# Independent Assessment of Nuclear Criticality Safety Program and Controls for the Uranium-233 Processing Campaign at Oak Ridge National Laboratory

**April 2023**

Office of Enterprise Assessments
U.S. Department of Energy

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## Acronyms

| | |
|---|---|
| AIMS | Activity and Issues Management System |
| ANS | American Nuclear Society |
| ANSI | American National Standards Institute |
| CA | Corrective Action |
| CFR | Code of Federal Regulations |
| CR | Condition Report |
| CRAD | Criteria and Review Approach Document |
| DOE | U.S. Department of Energy |
| DSA | Documented Safety Analysis |
| EA | Office of Enterprise Assessments |
| FR | Facility Representative |
| FY | Fiscal Year |
| IPAQ | Isotek Program to Assure Quality |
| Isotek | Isotek Systems, LLC |
| NCS | Nuclear Criticality Safety |
| NCSA | Nuclear Criticality Safety Approval |
| NCSE | Nuclear Criticality Safety Evaluation |
| NCSP | Nuclear Criticality Safety Program |
| OFI | Opportunity for Improvement |
| OREM | Oak Ridge Office of Environmental Management |
| ORNL | Oak Ridge National Laboratory |
| SME | Subject Matter Expert |
| TSR | Technical Safety Requirement |
| U-233 | Uranium-233 |

# INDEPENDENT ASSESSMENT OF NUCLEAR CRITICALITY SAFETY PROGRAM AND CONTROLS FOR THE URANIUM-233 PROCESSING CAMPAIGN AT OAK RIDGE NATIONAL LABORATORY

## Executive Summary

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an independent assessment of the nuclear criticality safety (NCS) program (NCSP) and controls implementation for uranium-233 (U-233) processing campaign activities at the Oak Ridge National Laboratory on January 23-27, 2023. Isotek Systems, LLC (Isotek) is the primary contractor for the U-233 processing campaign, with the Oak Ridge Office of Environmental Management (OREM) having overall Federal oversight responsibilities. The primary objective of this assessment was to evaluate the effectiveness of Isotek's updates to the Building 2026 and 3019 NCSP, controls, and operating practices supporting the campaign's high-dose U-233 disposition activities. Additionally, the assessment evaluated the effectiveness of OREM oversight of Isotek's NCS activities related to the campaign.

EA identified the following strengths:

- Isotek has established a comprehensive NCSP for the U-233 processing campaign in accordance with applicable DOE requirements.
- Isotek has developed and implemented robust formal NCS training programs for campaign operational personnel.
- Operators and supervisors demonstrated thorough knowledge of applicable NCS requirements and strong adherence to conduct of operations principles during field observations.
- Operators and supervisors expressed they do not fear retaliation for reporting safety concerns, facility management consistently values safe operations above schedule pressures, and Isotek senior leadership both encourages and rewards a strong questioning attitude.
- Isotek NCS engineers maintain a strong presence in the field and demonstrated comprehensive knowledge of U-233 campaign processes and procedures.
- OREM performs routine field walkdowns, closely engages with Isotek, and conducts formal assessments to ensure effective Federal oversight of NCS activities.

EA also identified the weaknesses summarized below:

- An Isotek nuclear criticality safety evaluation for Building 2026 did not analyze the potential for a criticality event due to the introduction of water into cells from nearby non-seismically qualified water-bearing systems following a seismic event.
- Isotek has not established a method to reliably determine an accurate down-blending system flow rate for demonstrating the ongoing implementation of a minimum volume ratio credited as an NCS control.

In summary, Isotek has effectively established and implemented a NCSP, controls, and operating practices for the U-233 processing campaign. OREM has also performed effective Federal oversight of related Isotek NCS activities. Isotek's NCSP and associated implementing documents incorporate appropriate standards and DOE requirements. Campaign NCS controls and limits are properly communicated to operational personnel through robust training programs that appropriately reference relevant safety basis NCS requirements. However, EA identified gaps associated with completeness of seismic flooding hazard analyses and methods for ongoing demonstration of a minimum volume ratio NCS control. Resolution of the weaknesses identified in this report will serve to enhance the management and overall effectiveness of the U-233 processing campaign NCSP, controls, and operating practices.

