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**DEFENSE NUCLEAR FACILITIES  
SAFETY BOARD**

Washington, DC 20004-2901



May 23, 2014

The Honorable Ernest J. Moniz  
Secretary of Energy  
U.S. Department of Energy  
1000 Independence Avenue, SW  
Washington, DC 20585-1000

Dear Secretary Moniz:

Members of the Board's staff reviewed the Department of Energy (DOE) Readiness Assessment (RA) conducted in March 2014 to support startup of the Idaho National Laboratory's Integrated Waste Treatment Unit (IWTU). Based on issues identified during the DOE RA and the continued identification of new design and operational issues during IWTU's startup testing, the Board believes that additional independent assessment is warranted before the commencement of radioactive waste processing operations.

The DOE RA was conducted without the safety-significant off-gas system operating. This prevented the RA from meeting the requirements of DOE Order 425.1D, *Verification of Readiness to Start Up or Restart Nuclear Facilities*. Throughout the DOE RA, and subsequent startup testing, the need for substantial changes to the facility's safety basis, credited control set, component design, and operating procedures were identified. These changes have the potential to result in substantial revisions and modifications that have not been subjected to readiness reviews. These issues and others are discussed in the enclosed report.

Therefore, pursuant to 42 U.S.C. § 2286b(d), the Board requests a report and briefing within 30 days, on DOE's evaluation of the need for additional independent assessment at the completion of IWTU startup testing and prior to the introduction of radioactive waste feed.

Sincerely,

Peter S. Winokur, Ph.D.  
Chairman

Enclosure

c: Mr. Joe Olencz

# DEFENSE NUCLEAR FACILITIES SAFETY BOARD

## Staff Issue Report

April 24, 2014

**MEMORANDUM FOR:** S. A. Stokes, Technical Director

**COPIES:** Board Members

**FROM:** M. Horr and B. Sharpless

**SUBJECT:** Integrated Waste Treatment Unit Readiness

This report documents an on-site visit by members of the Defense Nuclear Facilities Safety Board's (Board) staff to Idaho National Laboratory's Integrated Waste Treatment Unit (IWTU) during March 10–13, 2014, and subsequent review of IWTU startup testing.

**Background.** Prior to IWTU's initial startup, CH2M-WG Idaho, LLC (CWI) conducted a Contractor Operational Readiness Review (ORR) that concluded in February 2012. This was followed by a Department of Energy (DOE) ORR that concluded in April 2012. Project managers subsequently received approval from the Startup Authorization Authority on April 22, 2012, to commence the initial facility startup.

In June 2012, while facility workers were executing Test Instruction-102, *IWTU Integrated System Test: Hot Start-up*, IWTU experienced an over-pressurization event that forced a prolonged shutdown of the facility. During this shutdown, project personnel developed and implemented a Corrective Action Plan (CAP) in response to the over-pressurization event. After the completion of the actions required by the CAP, CWI conducted a Contractor Readiness Assessment (CRA) beginning in January 2014. Due to equipment faults and preparation deficiencies, CWI personnel were not able to achieve operational conditions at IWTU during the CRA, and it was suspended before all review objectives could be fulfilled. The CRA resumed on March 3, 2014, after normal operating temperatures and pressures had been achieved in a portion of the facility's systems, and without the introduction of steam or non-radioactive waste simulant. The CRA team concluded its review on March 7, 2014, without fully satisfying the CRA Implementation Plan (IP) criterion to have achieved full operating temperature.

The DOE Readiness Assessment (RA) team commenced its review at IWTU on March 11, 2014. Members of the Board's staff were on-site to observe the DOE RA team conduct the first three days of its assessment.

**Staff Observations of DOE RA.** The staff review team made the following observations during the DOE RA. The review team shared these observations with DOE Idaho Operations Office (DOE-ID) personnel, including the DOE-ID Manager.

*Facility Operating Status*—The staff members noted that IWTU’s off-gas system was not operating at the beginning of the DOE RA and had not been brought up to operating temperature. IWTU’s greatest hazards to facility and collocated workers are controlled by the off-gas system, and it includes the majority of safety-significant controls in the facility. As a result of the June 2012 over-pressurization event, project personnel implemented many design modifications to the off-gas system. The modified components had not yet been tested under their normal operating temperature, pressure, and flow conditions. Therefore, the effects of these design modifications on operating parameters throughout the rest of the IWTU plant, including on safety systems, were unknown. The staff team believes that without this information, it is not possible to make a defensible conclusion that the facility can proceed safely with nuclear waste processing operations.

