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Nuclear Reactor Operations Criteria and Review Approach Document		
Authorization and Approval	C. E. (Gene) Carpenter, Jr. Director Office of Nuclear Safety and Environmental Assessments EA-31 Date: April 8, 2019	Lead, Kevin M. Witt Nuclear Engineer EA-31 Date: April 8, 2019

1.0 PURPOSE

The mission of the U.S. Department of Energy (DOE) Office of Environment, Safety and Health Assessments (EA-30) is to assess the effectiveness of safety and emergency management systems and practices used by line and contractor organizations and to provide clear, concise, rigorous, and independent evaluation reports of performance in protecting workers, the public, and the environment from the hazards associated with DOE activities.

In addition to the general independent oversight requirements and responsibilities specified in DOE Order (O) 227.1A, *Independent Oversight Program*, this criteria and review approach document (CRAD), in part, fulfills the responsibility assigned to EA in DOE O 226.1B, *Implementation of Department of Energy Oversight Policy* to conduct independent appraisals of high consequence activities. This CRAD is based, in part, upon the U.S. Nuclear Regulatory Commission's inspection manual chapter 2545, *Research and Test Reactor Inspection Program*, and its applicable inspection procedures.

The CRADs are available to DOE line and contractor assessment personnel to aid them in developing effective DOE oversight, contractor self-assessment, and corrective action processes. The current revision of EA's CRADs are available at http://www.energy.gov/ea/criteria-and-review-approach-documents.

2.0 APPLICABILITY

The following CRAD is approved for use by the Office of Nuclear Safety and Environmental Assessments (EA-31).

3.0 FEEDBACK

Comments and suggestions for improvements on this CRAD can be directed to the Director, Office of Environment, Safety and Health Assessments.

4.0 CRITERIA AND REVIEW APPROACH

The scope of this CRAD is sufficiently broad to address many cross-cutting areas at nuclear reactor facilities operated by small staffs, and is not intended to provide a comprehensive assessment of the safety management programs (SMPs) associated with each area. If sufficient weaknesses are identified with a particular area, then a subsequent assessment using a more comprehensive CRAD would be warranted. EA-31 intends to use this CRAD to periodically assess nuclear reactor facility operations across the DOE complex for consistency of operations and lessons learned.

OBJECTIVES

RX.1: Organizational structure and management processes provide for safe operation of the reactor. (10 CFR 830.122(a), DOE O 414.1D, DOE O 422.1)

Criteria:

1. The DOE contractor has established, documented, and implemented the organizational roles, functional responsibilities, levels of authority and accountability, and interfaces for those managing, performing and assessing the operation of the reactor. (10 CFR 830.122 (a)(1), DOE O 414.1D, Attachment 2, 1.a., DOE O 422.1, Attachment 2, 2.a.(1))
2. The DOE contractor has established and implemented the adequate material and personnel resources for planning, scheduling, and performing reactor operations. (10 CFR 830.122 (a)(2), DOE O 414.1D, Attachment 2, 1.b., DOE O 422.1, Attachment 2, 2.a.(2))

    - Does the facility's organization meet technical safety requirements (TSRs) and other commitments?
    - Is the minimum shift staffing composition for operation, including on-call personnel, consistent with the TSR?
    - Do the records associated with recent startup operations demonstrate that the facility had satisfied the TSR requirements for staffing?
    - Do written policies state goals for operations, safety, and security, the means to achieve them, and the controls instituted for the Conduct of Operations Program?
    - Do policies and procedures implement DOE requirements for operations?

- Do policies and procedures implement DOE safety requirements?
- Do policies and procedures implement DOE security requirements?
- Are personnel and organizations assigned responsibilities for implementing policies?
- Do policies clearly define operations personnel authority, accountability, and relationships with other groups, including Stop-Work authority?
- Are sufficient qualified operators available to complete assigned tasks without excessive overtime?
- Are adequate technical personnel assigned to support operations?
- Are staff development, retention, and succession managed under a long-range staffing plan?
- Are adequate material, tooling, equipment, safety gear, and facilities available for safe operations?

