Environmental Defense Institute

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Attachment B

Defense Nuclear Facilities Safety Board Report Excerpts

February 1, 2019
Integrated Waste Treatment Unit (IWTU) Process Gas Filter (PGF). Fluor Idaho continues to test and gather data to determine causes and solutions for PGF issues. The final set of coupons and the sintered powdered metal filter elements were removed in mid-January from the PGF at an independent research laboratory's IWTU model pilot plant for analysis. The research laboratory is supporting startup of the facility for the PGF filter element high temperature testing. Fluor Idaho is evaluating potential plant modifications (e.g., off-gas cooling) and use of alternate filter media if the sintered powdered metal filter elements do not prove to function as designed.

March 1, 2019
DNFSB Staff Activity. Board's staff members did not conduct any on-site activities during February 2019. The Board's staff has provided an average of 1 person-week per month of on-site oversight for the first five months of fiscal year 2019.
Integrated Waste Treatment Unit (IWTU) Status. In early-February, Fluor Idaho began a process system heatup in support of the next 50-day non-radiological test. With the denitration mineralization reformer (DMR) and carbon reduction reformer (CRR) at normal operating temperatures, operations was preparing to shift to Operations Mode. On February 20, an unexpected power outage (see next item) within Idaho Nuclear Technology and Engineering Center (INTEC) initiated multiple rapid system shutdowns at IWTU. Plant personnel must complete certain safety-related actions to recover from a loss of power event; therefore, they are cooling the plant down. A recovery schedule has been developed, which includes several vessel inspections, potentially including a thorough inspection of the CRR.

INTEC Power Loss Event. On February 20, INTEC experienced a power outage, which adversely affected IWTU operations. IWTU entered a limiting condition for operation (LCO) due to the power outage affecting a facility ventilation exhaust blower. At the time of the power loss, IWTU was in Warm Standby Mode with the DMR and CRR at normal operating temperature and pressure. The power outage resulted in multiple rapid shutdown system events at IWTU that caused the fluidizing gas and process off-gas blowers to be secured. Within two hours, IWTU had returned another ventilation exhaust blower to service and exited the LCO.

Battelle Energy Alliance (BEA) Power Management was conducting routine maintenance on a breaker within Substation 2, for which BEA is responsible. INTEC Power Operations (IPO) is responsible for all electrical power distribution, operations, and/or maintenance within INTEC. Fluor Idaho management believes that the INTEC power outage was due to IPO operator error; however, the IPO operators insist that the human-machine interface line-up was correct. Of note, the 20 year old

INTEC utility control system software is scheduled to be replaced this fiscal year. Fluor Idaho has implemented an additional procedure step—IPO operators must now visually verify breaker position at the breaker. Other corrective actions may include improving site communications regarding status of facilities' electrical power line-ups and consideration of suspending maintenance related to the substation feeding IWTU during heat-up and operations.

2/27/19
DNFSB ARCHIVE: 2018-100-015, IWTU Safety Basis Review
The Defense Nuclear Facilities Safety Board completed a review of the safety basis for Idaho National Laboratory's Integrated Waste Treatment Unit (IWTU) in October 2017. The Board's review team identified the following weaknesses in IWTU's safety basis:
• Several hazards are designated as standard industrial hazards and are screened from further analysis in IWTU's safety basis. As a result, IWTU's safety basis does not adequately analyze some events, such as a carbon dust explosion in the fuel storage silos, and oxygen displacement in the process areas. These types of events may require identification of safety-significant controls for protection of workers.
• IWTU's fire hazard analysis relies on the implementation of site-wide safety management programs to screen out hazards during the unmitigated analysis. This is inconsistent with the Department of Energy's documented requirements.
Consequently, IWTU's safety basis does not analyze several possible accident events, such as a carbon dust fire in the additive storage room. A carbon dust fire could spread to the adjacent mechanical equipment area, potentially damaging the safetysignificant components in that space.
IWTU has implemented safety management programs and non-credited safety controls that are intended to address these potential hazards within the short expected operational life of the facility but has not sufficiently documented the hazards and the controls in the safety basis.
Such documentation should be completed regardless of the expected operational life of a facility.

March 27, 2018
The Defense Nuclear Facilities Safety Board completed a review of the safety basis for Idaho National Laboratory's Integrated Waste Treatment Unit (IWTU) in October 2017. The Board's review team identified the following weaknesses in IWTU's safety basis:
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IWTU has implemented safety management programs and non-credited safety controls that are intended to address these potential hazards within the short expected operational life of the facility but has not sufficiently documented the hazards and the controls in the safety basis. Such documentation should be completed regardless of the expected operational life of a facility.