Considering the non-operational status of the off-gas system, the staff members believed that the IWTU facility was not in an appropriate condition to adequately conduct the full independent assessment that an RA is expected to provide. Specifically, the requirements of the DOE RA’s Plan of Action (POA) and IP could not be met in this plant configuration, as the majority of safety-credited systems were not operating, and several recent design modifications could not be tested. The POA states, “The DOE Readiness Assessment will be conducted with the plant at full operating temperature under test procedure TI-102, once CWI provides a readiness to proceed memorandum to the Department.” DOE Order 425.1D, *Verification of Readiness to Start Up or Restart Nuclear Facilities*, requires RAs to be conducted in strict accordance with their POAs and IPs. Therefore, the staff team considered IWTU’s declaration of readiness to be premature and that the facility had not demonstrated its readiness to safely restart operations.

The staff review team discussed its observations with DOE-ID and DOE RA team personnel. The DOE RA team leader subsequently requested that CWI commence the off-gas system heat-up during the DOE RA. CWI’s managers agreed to this request. This evolution required the resolution of 21 specific engineering actions, from procedural changes to calculating new process operating parameters. Similar additional engineering actions are required before IWTU can introduce steam, and eventually waste simulant, into the process system, which is necessary to complete DOE-ID’s IWTU startup plan. While conducting the off-gas system heat-up, a Technical Safety Requirement (TSR) violation occurred due to a safety-significant system in the off-gas system not being properly configured for operation. Operators entered a Limiting Condition for Operations and shifted the facility to its warm standby mode. In the DOE RA team’s out-brief to facility personnel, the RA team leader noted the resolution of this situation as a pre-start issue.

*DOE RA Scope*—DOE Order 425.1D requires the scope of the RA to “be based, in part, on the status of and changes to the facility.” The POA for the DOE RA lists 24 specific facility modifications to be reviewed, but notes that the list is not all-inclusive. The IP contains the same list of modifications in its scope, but omits the “not all-inclusive” caveat. When the staff members discussed this inconsistency with the DOE RA team leader, he indicated that the DOE RA team did not have the resources to perform a review of every facility modification. The staff review team believes that a review of all facility modifications is needed to comply with the intent of DOE Order 425.1D, particularly for such a first-of-a-kind facility startup.

*DOE RA Scheduling*—The POA for the DOE RA included an approximate two-week break between the CRA and the DOE RA. However, prior to the March 2014 restart of the CRA, DOE-ID managers made the decision to commence the DOE RA approximately 48 hours after the approval of the CRA team’s final report. The extent of the corrective actions that would be required by the CRA’s pre-start findings was unknown at the time the decision was made to move up the start date of the DOE RA. The DOE RA team’s final report states the following, “DOE-ID is not consistently holding IWTU to the high standard defined in DOE Order 425.1D and compliance with the approved RA Plan of Action.” The report also states that there were only two days between the issuance of CRA final report and the DOE-ID declaration of readiness to proceed with the RA and noted that several poor practices existed, e.g., review of the CRA prestart corrective actions and associated objective evidence indicated marginally compliant evaluation and rigor in corrective actions. The Board’s staff review team believes that the decision to reduce the time between the CRA and the DOE RA negatively impacted the ability of the RA to fulfill the need for a complete assessment of facility operations.

**DOE Lessons Learned Summary on IWTU.** On March 13, 2014, DOE’s Office of Health, Safety and Security (HSS) published Operating Experience Summary Issue Number 2014-01, Article 1: *Lessons Learned from Inadequacies in Management and Oversight at the IWTU*. Regarding IWTU’s 2012 ORRs, the HSS summary notes that, “Startup of first-of-a-kind facilities such as IWTU requires a phased approach to ensure that personnel adequately understand the attributes of each component singly and within an integrated system. The selected demonstrations for the ORRs did not provide a representative spectrum of the activities necessary to safely startup the facility as described in the Startup Plan.” The staff review team believes that the completion of an integrated startup testing program, prior to declaring readiness, would ensure that the operators and equipment at a first-of-a-kind facility are capable of demonstrating all activities necessary to safely startup the facility during its readiness reviews. Such a program was not completed before the DOE RA at IWTU.