RX.2: Technical safety requirements are developed that are derived from the documented safety analysis to ensure that the necessary operability and quality of safety structures, systems, and components is maintained; that reactor operations are within safety limits; and that limiting control settings and limiting conditions for operation are met. (10 CFR 830.205(a))

Criteria:

1. Technical safety requirements are developed to ensure the operability of the safety structures, systems, and components and define actions to be taken if a safety structure, system, or component is not operable. (10 CFR 830 Subpart B Appendix A, G.3)
2. Surveillance requirements for safety structures, systems, and components are performed to ensure necessary operability and quality is maintained to operate the reactor within the envelope of the documented safety analysis. (10 CFR 830 Subpart B Appendix A, G.6, Table 4, (5))
3. Instrumentation and measurement and test equipment for the system are calibrated and maintained. (10 CFR 830.122 Criterion 8)

- 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?
- Do surveillances meet the TSR surveillance requirements and are they acceptably conducted for the as-built condition of the facility?
- Are monitoring and test equipment as used appropriate for the task and calibrated where necessary?
- Does surveillance and testing of the system demonstrate that all required components within the system are capable of accomplishing their safety functions and continue to meet applicable system requirements and performance criteria?
- Do surveillance and test procedures confirm that key operating parameters for the overall system and its major components remain within safety basis and operating limits?
- Does the procedure contain instructions to perform the test successfully and assure validity of test results?
- 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 fully confirming that safety/operability requirements are satisfied?
- Do system line-ups ensure 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?
- Are limiting conditions for operation (LCOs) maintained in accordance with the facility's procedural requirements?
- Are operations personnel knowledgeable of the LCOs and do they understand their technical bases?

RX.3: Temporary or permanent changes in the reactor facility as described in the existing documented safety analysis are reviewed according to a DOE approved Unreviewed Safety Question (USQ) process. (10 CFR 830.203(d)(1))

Criteria:

1. Applicable requirements and design bases are incorporated in design work and design changes. (10 CFR 830.122 Criterion 6)
2. An unreviewed safety question (USQ) process has been established and is being appropriately implemented to control changes to safety systems. (10 CFR 830.203)

- Have design changes been appropriately evaluated using the USQ process?
- 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)?
- 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 performed as necessary to support the change?
- Is there adequate evidence that the cognizant system engineer (CSE) has reviewed and concurred with design changes and the associated system modification work packages?
- 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?

RX.4: Cognizant System Engineer Program implementation is effective in ensuring safety systems can reliably perform as intended. (DOE O 420.1C Chapter V)

Criteria:

1. The DOE contractor has established a documented CSE program to ensure continued operational readiness of systems within the program scope. (DOE O 420.1C Chapter V)
2. The CSE program must be applied to active safety class and safety significant systems as defined in the facility's DOE approved safety basis, as well as to other active systems that perform important defense-in-depth functions, as designated by facility line management. (DOE O 420.1C Chapter V, 3.b., (1))
3. Nuclear reactors must have a qualified CSE assigned to each system within the scope of the Program. (DOE O 420.1C Chapter V.3.a)

- 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, vendor manuals, and with existing system condition and performance?
- Do CSEs provide technical support for operations and maintenance through the activities described in DOE O 420.1C, 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?
- Do system assessments ensure that potential/actual system degradation is monitored and/or prevented to ensure continued system functionality/operability?
- Do system assessments verify that equipment is qualified for the environment expected under all conditions; that equipment is adequately protected from natural external events; and that safety margins have been maintained?
- Do system assessments include appropriately qualified experts in the necessary engineering and other disciplines?

- Do the detailed and comprehensive assessments include an evaluation of the system design as well as maintenance and operation?
- Are system engineers trending safety system performance?
- Has the completed design been recorded in design output documents, such as drawings, specifications, test/inspection plans, maintenance requirements, and reports?

RX.5: Experiments are reviewed prior to implementation to ensure they do not challenge the integrity of the safety basis. (10 CFR 830.203(h)(2))

Criteria:

1. The DOE contractor has established a program for introduction of new experiments into the reactor only after appropriate use of the USQ process. (10 CFR 830.203(d)(3))
   - Does the safety review process adequately review and approve experiments and any subsequent changes in accordance with 10 CFR 830.203, TSR requirements, and the facility's administrative procedures?
   - Are appropriate processes developed and implemented to ensure adequate and comprehensive analysis of hazards for research experiment proposals?
   - Do experiment approval processes address all significant potential hazards including: materials and physical properties, toxicity, chemical reactivity, pyrophoricity or flammability, induced prompt radiation, activation, heating, swelling, pressurization, cryogenics, mechanical stresses, electrical hazards, neutronics, etc.?
   - Are appropriate processes developed and implemented to ensure adequate analysis and comprehensive development of hazards control and mitigation sets for proposed research and experiments, including specific core and reflector configurations?
   - Are appropriate processes implemented to ensure review and approval of research experiment proposals including the hazards analysis and control sets?
   - Are hazards analyses and control set development results communicated to appropriate operations and support personnel (i.e., experimenters, assigned radiation protection technicians) as part of the experiment review and approval process?

