluates engineering, configuration management, maintenance, surveillance and testing and operations work performed for safety systems, and effectively utilizes performance indicators/measures in identifying performance trends and potential problems, allocating resources, and applying lessons learned and good practices.
- Requirements and formal processes have been established and implemented that ensure personnel responsible for managing and performing engineering, configuration management, maintenance, surveillance and testing and operations assurance activities possess appropriate training, experience, knowledge, skills, and abilities commensurate with their responsibilities.
- Formal processes are in place and effectively implemented to identify and analyze engineering, configuration management, maintenance, surveillance and testing and operations problems and issues; including operational events; to identify, track, monitor, and close corrective actions; to verify the effectiveness of corrective actions; to identify lessons learned from external and internal sources; to disseminate lessons learned to appropriate personnel; and to ensure that lessons learned are understood and applied.
- Formal programs and processes have been established and effectively implemented to solicit feedback from workers and work activities on the effectiveness of engineering, configuration

management, maintenance, surveillance and testing and operations, and to apply lessons learned.

- Results of engineering, configuration management, maintenance, surveillance and testing and operations assurance processes for safety systems are periodically analyzed, compiled and, as appropriate, reported or available to DOE line management as part of contract performance evaluation.
- DOE line management has established and implemented effective processes for monitoring and assessing contractor programs for ensuring effective design, configuration management, maintenance, and operation of safety systems.
- DOE line management and their contractors have included the review of safety systems in the evaluation and approval of the startup and restart of nuclear facilities and activities.

**Inspection Activity:**

- Review engineering, configuration management, maintenance, surveillance and testing and operations assessment program descriptions, procedures, instructions, guidance, and contractual requirements.
- Review assessment activity schedules for independent, management, and other self-assessments and external reviews/inspections of engineering, configuration management, maintenance, surveillance and testing and operations.
- Review self-assessments, independent assessments, causal analyses, corrective action plans, lesson-learned documents, Price-Anderson Amendment Act notifications and corrective action plans, close-out reviews as they relate to the requirements and functions of the system(s) selected for review and/or other safety systems if appropriate.
- Interview contractor and subcontractor engineering, configuration management, maintenance, surveillance and testing and operations managers and staff to determine how assessments are planned and performed and how they are used to improve performance.
- Interview engineers (design and system), maintenance supervisors and staff, and operations personnel to determine whether and how their feedback is solicited and acted upon to foster improvements.
- Review documentation related to engineering, configuration management, maintenance, surveillance and testing and operations deficiencies (e.g., critique minutes, causal analyses and corrective action plans, verification/validation records, and effectiveness determinations).
- Review corrective actions which were initiated by engineering, configuration management, maintenance, surveillance and testing and operations organizations as a result of normal daily activities and based on CSE reviews.
- Review trend analysis and performance indicator reports and evaluate the analyses, conclusions, and any related corrective actions.
- Review the assignment of significance level (priority) to deficiencies by facility management.
- Review a sample of corrective actions covering deficiencies identified in assessments, daily activities and CSE reviews.
- Review a sample of corrective actions taken in response to previous Independent Oversight appraisal activities.

- Review training and qualification records for personnel performing assessments of engineering, configuration management, maintenance, surveillance and testing and operations.
- Review implementation of facility startup review procedures for any recently facility startups. Interview personnel responsible for ensuring review of safety systems during facility startup analyses and reviews are conducted in accordance with DOE O 425.1D, *Verification of Readiness to Startup or Restart Nuclear Facilities.* Review field office procedures and selected assessment results.