The HSS summary also emphasized the need to establish expectations for normal and abnormal process conditions and to “require rigorous assurance that equipment and personnel will function as credited in the approved safety basis documentation” during startup of a first-of-a-kind facility like IWTU. The staff review team believes that this rigorous assurance is best provided by independent technical assessments that ensure safety system performance under expected operating parameters.

**Issues Identified During IWTU Startup Testing.** Since the completion of the DOE RA in March 2014, CWI personnel have identified several issues during startup testing. These issues appear to require significant engineering efforts to resolve and may result in changes to the IWTU safety basis and design. The magnitude of the engineering and operational changes may be significant enough to warrant independent review prior to the start of nuclear operations. Examples of some of these issues are described below. DOE-ID and CWI personnel expect to identify additional issues as startup testing continues.

*Granular Activated Carbon (GAC) Bed Potential Inadequacy of the Safety Analysis (PISA)*—On April 3, 2014, during a subsequent attempt at off-gas system heat-up, CWI declared a PISA at IWTU with respect to the estimated time to GAC vessel failure when subjected to the maximum credible fire temperature of 1000 °C. The GAC vessels are a significant portion of the

off-gas system and have several safety-significant controls to ensure their proper operation. Engineers discovered that the GAC vessel wall thickness used in the original engineering analysis of a fire in the vessel did not take into account the corrosion rate of the vessel wall. Following the declaration of this PISA, a test hold was put in place with the process off-gas bypassing the GAC vessels. CWI is performing an analysis of the GAC vessels with the anticipated wall corrosion rate. Following the conclusion of the analysis, CWI engineers will determine if changes are required to IWTU's safety basis and/or operating procedures.

*High Off-Gas Temperature Causes Actuation of Safety Instrumented Function (SIF)-2 Panel*—On April 11, 2014, while heating up the GAC beds, IWTU experienced a SIF-2 trip due to high temperature in the process off-gas system. The SIF-2 safety instrumented system performs a safety-significant function to prevent a release of hazardous concentrations of nitrous oxide and mercury resulting from a breach in the off-gas system due to high off-gas temperatures. To assist in the heat-up of the GAC beds, the Shift Supervisor directed the Control Room Operator (CRO) to increase the outlet temperature of the Off-Gas Cooler (OGC). The CRO made the associated adjustment to the OGC's automatic temperature controller. After approximately 30 minutes, the CRO shifted the OGC's temperature control from automatic to manual to aid in maintaining the desired outlet temperature. Soon after, the test engineer noted that the OGC and GAC bed outlet temperatures were rising more rapidly than previously observed. Consequently, the Assistant CRO (ACRO), who had responsibility for maintaining the OGC outlet temperature, attempted to lower the OGC temperature. In doing so, the ACRO adjusted the temperature controller in the wrong direction, reducing the amount of cooling provided by the OGC. The OGC outlet temperature subsequently rose to 204 °C, causing the SIF-2 trip, which prevented further heat-up of the GAC beds.

*Inadequate Operation of Hydrogen Analyzer System*—On April 18, 2014, while reviewing the hydrogen analyzer in preparation for adding steam to IWTU's processing systems, CWI engineers noted that a gas sampling line was unexpectedly cold. Gas samples are drawn from the Process Gas Filter (PGF), routed through the hydrogen analyzer, and returned to the Denitration Mineralization Reformer. An eductor provides the motive force to move the sampled gas. The engineers directed a series of troubleshooting actions to determine if obstructions existed in the sample lines or the eductor, but found none. The engineers believe that the design of the eductor is inadequate to draw the required sample from the PGF. They are re-evaluating the eductor's design and intend to procure a replacement. Management personnel made the decision to shut down and cool down the facility until corrective actions can be implemented. This situation highlights the consequences of the numerous unknowns associated with how the as-built IWTU facility operates.

**Staff Conclusion.** The staff review team believes that the scope and depth of the engineering actions required to address the TSR violation, PISA, design changes, and transitions to steam and non-radioactive simulant feeds indicate a lack of assurance that the facility can safely proceed with nuclear operations. These changes may result in a safety basis, facility design, and operational procedures very different from those assessed during the DOE RA. DOE Order 425.1D requires a readiness review after substantial process, system, or facility modifications. Additional and independent technical assessments, such as an additional readiness review, may be necessary to ensure that all potential safety and operational issues have been identified and appropriately resolved prior to introducing radioactive feed.