RX.6: Operations are conducted in a manner that ensures the reactor is safe, and safety systems are available to perform intended safety functions when required. (DOE O 422.1)

Criteria:

1. The operator must establish and implement operations practices to ensure that shift operators are alert, informed of conditions, and operate equipment properly. (DOE O 422.1, *Conduct of Operations*, Attachment 2)
2. The operator must establish and implement operations practices for developing and maintaining accurate, understandable written technical procedures that ensure safe and effective facility and equipment operation. (DOE O 422.1, *Conduct of Operations*, Attachment 2)
3. The operator must establish and implement operations practices for initial equipment lineups and subsequent changes to ensure reactor facilities operate with known, proper configuration as designed. (DOE O 422.1, *Conduct of Operations*, Attachment 2)
4. Operator training must be sufficiently comprehensive to cover areas which are fundamental to the candidate's assigned tasks to ensure that personnel are capable of safety performing their job duties. The training program must include a core of subjects; such as instrumentation and control and major facility systems, as applicable to the facility and position. (DOE O 426.2, Attachment 1 Chapter II.6)

5. The training program must include on-the-job and classroom training to ensure personnel are familiar with all aspects of their positions; including but not limited to: normal and emergency procedures, administrative procedures, location and function of pertinent safety systems and equipment, and TSRs. (DOE O 426.2 Attachment 1 Chapter II.6)
6. Formal processes have been established to control safety system equipment and system status to ensure proper operational configuration control is maintained. (DOE O 422.1, *Conduct of Operations*, Attachment 2)

- Is the system operated in accordance with the system design?
- 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 the certification of operators meet the reactor specific requirements of DOE O 426.2 and the DOE approved training implementation matrix (TIM) or training program plan (TPP), e.g., reactor facility personnel education and experience requirements, written examination contents, simulator requirements (for Hazard Category 1 reactors), etc.?
- Are the following training activities performed, consistent with the DOE-approved TIM or TPP:
  1. Discuss and review changes in the facility, procedures, and DSA?
  2. Review and simulate abnormal conditions and implementation of emergency response procedures?
  3. Ensure that operators maintain an active duty status in accordance with DOE O 426.2?
  4. Conduct formal continuing training; e.g., lectures, and seminars?
- Does training reflect system modifications?
- Does the certification of fuel handlers (or fissile material handlers) meet the reactor specific requirements of DOE O 426.2 and the DOE approved TIM or TPP?
- Are criticality safety personnel involved with fuel movements appropriately trained and qualified?
- Can the procedures be performed as written?
- Does the procedure change process evaluate the need for training on the changes and is there an appropriate administrative program to manage the training (e.g., required reading) process?
- 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?
- Are shift routines and operation practices associated with the system(s) selected consistent with requirements of the site's Conduct of Operations program?
- Is the final, actual location of the fuel consistent with that specified in the records?
- Are fuel inventory records accurate and do they sufficiently document fuel conditions, loading, and burn up history?
- Are the Operator Aid and component label programs for the system compliant with the site Conduct of Operations program?
- Is the operational configuration of safety system components including supporting systems and equipment properly maintained?
- 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?

- Are operations personnel 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?
- Are operations personnel knowledgeable of system design and performance requirements in accordance with the facilities safety basis?
- Are operational logs and records maintained as required by the facility's administrative procedures?
- Are operational logs and records adequately reviewed and signed by appropriate shift supervisors and facility management?
- Are operations logs and records sufficiently detailed and legible to communicate pertinent issues or conditions to reviewers?
- Are the facility's administrative control procedures consistent with TSR, DSA, and other commitments?
- Are fuel handling operations deliberate based on pre-defined, reviewed, and approved analysis, established procedures, and/or task specific plans?
- Do fuel movement plans appropriately address inadvertent criticality, radiation exposure, security considerations, and emergency response guidance for issues or incidents during fuel handling?
- Are fuel handling activities reviewed under the criticality safety program or specific procedures for experimental reactor configurations?
- Are changes or trends in pool cooling water make up rates, conductivity, ion exchange resin loading, or isotope source terms monitored before, during, and after fuel movement activities?
- Are airborne activity and area dose rates monitored during fuel movement activities?
- Are facility management and radcon support availability and responsibilities specified for fuel movement activities?
- Are appropriate controls in place to prevent unauthorized or unevaluated access to or movement of fuel?