# INDEPENDENT ASSESSMENT OF NUCLEAR CRITICALITY SAFETY PROGRAM AND CONTROLS FOR THE URANIUM-233 PROCESSING CAMPAIGN AT OAK RIDGE NATIONAL LABORATORY

## 1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of Isotek Systems, LLC (Isotek) nuclear criticality safety (NCS) program (NCSP) and controls implementation for uranium-233 (U-233) processing campaign activities at the Oak Ridge National Laboratory (ORNL). Remote assessment planning and document collection activities began in December 2022, and onsite assessment activities were conducted on January 23-27, 2023.

In accordance with the *Plan for the Independent Assessment of Nuclear Criticality Safety Programs and Controls for the Uranium-233 Processing Campaign at Oak Ridge National Laboratory*, *January 2023*, the assessment evaluated the effectiveness of Isotek activities to manage and maintain an appropriate NCSP, controls, and operating practices for the U-233 processing campaign. This assessment also reviewed DOE oversight by the Oak Ridge Office of Environmental Management (OREM) of Isotek's NCS activities related to the campaign. This assessment was performed at the request of OREM.

The U-233 processing campaign supports the safe and secure disposal of Cold War-era legacy nuclear material currently stored in Building 3019 at ORNL. OREM and Isotek completed a planned two-year low-dose U-233 disposition campaign in August 2021 and began the current high-dose U-233 disposition campaign in October 2022. To facilitate the high-dose U-233 disposition activities, Building 2026 has been modified and elevated to a hazard category 2 nuclear facility to receive legacy U-233 from Building 3019 and process the material using refurbished hot cells and handling systems supporting thorium extraction and down-blending operations. These modifications and changes to both facilities' missions have required the development, review, and approval of updated safety analyses and NCS controls for Buildings 2026 and 3019.

## 2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which EA implements through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. This report uses the terms "best practices, deficiencies, findings, and opportunities for improvement (OFIs)" as defined in the order.

As identified in the assessment plan, the criteria used to guide this assessment were based on objectives CS.1, CS.2, and CS.3 of EA Criteria and Review Approach Document (CRAD) 31-30, Rev. 4, *Criticality Safety Program and Criticality Safety Controls Implementation*. In addition, elements of EA CRAD 30-07, Rev. 0, *Federal Line Management Oversight Processes*, were used to collect and analyze data on OREM oversight activities. To gather relevant assessment data, EA reviewed Isotek and OREM policies, processes, procedures, calculations, and records supporting the U-233 processing campaign NCSP, nuclear criticality safety evaluations (NCSEs), work planning and execution, implementation and communication of NCS controls (including training), and issues management. EA observed relevant U-233 disposition activities and work planning meetings. EA also interviewed key contractor and Federal personnel responsible for developing, implementing, maintaining, and overseeing the U-233 processing

campaign NCSP and controls. The members of the assessment team, the Quality Review Board, and the management responsible for this assessment are listed in appendix A.

There were no previous findings for follow-up addressed during this assessment.

## 3.0 RESULTS

### 3.1 Nuclear Criticality Safety Program and Processes

This portion of the assessment evaluated the effectiveness of Isotek's U-233 processing campaign NCSP and associated processes.

Isotek has established a comprehensive NCSP described in ISO-NCS-002, *Nuclear Criticality Safety Program Description Document*, and implementing documents ISO-NCS-201, *Nuclear Criticality Safety Procedure*, and ISO-NCS-301, *Preparing and Reviewing Nuclear Criticality Safety Evaluations*. These documents adequately describe the NCSP, including roles, responsibilities, and required qualifications for all organizational personnel implementing the NCSP. ISO-NCS-201 provides appropriate instructions for implementing the NCSP to ensure that NCS hazards are identified and evaluated and NCS controls are established to reduce the risk of inadvertent nuclear criticality to an acceptable level. ISO-NCS-301 provides appropriate instructions for preparation and peer review of NCSEs. These documents adequately address 10 CFR 830.204(b)(6) and DOE Order 420.1C, *Facility Safety*, att. 2, ch. III requirements.

Further, ISO-NCS-002, ISO-NCS-201, and ISO-NCS-301 appropriately address DOE-STD-3007-2017, *Preparing Criticality Safety Evaluations at Department of Energy Nonreactor Nuclear Facilities*, and American National Standards Institute/American Nuclear Society (ANSI/ANS)-8 series of NCS standards, as invoked by DOE Order 420.1C, att. 2, ch. III, sec. 3.d. ISO-NCS-002 adequately ensures that NCSEs and associated hazard analyses are used as inputs to ISO-SAF-002, *Documented Safety Analysis* [DSA] *for the Building 3019 Complex*; ISO-SAF-603, *Documented Safety Analysis for the Building 2026 Initial Processing Campaign*; ISO-SAF-003, *Technical Safety Requirements* [TSRs] *for the Building 3019 Complex*; and ISO-SAF-604, *Technical Safety Requirements Analysis for the Building 2026 Initial Processing Campaign*.