March 3, 2017
Integrated Waste Treatment Unit. Operators at IWTU are conducting facility testing as part of its long-term startup plan. Near the end of the week of February 5, while heating up IWTU's processing system as part of this testing, operators noted that the thermocouple on the Denitration Mineralization Reformer's auger/grinder was not providing proper temperature readings and that the heater for the auger/grinder purge gas had failed (unrelated events). Corrective actions for the thermocouple problem required a cell entry, thus the operators had to shut down and cool down the plant. Operators discovered an inadequate electrical connection associated with the thermocouple. The purge gas heater suffered a failure of electrical components. Operators corrected both of these problems.

The heat up at IWTU resumed on the afternoon of February 16. The heat up was stopped again on February 22 due to an inability to sufficiently increase the temperature inside the Carbon Reduction Reformer. Operators subsequently cooled down the plant to investigate the cause and identified two fluidizing gas rails with Vector couplings that were not properly installed, resulting in the leakage of hot gas from the processing system. The flanges and rails were inspected, no damage was identified, and the flanges were properly installed and tightened.

June 1, 2018
Integrated Waste Treatment Unit. On May 9, 2018, while conducting a process system heat-up at IWTU to perform non-radioactive waste simulant testing, a low oxygen alarm sounded in the vicinity of IWTU's superheater. Industrial hygienists identified nitrogen leakage from fluidizing gas line flanges at the connections with two pressure safety valves that had been installed during the most recent facility maintenance outage. Engineers noted inconsistencies between the fasteners specified on facility drawings and the actual fasteners installed in the flanges. An extent of condition review revealed a similar situation on a Carbon Reduction Reformer (CRR) nozzle. On May 17, 2018, IWTU's Nuclear Facility Manager declared a management concern regarding the incorrect fasteners installed in the gas line flanges and the CRR nozzle.

February 2, 2018
Integrated Waste Treatment Unit (IWTU). Workers at IWTU continue to make facility modifications that must be finished before the next non-radioactive waste simulant test run begins. Modifications that have been completed or are in progress include:
- Replacement of castable refractory in the Carbon Reduction Reformer's fluidized bed zone with brick refractory due to extensive cracking and spalling of the castable refractory.
- Installation of an 18-inch manway in the Denitration Mineralization Reformer (DMR).
- Installation of a cone-shaped dual plenum bottom in the DMR to improve bed fluidization.
- Installation of a redesigned auger grinder in the bottom of the DMR.

IWTU's managers plan to conduct a Contractor Readiness Assessment after all modifications have been completed, in advance of the waste simulant test.

September 7, 2018
Integrated Waste Treatment Unit. On August 20, 2018, operators at INL's Integrated Waste Treatment Unit (IWTU) concluded a functional test of the facility's processing systems. The test operation, in which non-radioactive waste simulant was used, was intended to run for 30 days, but managers made the decision to shut down and cool down IWTU's processing systems at the 29.66-day mark due to a high differential pressure observed across the system's process gas filter (PGF). Fluor Idaho, LLC (Fluor Idaho), personnel are working with the filter's vendor and a variety of laboratories and manufacturers to determine why the PGF elements clogged and how to prevent a recurrence.

January 6, 2017

Integrated Waste Treatment Unit (IWTU). On December 06, IWTU workers began an internal inspection of the inlet and outlet isolation dampers for process high-efficiency particulate air (HEPA) filter bank "D." During the course of the inspection, the inlet damper seal was discovered to be damaged/deteriorated, potentially affecting its ability to provide a seal with the damper housing.

IWTU contains four process HEPA filter banks (installed in parallel), which are components of the IWTU process off-gas system. The process off-gas system is designated as a safety-significant structure, system, or component by the IWTU documented safety analysis to prevent exposure of workers to hazardous concentrations of nitrous oxide (NOx) and mercury. Each process HEPA bank contains an inlet and outlet isolation damper to allow isolation of the filter bank from the process off-gas system. TSR-level controls are placed on the isolation dampers to prevent an uncontrolled release of hazardous gases into the occupied area during filter replacement activities while the facility is in Operations Mode.