RX.7: Maintenance activities are properly planned, scheduled, and performed to ensure that safety systems can reliably perform intended safety functions when required. (DOE O 433.1B)

Criteria:

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

    - 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 nuclear maintenance management program 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 433.1B?
- 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?
- 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?
- Are vendor recommended preventive and predictive maintenance requirements for the safety system included in the maintenance program?
- Are preventive and predictive maintenance activities completed as scheduled?
- Are predictive maintenance results used to identify and schedule maintenance prior to safety system failure?
- 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?
- 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?
- Have worker qualification requirements been established in accordance with applicable industry standards and have these requirements been met?
- Are the level of authority and review required to conduct maintenance on the various systems and conditions specified by the facility's administrative procedures?
- Was maintenance performed consistent with the TSR and the facility's procedures that govern maintenance activities?
- Are maintenance activities planned, communicated, and coordinated to minimize impacts or risks to inter-related systems or operations within the facility or other personnel?
- Are CSEs included and engaged in planning, monitoring, and evaluation of maintenance activities involving or impacting their assigned systems?

- Are maintenance logs and records maintained as required by the facility's NMMP and administrative procedures?
- Have significant problems and events identified by review of the maintenance logs and records been trended, reported, and resolved in accordance with TSR requirements and the facility's administrative procedures?
- Are component obsolescence and degradation issues being appropriately managed?

RX.8: Reactor facility operations are conducted in compliance with a documented radiation protection program as approved by the DOE. (10 CFR 835.101(a))

Criteria:

1. The radiation protection program shall specify existing or anticipated operational tasks that are within the scope of the radiation protection program, and tasks outside of the scope of the radiation protection program shall not be initiated until the radiation protection program is revised and approved. (10 CFR 835.101 (d))
2. Monitoring of individuals and areas shall be performed to demonstrate compliance with 10 CFR 835; to document radiological conditions; to detect changes in radiological conditions; to detect the gradual buildup of radioactive material; to verify the effectiveness of engineered and administrative controls in containing radioactive material and reducing radiation exposure; and to identify and control potential sources of individual exposure. (10 CFR 835.401)
3. Instrumentation and equipment used for monitoring shall be periodically maintained and calibrated on an established frequency; shall be appropriate for the type(s), energies, and levels of the radiation encountered; shall be appropriate for existing environmental conditions; and shall be routinely tested for operability. (10 CFR 835.401)
4. For the purpose of monitoring individual exposures to external radiation, personnel dosimeters shall be provided to and used by appropriate radiation workers and others as required. (10 CFR 835.402)
5. Each access point to a controlled area shall be appropriately posted whenever radiological areas or radioactive materials exist in the area, and each access point to a radiological area or radioactive material area shall be posted with conspicuous signs bearing wording compliant with 10 CFR 835 requirements. (10 CFR 835.602, 10 CFR 835.603)
6. Experimental activities, if any, shall be covered by the radiation protection program. (10 CFR 835.101)

- In accordance with 10 CFR 835.101, has the facility developed, documented and implemented a RPP?
- Do RPP assessments and reviews as required by 10 CFR 835.102 completely cover the facility's safety management program content and implementation as described in the DSA?
- Does the RSO review and approve radiation protection program changes, experiments, and radiation protection related events and conditions in accordance with the TSR and procedural requirements?
- Are the personnel dose limits in conformance with 10 CFR Part 835 and facility's administrative limits? Are appropriate adjustment processes in place to consider neutron spectrum for various groups of workers?
- Are the principles of As Low as Reasonably Achievable (ALARA) implemented effectively by the facility?
- Are required radiation survey, sampling, and monitoring performed in accordance with regulatory requirements and the facility's procedures?
- Are personnel knowledgeable of the radiological conditions in the areas they frequent?
- Are survey results appropriately documented and communicated to impacted personnel?