Isotek has established generally effective supporting engineering processes described in ISO-ENG-228, *Preparation and Review of Engineering Documents*, ISO-ENG-STD-231.103, *Isotek Engineering Standards Manual Section 103 – Engineering Calculations*, and ISO-ENG-STD-231.110, *Isotek Engineering Standards Manual Section 110 – Format and Content for Test.* ISO-ENG-228 appropriately invokes ISO-QAC-001, *Project Quality Assurance Plan*, requirements for independent verification of engineering documents. However, ISO-ENG-STD-231.103 lists ISO-ENG-228 and ISO-QAC-001 under "Isotek Use References" instead of "Mandatory Standards" and does not provide detailed instructions for controlling independent verification or documenting the level of analysis for engineering calculations. (See **OFI-Isotek-1**.) Specifically, ISO-ENG-STD-231.103 instructions for engineering calculations rely on a high-level checklist to guide independent verification and do not clearly define what constitutes an independent verification, acceptable verification methods, authorized independent verifiers, or the minimum acceptable level for the documentation of analysis/calculation details.

#### Nuclear Criticality Safety Program and Processes Conclusions

Isotek has established an adequate NCSP and supporting processes that are compliant with applicable DOE requirements. However, Isotek's engineering calculation procedure currently lists requirements

documents under "Isotek Reference Use" instead of "Mandatory Standards" and does not provide detailed instructions for controlling independent verification and documenting the level of analysis for engineering calculations.

### 3.2 Nuclear Criticality Safety Evaluations and Controls

This portion of the assessment evaluated the effectiveness of U-233 processing campaign NCSEs and NCS controls to ensure that activities involving fissionable materials will remain subcritical under normal and credible abnormal conditions, including those initiated by design basis events.

Four of the five reviewed NCSEs adequately implemented ISO-NCS-201 and ISO-NCS-301 requirements and used sound engineering/scientific principles (e.g., defense in depth, conservative design margins, human factors engineering). Each of the four NCSEs properly specified technical, functional, and performance requirements for NCS controls and described their safety functions. However, contrary to ISO-NCS-301, att. 13.2, NCS criteria, item 16, the fifth reviewed NCSE, ISO-NCS-CSE-602, *Nuclear Criticality Safety Evaluation Building 2026 Division Cell Operations*, did not analyze the potential for a criticality event due to the introduction of water into cells from nearby non-seismically qualified water-bearing systems following a seismic event. (See **Deficiency D-Isotek-1**.) Not formally analyzing such events reduces the completeness of the NCSE hazard analyses and associated validation of bounding seismic scenarios. There are several non-seismically qualified water-bearing systems (e.g., fire suppression piping, eye wash stations) external to the division cells. The cells' shield windows are also not seismically qualified. While ISO-NCS-CSE-602 conservatively demonstrated that the two shield window leakage events analyzed in the NCSE will not result in a criticality event, it did not analyze the consequences of an external water stream from the nearby water-bearing systems entering a cell through seismically induced failures of the cell shield windows. Isotek readily acknowledged the issue and has preliminarily evaluated that existing cell moderator intrusion NCS analyses are likely bounding for the currently unanalyzed seismically induced occurrences.

NCS controls described in ISO-SAF-603 and ISO-SAF-604 (the Building 2026 DSA and TSR documents, respectively) were generally correctly supported by design basis documents, tests, and operating procedures. However, contrary to DOE Order 420.1C, att. 3, sec. 3.a(2)(b), Isotek has not established a method to reliably determine an accurate down-blending system flow rate for demonstrating the ongoing implementation of a minimum volume ratio credited as an NCS control in ISO-NCS-CSE-603, *Nuclear Criticality Safety Evaluation of Building 2026 Processing Cell Operations*, and described in section 6.3.2 of the Building 2026 DSA. (See **Deficiency D-Isotek-2**.) Inadequate methods to demonstrate the continued reliability of DSA-required controls may reduce the ability to effectively monitor that the control continues to perform as designed. Specifically, Isotek currently does not have a method to adequately address potential impacts on the accuracy of flow rate measurements due to increased hydraulic resistance during operations from harsh environments and equipment degradation.