IWTU has not yet processed any radiological material. There were no personnel injuries or releases to the environment related to this discovery. An extent-of-condition (EOC) review performed after the discovery of the damaged/deteriorated isolation damper seal involved an inspection of the inlet and outlet isolation damper seals for the remaining three process HEPA filter banks. The EOC review indicated the inlet and outlet isolation damper seals on the remaining three process HEPA filter banks exhibited similar damage/deterioration.
On December 19, IWTU's Nuclear Facility Manager (NFM) declared a potential inadequacy of the safety analysis due to the discovery that the process HEPA filter inlet and outlet isolation damper sealing capability may be at a lower differential pressure than that which is required to provide off-gas confinement. Under certain plant conditions, the pressure differential across the process HEPA isolation dampers could exceed could the dampers' sealing capability (1.8 psid) while remaining below the setpoint for the protective rupture disc (3.0 psid) located upstream of the process HEPA banks.

The NFM directed the implementation a compensatory measure to prohibit any activity that would compromise the process HEPA filter confinement boundary when feeding simulant or sodium-bearing waste. IWTU remains in Shutdown Mode for planned facility maintenance.

January 24, 2007

The Defense Nuclear Facilities Safety Board (Board) and its staff have closely followed conceptual and preliminary design activities, pilot plant testing, and safety basis development for the Integrated Waste Treatment Unit (IWTU) at the Idaho National Laboratory .

The Board has no significant safety issues with the project at this time (Critical Decision 2/3B) . The final design, however, is progressing and there remain a number of items the Board believes must be addressed before the approval of final design and construction of the project . These items are listed below for your information:

• Distributed control system design, including 1) fail-safe logic that places the steam reforming process in a safe configuration following control system failure, and 2) rapid shutdown system sensitivity to safety-related operating parameters .
• Completion of the pilot plant mercury adsorber bed over-temperature event investigation, and development of an adequate control set to prevent recurrence in the full scale IWTU.
• Completion of the analysis of pilot plant testing results for the mineralized waste form and assessment of the ability of the existing facility design to accommodate any needed process design changes to allow utilizing this waste form if needed in the future.
• Validation that the radionuclide assumptions in the safety basis are accurate, either through completion of sampling or through batch feed sampling requirements .
• Routine configuration management of important safety documents, e .g., the Preliminary Documented Safety Analysis report, to ensure safety requirements are properly incorporated during final design. In addition to these items, the Board encourages the IWTU project to consider incorporating limited, post-seismic monitoring capability into the IWTU control system as defense-in-depth assurance of safe shutdown. Currently, no seismically qualified system exists to verify safe shutdown following an earthquake .

DNFSB Enclosure
Integrated Waste Treatment Unit Project Summary

The Integrated Waste Treatment Unit (IWTU) will convert approximately 900,000 gallons of acidic, liquid sodium bearing waste to a solid carbonate or mineralized product for permanent disposal at the Waste Isolation Pilot Plant or an off-site geologic repository . The sodium bearing waste is currently stored in three tanks at the Idaho Nuclear Technology and Engineering Center (INTEC) and will be treated using steam reforming technology . The IWTU will also stabilize liquid wastes generated from continued cleanup of the INTEC area . Portions of the facility's structure may have a future mission to support the recovery of High-Level-Waste Calcine for off-site disposal, and are thus being designed to more rigorous structural requirements .

The safety strategy relies on confinement of hazardous materials, radiation shielding, and accident prevention during steam reforming and waste product handling operations. Significant hazards include mercury release from a charcoal adsorber bed fire, hydrogen deflagration in process equipment, and confinement boundary failure resulting in release during a seismic event .

Engineered and administrative controls will prevent and mitigate worker consequences from these and other events identified in safety basis documents . Controls credited as safety significant for the IWTU include the following :

•rapid shutdown system (including its uninterruptible power supply) ;
•off-gas cooling system ;
•radiation shielding (process cell, carbon reduction reformer cell, packaging station cell, storage vaults, vault loading area, 72B transport cask and adapter, and remote handled transuranic (RH-TRU) waste canister transfer bell) ; and
•confinement (storage vaults, process cell, carbon reduction reformer cell, packaging station cell, RH-TRU canister, and denitration and mineralization reformer and carbon reduction reformer in-cell carbon addition lines) .

To provide additional worker protection, all components providing primary confinement of the waste during operations with the exception of the RH-TRU canister are credited as defense-in-depth. The building ventilation system is also credited as defense-in-depth, and a Technical Safety Requirement level control will require cessation of steam reforming operations if the system becomes inoperable.