- Are survey results appropriately reviewed by operations and management and trended as necessary to identify changing or hazardous conditions?
- Are radiological survey, sampling, and monitoring instruments calibrated and maintained in accordance with TSR requirements, the facility's procedures, and manufacturers' recommendations?
- Are monitoring instruments verified to be accurate and appropriate to the types and energies of radiation to be detected sufficient to ensure worker safety, and that appropriate staff are knowledgeable of the instruments' characteristics, operations, and limitations?
- Do technical basis documents address source terms, radiation quality factors, and dose pathways to verify that appropriate monitoring technologies are applied?
- Is the required personnel dosimetry program conducted in accordance with regulatory requirements and the facility's procedures?
- Do technical basis documents address source terms, radiation quality factors, and dose pathways verifying appropriate dosimetry technologies are applied?
- Is appropriate dosimetry or dose monitoring/assessment capability applied for all individuals likely to exceed 100 mrem in a year due to normal operations or reasonably anticipated off normal conditions?
- Is appropriate secondary dosimetry issued for individuals entering posted radiation and high radiation areas?
- Is the personnel dosimetry appropriate for the source terms, energies, and dose ranges likely to be encountered during normal and anticipated abnormal conditions?
- Are the results of the dosimetry reviewed at an appropriate frequency, analyzed for ALARA planning and hazard reductions, and results communicated to affected individuals?
- Are personnel aware of their dosimetry results? If not, do they know how to find out?
- Has the facility developed and implemented policies and procedures to address potential planned special exposures and prepared responses to unplanned exposures in excess of administrative or regulatory limits? Were planned special exposures implemented in accordance with the requirements of 10 CFR 835.204?
- Where applicable, did the dose to the embryo or fetus of declared pregnant women meet the requirements of 10 CFR 835.206?
- Where applicable, were radiological effluent releases in compliance with applicable conditional release limits in the TSR and the DSA?
- Are current notices to workers posted in accordance with regulatory requirements and the facility's procedures?
- Are restricted areas posted in accordance with regulatory requirements and the facility's procedures?
- Are appropriate access controls implemented in accordance with 10CFR835 and where appropriate do these controls and implementing procedures conform to life safety code requirements?
- Are high radiation area controls near beams and experiment stations in conformance with 10CFR835.502?
- Are radiological sources, samples, and experiments labeled and controlled in accordance with 10CFR835 requirements?
- Are contamination controls appropriately implemented in accordance with the postings and source terms?
- Is appropriate personal protective equipment available, maintained, and used in accordance with the facility's procedural requirements and appropriate for the hazards?
- Are personnel working around radioactive materials instructed in radiation safety as required by regulatory requirements and the facility's procedures, and are they knowledgeable of the current hazards and conditions in the work areas?

- If the reactor facility is expected to have airborne contamination, are there airborne radiation area postings and controls requiring the use of respiratory protection equipment? Typically, the emphasis will be on local or facility ventilation controls and monitoring rather than respiratory protection. If the use of respiratory protection equipment is required, does the facility's respiratory protection program meet the requirements of 10 CFR 851?
- Are engineered controls installed to limit radiation exposures ALARA as required by applicable experiment protocols, authorizations, procedures and TSR?
- Are facilities and implemented engineered controls adequate for safe handling processing and storage of experiment equipment and research samples? Particular attention should be given to handling of powdered or dispersible irradiated samples.
- Are procedures, processes, staffing, and equipment sufficient for monitoring experiment locations and sample handling?
- Do approved experimental procedures incorporate appropriate mitigative controls and actions for abnormal conditions? If yes, are experimenters and facility personnel appropriately trained for those responses and familiar with any necessary and available emergency equipment?

RX.9: Reactor facility operations are conducted in compliance with a documented fire protection safety management program as approved by the DOE. (10 CFR 830.204, DOE O 420.1C)

Criteria:

1. A documented fire protection program exists as required by applicable safety criteria and includes the elements and requirements for design and operations, emergency response, fire analysis and assessments, wildland fire, and site-specific fire protection criteria. (10 CFR Part 830; 10 CFR Part 851; DOE O 420.1C, Attachment 2, Chapter II).

    - Does the reactor facility have a written fire protection program encompassing all required elements of the program?
    - Is the fire hazard analysis accurate and up-to-date with the conditions of the facility?
    - Are the results of the fire hazard analysis properly integrated into the safety basis controls?
    - Have there been any modifications to the fire protection program or staffing since the last review? If yes, what and why?
    - If there is a potential for inadvertent criticality of bare assemblies as a result of firefighting and fire suppression activation, has this been adequately evaluated and are controls in place to prevent inadvertent criticality?
    - Is fire suppression system testing routinely performed, and is the monitoring capable of verifying adequate head pressure and flow at the most remote locations or identifying degradation in the system?
    - Are detection, alarm, and communications systems, routinely tested and demonstrated to be functional in conformance to National Fire Protection Association (NFPA), DOE, and appropriate contractual requirements?
    - Are emergency lights and egress systems routinely tested and demonstrated to be functional?
    - Are fire plans up-to-date reflecting conditions in the facility? Are alarm panels, pre-staged equipment, and combustible storage containers properly identified?
    - Are response agreements, baseline needs assessments, and mutual aid agreements up-to-date and do they reflect actual current training, staffing, and equipment conditions?
    - Are systems in place to verify availability, reliability, and functionality of basic water supply infrastructure, fire water tanks, and emergency pumps?
    - Are combustible controls and ignition source controls properly implemented throughout the facility?