#### Nuclear Criticality Safety Evaluations and Controls Conclusions

The reviewed U-233 processing campaign NCSEs were generally compliant with the procedural requirements governing their implementation. However, the NCSE for Building 2026 division cell operations did not address introduction of water into cells from nearby non-seismically qualified water-bearing systems following a seismic event. Additionally, Isotek has not established a method to reliably determine an accurate down-blending system flow rate for demonstrating the ongoing implementation of a minimum volume ratio credited as an NCS control.

### 3.3 Nuclear Criticality Safety Controls Implementation

This portion of the assessment evaluated the effectiveness of Isotek's communication of NCS controls, operational and oversight activities, and management of NCS issues to ensure that U-233 processing campaign NCS controls are implemented in accordance with the applicable standards.

**Communication of NCS Controls**

Isotek communicates NCS requirements for the U-233 processing campaign through nuclear criticality safety approvals (NCSAs), workstation postings, procedures, and training programs that reference appropriate NCS controls and TSR material limits.

NCSAs and workstation postings provide operators with a consolidated list of specific facility and process NCS controls derived directly from the associated NCSEs. NCSA 601, *2026 Container Handling for Hot Cell Processing Activities*, and NCSA 602, *Building 2026 Division Cell Operations*, have proper approvals and define NCS fire suppression, design feature, administrative control, and signage requirements as described in applicable NCSEs. The ORNL Fire Department Building 2026 pre-fire plan correctly identifies facility moderator control areas and fire suppression tactics in accordance with NCSA requirements. During walkdowns of Buildings 2026 and 3019, NCS signage was readily visible near fissile material staging areas and material handling workstations. The signage contained NCS control information appropriate for the respective work areas and was consistent with applicable NCSAs.

The reviewed Building 2026 and 3019 operating procedures effectively incorporate applicable NCS requirements into prerequisites, action statements, checklists, and signoffs for both normal and abnormal operating conditions. Fissile material handling procedures ISO-OPS-105, *Material Handling Data Management*, and ISO-OPS-238, *Handling Radioactive Materials from Building 2026*, and fissile material processing procedures ISO-OPS-605, *Hot Cell Operations*, ISO-OPS-613, *Division Cell Operations*, ISO-OPS-614, *Processing Cell Operations*, and ISO-OPS-611, *Down-Blending System Operations*, all clearly identify NCS precautions, limitations, and controls for each relevant process step and properly reference associated NCSA, DSA, and/or TSR NCS requirements. Each fissile material processing procedure also provides a separate section that adequately details initial operator actions and NCS personnel notification requirements for abnormal fissile material handing events (e.g., incorrect canister inventory, spills, fire in hot cell, emergency evacuations). The interviewed operators and supervisors stated that the NCS organization is directly involved in the development, review, approval, and update of all fissile material handling and processing procedures. The interviewed operational personnel also attributed their ease of implementing NCS controls in the field to close engagement with the NCS organization throughout the procedure development process.

Isotek provides effective, robust formal training to U-233 processing campaign operational personnel on pertinent NCS subject matter. Initial qualification programs for the 2026 Hot Cell Technician, 2026 Process Support Technician, 3019 Fissionable Material Handler, and 3019 Operations Technician positions leverage a balanced combination of classroom and computer-based training to educate operators on NCS worker fundamentals, complex-wide NCS lessons learned, U-233 processing campaign NCSE/TSR requirements, and specific facility/process NCS procedural requirements. The interviewed NCS engineers stated that they work closely with the Isotek training organization and are directly involved in developing, reviewing, updating, approving, and presenting U-233 processing campaign NCS training modules. The reviewed training modules for fissionable material worker, NCS lessons learned, and NCSEs clearly described NCS requirements in operationally focused terminology and received proper approvals from both the NCS and training organizations. The interviewed operators and supervisors all demonstrated thorough knowledge of NCS controls related to their respective facilities/processes. Several of the interviewed operational personnel further stated that having NCS

engineers provide initial and recurring NCS training for operators has greatly assisted their overall understanding of facility/process NCS requirements.