**Inspection Lines of Inquiry:**

- Have rigorous assessments of engineering, configuration management, maintenance, surveillance and testing and operations processes and their implementation been performed and appropriate corrective actions implemented?
  - Has the site office performed an assessment of the (1) conduct of engineering, (2) configuration management, (3) surveillance and testing, and (4) operations?
  - Has the contractor performed independent assessments and management or self-assessment of the (1) conduct of engineering, (2) configuration management, (3) surveillance and testing, and (4) operations?
- Have these assessments identified deficiencies and opportunities for improvement? If so, have they been formally tracked and corrected?
- Was an effectiveness review performed of the corrective actions? Have any repeat problems been identified subsequent to completion of the corrective action?
- Has the contractor defined the requirements for experience, knowledge, skills, and abilities for personnel implementing contractor assurance system elements for engineering, configuration management, maintenance, surveillance and testing and operations?
- Has the contractor provided and ensured completion of training for personnel in engineering, configuration management, maintenance, surveillance and testing and operations organizations related to corrective action program(s)? Did the training address the critical aspects of a corrective action program, including:
  - Clearly stated management expectations
  - Initiation process
  - Low initiation threshold
  - Assignment of significance level to a deficiency
  - Requirements to evaluate the impact on operability, reportability, and extent of condition for all deficiencies
  - Requirements to perform a full root cause analysis for a significance deficiency
  - Feedback to the initiators
- Has the contractor management established a culture that encourages the identification of deficiencies and their formal resolution via a corrective actions system?
  - What were the means (other than training) by which was this done (e.g., clearly stated expectations in written and verbal communications, continues reinforcement, etc)?
- Has the contractor provided and ensured completion of training for personnel implementing contractor assurance system elements for engineering, configuration management, maintenance, surveillance and testing and operations?
- Have guidance and support tools such as checklists, templates, and databases for performing assessments been provided?

- Are events related to engineering, configuration management, maintenance, surveillance and testing and operations of safety systems investigated in accordance with formal programs and processes that identify issues, properly analyze, and report as required by directives?
  - Was the problem, deficiency, or weakness identified in the system properly dispositioned through the USQ process?
  - Were the root causes and corrective actions for the system properly identified and characterized?
- Are corrective action plans for various system deficiencies being properly tracked such that responsible individuals can ensure timely resolution of issues and completion of actions?
- Did the corrective actions include training on the changes made and was the training adequately completed prior to placing the system in operation?
- Are there recurring problems or deficiencies in the system? If so why haven't corrective actions been effective?
- For the engineering, configuration management, maintenance, surveillance and testing and operations of safety systems are line managers effectively utilizing performance measures to demonstrate performance improvement or deterioration relative to identified goals, in allocating resources and establishing performance goals, in development of timely compensatory measures and corrective actions for adverse trends, and in sharing good practices and lessons learned?
- Have subcontractors performing engineering work implemented appropriate and effective self-assessment programs and is the contractor's subcontractor oversight program effectively evaluating performance, providing feedback to subcontractors, and ensuring correction of process and performance deficiencies?
- Are assessment activities sufficiently performance based, including an appropriate focus on observation of engineering, maintenance, surveillance and testing and operations work, inspection of field conditions, and review of evidence of compliant and effective performance?
- Are there effective mechanisms for soliciting, reviewing, resolving, and addressing concerns, comments, and suggestions from engineering and other workers?
- Have the appropriate performance indicators and parameters been selected to effectively measure performance and identify adverse trends in a timely manner to ensure prompt mitigation and corrective actions?
- Is the performance indicator program periodically reviewed to ensure the most appropriate sets of data and data analysis parameters are being employed?
- Have adequate processes, procedures, and guidance been developed to ensure an effective performance indicator program?
- Have quality assurance assessments been performed? Did the assessments include evaluation of quality assurance of engineering products including calculations?
- Is performance data being sufficiently analyzed, with conclusions drawn and presented to management, and needed actions identified and taken?
- Are system engineers trending safety system performance?
- Are findings related to safety system functionality from previous Independent Oversight appraisal activities effectively corrected?
- Are detailed and comprehensive assessments of safety system operability being performed?
- Do the detailed and comprehensive assessments include appropriately qualified technical experts to assess the safety system operability?

- Do the detailed and comprehensive assessments include an evaluation of the system design as well as maintenance and operation?
- Has the site office established formal plans for safety system oversight? Is safety system oversight implemented in accordance with these procedures?
- Is site office oversight of the safety system activities effective in identifying and correcting deficient conditions?
- Do site office safety system oversight personnel and/or facility representatives ensure that operations are consistent with the safety basis document?
- Are findings related to safety system functionality from previous Independent Oversight assessments effectively corrected?
- For issues identified by the current inspection, what prevented contractor or DOE line oversight activities from identifying and correcting the problems?
- Is DOE O 425.1D invoked in contracts?
- Have DOE/National Nuclear Security Administration (NNSA) site and field offices developed written procedures that capture the requirements associated with safety systems for startup and restart of nuclear facilities?
- Is the startup planning process considered early during design/modification of safety systems?
- Do readiness review reports adequately describe the results of the review of selected systems and provide an appropriate basis for making startup decisions?