- Are there any fire loading controls and housekeeping issues that could impact evacuation or fire response efforts?
- Are there emergency egress procedures and routes posted in conformance to life safety code requirements for egress?
- Are facility personnel knowledgeable of and exercised in the fire response procedures?

RX.10: Reactor facility operations are conducted in compliance with a documented emergency preparedness safety management program as approved by DOE. (10 CFR 830.204, DOE O 151.1D)

Criteria:

1. The contractor must establish and maintain a documented emergency management program that implements the requirements of applicable Federal, State, and local laws, regulations, and ordinances for fundamental worker safety programs (e.g., fire, safety, and security). (DOE O 151.1D)

   - Are the emergency management plan and implementing procedures current and readily available to reactor operators as required?
   - Have facility-level procedures been fully integrated with those of the site-wide emergency management program?
   - Are facility personnel trained to respond to emergency events as required by the emergency management plan, facility implementing procedures, and administrative controls?
   - Are facility exercises and drills conducted as required per the emergency plan and documented?
   - Are the facility's and site-wide emergency alarms, notification, and communications systems operable and maintained as required by the TSR and DSA?
   - Can key emergency response personnel acceptably respond to emergency conditions as required?
   - Are facility emergency plans appropriately coordinated and integrated with site-wide emergency plans and are supporting emergency services personnel knowledgeable of facility conditions?
   - Are memoranda of understanding or agreement (MOUs/MOAs) for mutual aid and community notification up-to-date and can be implemented as written?
   - Is an individual assigned (e.g., building or facility manager or similar position) to manage and control all aspects of the facility emergency response?
   - Do emergency management plan and implementing procedures require accountability of employees after a facility emergency evacuation has been completed?
   - Have predetermined protective actions associated with potential facility emergencies been developed for onsite personnel and the public?
   - Are operating practices and hazardous material inventories consistent with the assumptions in the emergency planning hazards assessments?
   - Are hazards surveys, emergency planning hazards assessments, and emergency action levels up-to-date?

RX.11: Managers assess their management processes and identify and correct problems that hinder the organization from achieving its objectives, including monitoring and self-assessment of reactor facility operations. (10 CFR 830.122(i), DOE O 422.1)

Criteria:

1. Identify the causes of problems and work to prevent recurrence as a part of correcting the problem. (10 CFR 830.122 Criterion 3)
2. Contractors must monitor and evaluate all work performed under their contracts to ensure work performance meets the applicable requirements for environment, safety, and health; including quality

assurance, integrated safety management, safeguards and security, cyber security, and emergency management. (DOE O 226.1B Attachment 1 Section 1)

- Does the contractor assurance system include engineering, configuration management, maintenance, surveillance and testing and operations assessment activities and engineering performance indicators/measures for safety systems?
- Has the contractor's assurance system monitored and evaluated engineering, configuration management, maintenance, surveillance and testing, and operations work performed for safety systems?
- Are performance indicators/measures effectively utilized in identifying performance trends and potential problems, allocating resources, and applying lessons learned and good practices?
- Do contractor personnel responsible for managing and performing engineering, configuration management, maintenance, surveillance and testing, and operations assurance activities possess training, experience, knowledge, skills, and abilities commensurate with their responsibilities?
- Are 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?
- Are processes in place 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?
- Have formal programs and processes 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?
- Are the results of engineering, configuration management, maintenance, surveillance and testing, and operations assurance processes for safety systems periodically analyzed, compiled and, as appropriate, reported or available to DOE line management as part of contract performance evaluation?
- Have rigorous assessments of engineering, configuration management, maintenance, surveillance and testing and operations processes and their implementation been performed and appropriate corrective actions implemented?
- 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; and 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, continuous reinforcement, etc.)?