**Conduct of Operations**

EA observed strong adherence to conduct of operations principles and applicable NCS requirements during canister transfer preparation activities at Building 3019 and fissile material receipt, processing, and inventory logging activities at Building 2026. The reviewed canister transfer operations evolution plan, an associated update for empty canister retrieval, and transfer form appropriately documented required NCS and facility management approvals in accordance with ISO-OPS-105. During Building 2026 hot cell processing, operational personnel properly verified completion of NCS prerequisites, effectively employed three-way communications to confirm operator understanding of each step, and maintained in-hand procedural usage throughout the evolution in accordance with ISO-OPS-614. EA also observed effective implementation of the Isotek "step-back" process, where operational personnel pause work to gain clarification on a process or raise a perceived safety concern. During the step-back, operating crew members ensured that the process was in a safe configuration, paused the activity, discussed a point of clarification with their supervisor, confirmed that the crew was in alignment on the path forward, revalidated their place in the procedure, and continued. The interviewed operators and supervisors stated that all personnel have stop-work authority, they do not fear retaliation for reporting safety concerns, facility management consistently values safe operations above schedule pressures, and Isotek senior leadership both encourages and rewards a strong questioning attitude.

Operational and data management personnel appropriately performed, peer reviewed, and documented Building 2026 fissile material inventory results in accordance with ISO-OPS-620, *Building 2026 IPC Inventory Control*. The reviewed inventory log entries were correctly inputted by operational personnel from applicable material transfer documents and verified by two qualified reviewers (i.e., Isotek Data Manager and a transportation and waste specialist) as defined in ISO-OPS-620. The observed inventory control process was predominantly performed by hand with results manually entered into access-controlled paper logs. During interviews, the Isotek Data Manager and NCS personnel stated that the manual tracking process is adequate for present campaign throughputs; however, Isotek recognizes that the manual process may become more challenging to manage as operations expand during subsequent campaign stages. As a result, Isotek is currently exploring the use of a formal qualified electronic database to track Building 2026 fissile material inventory. Use of qualified electronic inventory databases reduces the potential for human errors and increases material tracking efficiency.

**Oversight and Assessments**

Isotek has effectively performed oversight of U-233 processing campaign NCS activities through routine field engagement and formal assessments. The lead NCS engineers for Buildings 2026 and 3019 maintain a strong presence in their respective facilities, performing walkdowns and observing fissile material operations several times a week. During interviews, the lead NCS engineers demonstrated comprehensive knowledge of campaign activities, procedures, and the interactions between Building 2026 and 3019 operations. The interviewed operators, supervisors, and facility management stated that the routine field presence of the lead NCS engineers has allowed operational NCS questions to be answered expeditiously and has assisted in strategically incorporating operator feedback on implementation of NCS requirements into procedures. Isotek's NCS organization has adequately performed required annual assessments of the U-233 processing campaign NCSP and associated controls implementation. Fiscal year (FY) 2020 to FY 2022 annual assessments were conducted by qualified NCS subject matter experts (SMEs), appropriately incorporated current ANSI/ANS-8.19-2014 requirements into review criteria, covered relevant program areas, and clearly documented results. The next annual

NCSP review has been appropriately included in the FY 2023 Isotek integrated audit and assessment schedule.

**Issues Management**

Isotek has effectively managed recent NCS issues and associated corrective actions (CAs). ISO-QAC-226, *Condition and Observation Reporting*, provides appropriate guidance on Isotek's CA reporting, review, tracking, and closure processes. NCS condition reports (CRs) CR-2021-62, CR-2022-74, CR-2022-75, and CR-2022-82 and associated tracking documentation demonstrated proper issue categorization and significance level determination; CA development, review, and execution; and issue closure verification in accordance with ISO-QAC-226. A demonstration of the Isotek Program to Assure Quality (IPAQ) issues management system showed it to be easy to use for reporting issues, determining significance levels, tracking assigned actions, documenting action closure, and searching for historical issues in related areas.

**Nuclear Criticality Safety Controls Implementation Conclusions**

Overall, Isotek has effectively implemented NCS controls for the U-233 processing campaign using properly documented and approved processes. NCS requirements are appropriately communicated to operational personnel through NCSAs, workstation postings, procedures, and training programs. During observed work activities, operators demonstrated strong adherence to conduct of operations principles and applicable NCS requirements. Isotek's NCS organization maintains a strong field presence and has appropriately performed required annual formal NCSP assessments. Isotek has effectively managed recent NCS issues and associated CAs.

## 3.4 Federal Oversight

This portion of the assessment evaluated the effectiveness of OREM's oversight of Isotek's U-233 processing campaign NCS activities and management of OREM-identified issues.