- 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?
  - 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?
- 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?
- Is performance data being sufficiently analyzed, with conclusions drawn and presented to management, and needed actions identified and taken?
- Are findings related to safety system functionality from previous Independent Oversight appraisal activities effectively corrected?
- Have self-assessments been conducted in accordance with the TSR requirements and the facility's administrative procedures?
- Does line management address the identified problems and events and consider independent assessments and recommendations?
- Have problems identified from the facility's required reviews been resolved in accordance with the TSR requirements and the facility's administrative procedures?
- Have problems been assessed using appropriate causal analysis, extent of condition review, corrective actions implementation and verification, and dissemination of lessons learned?
- Were concerns or problems prioritized, assignments made, and technically adequate corrective actions taken in accordance with the facility's administrative procedures?
- Are operating problems documented and evaluated, and are corrective actions taken?
- Do supervisors and managers directly observe operations frequently and provide feedback?
- Do appropriate outside organizations such as Quality Assurance or other oversight organizations observe operations and provide feedback?
- Are assessment and observation issues tracked and corrected?
- Are auditable, measurable, realistic, and challenging safety, environmental, and operations goals set? Examples are safety system operability; radiological or other exposure; facility operational

availability; unscheduled shutdowns; overtime; staffing; qualification, and training; waste production; and plant instrumentation alarms and warnings.
- Do facilities develop an action plan to achieve safety, environment, and operations goals with input from operations personnel, and review and approval by management?
- Do facilities monitor and report to line and DOE management their progress on completing the action plan and achieving goals? Are goals and plans adjusted and modified as needed?

RX.12: Federal safety oversight programs are established and effective in ensuring safety systems can reliably perform as intended. (DOE O 226.1B)

Criteria:

1. All applicable DOE organizations must: (1) Establish and implement an effective oversight program consistent with DOE P 226.1B and the requirements of DOE O 226.1B, and (2) Maintain sufficient technical capability and knowledge of site and contractor activities to make informed decisions about hazards, risks, and resource allocation; provide work direction to contractors; and evaluate contractor performance. (DOE O 226.1B Section 4)
2. The DOE site office has established and implemented an effective Safety System Oversight (SSO) program for qualifying staff to apply engineering expertise in its oversight of the assigned safety systems and to monitor performance of the contractor's CSE program. (DOE O 426.1 Appendix D)

    - Has DOE line management established and implemented effective processes for monitoring and assessing contractor programs for ensuring effective design, configuration management, maintenance, and operation of safety systems?
    - Has DOE line management included the review of safety systems in the evaluation and approval of the startup and restart of nuclear facilities and activities?
    - 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 member 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?
    - 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?

REVIEW APPROACH

Record Review:

- Safety basis documents, system design descriptions and supporting documents (e.g., system diagrams, pipe and instrumentation drawings, calculations).
- Documentation related to selected design modifications, configuration changes for processing selected changes made to the system requirements, installed equipment, and associated documents.
- USQ process procedure(s) and the results of USQ evaluations.
- Engineering and configuration management processes and procedures, particularly those supporting technical product development, design changes, and document control.
- Maintenance records, plans, and schedules for aging system equipment and components.
- Maintenance work backlogs and deferrals.
- Vendor manuals, industry standards, DOE orders, and other requirements used as technical bases for development of system maintenance work packages
- System or component history files for selected system components for the past three years.
- Procedure and process for performing inspections of the system, including interviews with personnel performing the inspections.
- Procurement processes and records for system components and services.
- 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.
- System alarm response procedures and operating procedures for normal, abnormal, and emergency system operations.
- Operator training for the system, focusing on the technical completeness and accuracy of the training manual and lessons plans.
- Contractor's system engineering program description and procedures.
- CSE training and qualifications requirements.
- Training and requalification records of CSEs.
- CSE system notebook/logs, system health reports, system assessment reports, and observations/findings from oversight activities.
- System modification, maintenance, and procurement work packages.
- Sample database records of system deficiencies, problems, engineering issues, and corrective actions. DOE site office's SSO program description and SSO training and qualification requirements.
- Previous and present oversight assessment plans and schedules of planned surveillance and assessment activities.
- Surveillance and assessment reports prepared by SSO personnel.
- Follow-up on sample SSO findings to ascertain how they are tracked and resolved.
- Engineering, configuration management, maintenance, surveillance and testing and operations assessment program descriptions, procedures, instructions, guidance, and contractual requirements.
- Assessment activity schedules for independent, management, and other self-assessments and external reviews/inspections of engineering, configuration management, maintenance, surveillance and testing and operations.
- 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.
- 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).

- 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.
- Trend analysis and performance indicator reports.
- Assignment of significance level (priority) to deficiencies by facility management.
- Sample of corrective actions covering deficiencies identified in assessments, daily activities and CSE reviews.
- Sample of corrective actions taken in response to previous Independent Oversight appraisal activities.
- Training and qualification records for personnel performing assessments of engineering, configuration management, maintenance, surveillance and testing and operations.
- Facility startup procedures for any recently facility startups.
- Documented Safety Analysis
- Technical Safety Requirements
- Site Contractor assessment records associated with the Conduct of Operations program, the operator training and qualification program, operational responses to off-normal events, and procedure compliance
- Site Contractor Conduct of Operations Matrix and associated implementing procedures
- Routine assessments and oversight of Conduct of Operations program implementation in support of facility operations
- Site Organization Charts
- Procedure for the development, preparation, revision, and use of procedures
- List of piping and instrumentation diagrams for Safety Class (SC), Safety Significant (SS), and defense-in-depth system(s) and supporting subsystems that are deemed SC, SS, or important to safety (defense in depth)
- List of surveillance requirement test procedures for safety systems
- List of completed surveillance requirement test packages for safety systems for the previous 18 months or previous three performances, if there have been less than three tests in the previous 18 months
- List of SC, SS, and defense-in-depth system modifications for the past three years
- Temporary modification control procedure and list of current temporary modifications, and any related impairment or out of service procedures or records
- Operator, Maintenance, and CSE staff training programs and procedures
- Operator and CSE training procedures, courses and lessons plans, and operator and CSE qualifications requirements
- Operator and CSE qualification cards
- Operator certification and continuing training program description
- Training records and written examinations for recently certified reactor operators
- Recertification records for recently disqualified operators, if applicable
- List of operating procedures
- List of operator round sheets, TSR surveillance recording documents, and normal, abnormal, alarm response, and emergency procedures
- System operability determination process/procedure and a list of completed operability determinations conducted within the last two years
- Facility administrative procedures
- Procedures for system inspection, test and maintenance, fuel handling, startup, operation, shutdown, and emergency response
- Operational logs and records for recent startup operations
- Evaluations and corrective actions for recent unplanned reactor scrams
- Fuel handling logs and records for recent fuel movements
- Fuel inventory records and records from recent fuel receipts and spent fuel shipments

- Records of recent maintenance, modifications or repairs to fuel handling equipment
- Safety review procedure for experiments review and approval
- Recent reviews and self-assessment reports
- Records of TSR required surveillance activities for recent startup operations
- USQ evaluations for recent facility modifications and other changes
- Procedure(s) for reviews of experiments and records of recent reviews/approvals
- Nuclear maintenance management program document
- Selected maintenance logs and records for recent safety related work
- Radiation protection program document and facility procedures
- RWPs/ TWDs for radiation protection
- Selected dose records for facility personnel
- Selected records for recent survey, sampling or monitoring activities
- Selected records for recent calibrations of radiological instruments
- Selected records for recent effluent releases
- Fire protection program document and fire plans
- Emergency management plan, hazards survey, emergency planning hazards assessment, emergency action levels, and facility emergency procedures
- Records for recent facility exercises and drills
- DOE field element oversight program plans and schedules
- DOE reports for recent facility assessments and reviews

Interviews:

- CSEs who support the facility
- Surveillance and testing personnel
- Design Engineers
- Engineering Management.
- SSO personnel
- Configuration management SME
- Maintenance Manager
- Maintenance supervisors
- Maintenance personnel
- Operations personnel
- Facility Manager
- Training Department Manager
- Procedure Development Lead
- Work Control Lead for the facility
- Work planners who support the facility
- Selected facility operational and support personnel
- Facility manager/supervisor(s)
- Reactor operators
- Fuel handlers
- Safety reviewers for experiments
- Work planners and maintenance technicians
- RSO and radiation protection technicians
- Fire protection engineer/technician
- Emergency Program Manager
- DOE oversight manager, FR(s) and SSO(s) (or subject matter experts)

Observations:

- 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.
- Walk-through of the surveillance test procedures with appropriate facility personnel (e.g., test technicians, engineers, operations personnel).
- 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 valves, breakers, and other safety system components.
- Local operation of system equipment.
- Walk down assigned systems with SSO.
- Normal maintenance activities.
- Facility operational demonstrations
- Facility and building walkdowns and reviews
- Facility operational rounds
- Table top demonstrations of selected operations procedures
- Shift turnover or daily startup
- Plan of the day/week meeting
- Reactor startup operation
- TSR required surveillance activity
- Pre-job brief and performance of activity-level work
- Radiological survey, sampling or monitoring activity
- Walkthrough for radiation protection postings
- Walkthrough for fire loading controls and posting of emergency egress routes