**Oversight and Assessments**

OREM has effectively performed oversight of NCS activities for the U-233 processing campaign through routine field observations, close engagement with Isotek's NCS organization, and formal assessments. The Facility Representative (FR) and OREM SME for Buildings 2026 and 3019 maintain a strong presence at both facilities, performing facility walkdowns several times a week and observing operational briefings and CA meetings. During interviews, the FR and SME demonstrated comprehensive knowledge of campaign activities and emphasized their close coordination with the OREM lead NCS engineer when evaluating the adequacy of NCS controls implementation in the field. The OREM lead NCS engineer performs recurring operational awareness activities and meets regularly with their Isotek NCS counterparts. The reviewed OREM NCS oversight activities for calendar year 2022 listed in the OREM Activity and Issues Management System (AIMS) documented bi-weekly meetings between the OREM lead NCS engineer and Isotek NCS personnel and monthly operational awareness walkdowns.

OREM-OM-IP-06, *Informal and Formal Assessments*, provides OREM personnel adequate guidance to conduct oversight and assessment activities meeting the requirements of DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*. OREM NCS assessment ASM-EM-21-7886, *Informal Assessment Report for the Evaluation of the Isotek Systems, LLC Nuclear Criticality Safety Program (Fiscal Year 2022 Second Quarter)*, was conducted by knowledgeable NCS SMEs, appropriately incorporated current ANSI/ANS-8.19-2014 requirements into review criteria, included

relevant interviews and document reviews, and clearly listed assessment results. The next review of Isotek's NCSP has been appropriately included in the FY 2023 OREM integrated assessment schedule.

**Issues Management**

OREM has performed effective oversight of recent Isotek NCS issues and associated CAs. EA reviewed CA documentation in both the IPAQ system and AIMS associated with three DOE-identified NCS issues described in CR-2022-74, CR-2022-75, and CR-2022-82. The documentation demonstrates appropriate FR involvement in procedural update CAs, OREM management concurrence on a material accountability CA, OREM NCS involvement in NCSE update CAs, and proper OREM concurrence on CA closures. The reviewed NCS-related issues in AIMS and OREM closure correspondence were properly documented. However, the interviewed users acknowledged that the system currently has limited data analysis tools, lacks built-in trending capabilities, and is challenging to use. (See **OFI-OREM-1**.)

**Federal Oversight Conclusions**

Overall, OREM has effectively performed Federal oversight of Isotek's NCS activities for the U-233 processing campaign in accordance with DOE Order 226.1B. OREM has appropriately communicated its NCS oversight findings and monitored associated CA development, execution, and closure through close coordination with Isotek. However, AIMS currently has limited data analysis tools, lacks built-in trending capabilities, and is challenging to use.

## 4.0 BEST PRACTICES

No best practices were identified during this assessment.

## 5.0 FINDINGS

No findings were identified during this assessment.

## 6.0 DEFICIENCIES

Deficiencies are inadequacies in the implementation of an applicable requirement or standard. Deficiencies that did not meet the criteria for findings are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

**Isotek Systems, LLC**

**Deficiency D-Isotek-1**: Isotek NCSE ISO-NCS-CSE-602 did not analyze the potential for a criticality event due to the introduction of water into cells from nearby non-seismically qualified water-bearing systems following a seismic event. (ISO-NCS-301, att. 13.2, NCS criteria, item 16)

**Deficiency D-Isotek-2**: Isotek has not established a method to reliably determine an accurate down-blending system flow rate for demonstrating the ongoing implementation of a minimum volume ratio credited as an NCS control in ISO-NCS-CSE-603 and described in section 6.3.2 of the Building 2026 DSA. (DOE Order 420.1C, att.3, sec. 3.a(2)(b))

## 7.0 OPPORTUNITIES FOR IMPROVEMENT

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

**Isotek Systems, LLC**

**OFI-Isotek-1**: Consider updating engineering calculation procedure ISO-ENG-STD-231.103 to specifically invoke ISO-QAC-001 requirements and more explicitly define what constitutes an independent verification, acceptable verification methods, authorized independent verifiers, and the minimum acceptable level for the documentation of analysis/calculation details. These updates may reduce the potential for misapplication or misinterpretation of independent verification requirements for safety significant engineering calculations, including those used in NCSEs.

**Oak Ridge Office of Environmental Management**

**OFI-OREM-1**: Consider expanding AIMS to include additional data analysis features, enhance built-in issues trending capabilities, and incorporate employee feedback to address challenges with system use. These updates may optimize issues data analysis processes to more effectively track corrective actions, identify trends, and prevent recurrence of similar issues.

## Appendix A
## Supplemental Information

**Dates of Assessment**

Onsite Assessment: January 23-27, 2023

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