A one-tenth scale pilot plant was constructed at Hazen Research, Inc . to demonstrate integrated operation of the IWTU process, confirm process chemistry and mass and energy balance calculations, and demonstrate acceptability of the waste product and off-gas emissions .

The first stage of testing produced a carbonate waste form . Valuable lessons learned were derived from this effort including, among others, the acceptability of sintered metal in the high temperature process gas filter and the control set to prevent and mitigate a charcoal adsorber bed fire. Testing for the mineralized waste form was completed at the end of 2006 .

The project is now moving forward into final design and is preparing for long-lead procurement of major process equipment .

June 5, 2015

Integrated Waste Treatment Unit (IWTU). On May 14, 2015, IWTU’s nuclear facility manager (NFM) declared a potential inadequacy in the safety analysis (PISA) at IWTU. The NFM declared the PISA due to the discovery of new information indicating that normal IWTU facility operations may result in process material being transferred from vessels within the process confinement area to the sample cell, which is not included in the process confinement area.

During IWTU operations, the process confinement area protects workers from exposure to radioactive and hazardous materials in the event of a loss of primary confinement. The IWTU process confinement area, as defined in the facility’s safety analysis report (SAR), is a safety significant system, structure, or component. The IWTU sample cell is currently not included in the SAR definition for the process confinement area, and therefore is not bound by SAR-related access controls during IWTU operations.

Staff Issue Report
April 24, 2014

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.

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. lD, Verification of Readiness to Start Up or Restart Nuclear Facilities, requires RAs to be conducted in strict accordance with their PO As 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 heatup, a Technical Safety Requirement (TSR) violation ocumped due to a safely-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. lD 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. JD, 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 manager 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.ID 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 believe 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 OR Rs did not provide a representative spectrum of the activities necessary to safely startup the facility as de cribed in the Startup Plan." The staff review team believes that the completion of an integrated st:'lrtup 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 compleled 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 I 000 °C. The GAC vessels are a insignificant 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 performjng 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 OCC' 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 lWTU'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-guvinating 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 sirnulant 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 425.10 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.

April 24, 2014

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. lD, Verification of Readiness to Start Up or Restart Nuclear Facilities, requires RAs to be conducted in strict accordance with their PO As 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 heatup, a Technical Safety Requirement (TSR) violation ocured due to a safely-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. lD 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. JD, 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 manager 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.ID 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 believe 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.

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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 I 000 °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 OCC' 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 significant 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 425.10 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.

August 31, 2015
Associate Under Secretary for Environment, Health, Safety and Security
U.S. Department of Energy

Dear Associate Under Secretary Moury:

The approach being used to evaluate the need to update the Idaho National Laboratory (INL) Probabilistic Seismic Hazard Analysis (PSHA) is not well-defined and may not be technically defensible. A PSHA provides the necessary input for evaluation of the seismic response of structures, systems, and components. Department of Energy (DOE) Order 420. lC, Facility Safety, requires that each site PSHA be reviewed at least every 10 years for significant changes in data, criteria, and assessment methods that would warrant updating the PSHA. INL is planning to perform this evaluation with a "risk-informed" approach that relies on a preliminary seismic hazard analysis not rigorous enough to be used in the evaluation or design of certain high-hazard nuclear facilities at INL. This "risk-informed" approach is not defined in DOE directives, and we are concerned that INL is completing work without first defining how the results will be objectively evaluated.

Pursuant to 42 U.S.C. § 2286b(d), the Board requests a report within 90 days of the issuance of this letter outlining the technical basis for the planned risk assessment approach.
This report should include:
1) The criteria used to assess whether a PSHA update is necessary at INL.
2) The technical definition of a "significant" increase in expected ground motions predicted by the preliminary seismic hazard analysis as it is compared against the Unifom1 Hazard Response Spectrum from the previous PSHA and the response spectra used to design or evaluate the Fuel Manufacturing Facility (FMF) and the Integrated Waste Treatment Unit (JWTU).
3) The basis for DOE's position on why the preliminary seismic hazard analysis mentioned above will provide values of calculated risk accurate enough to use in regulatory decision making.
4) How a probabilistic risk assessment and/or seismic margin assessment will be applied at FMF and IWTU, and how the results will be used to assess whether a PSHA update is necessary.
5) The procedure for evaluating site-wide risk, because the PSHA characterizes a site-wide hazard.

May 1, 2008

The Defense Nuclear Facilities Safety Board has completed a series of reviews related to the development and analysis of design basis ground motion supporting structural design of the Integrated Waste Treatment Unit (IWTU) . These reviews revealed a number of issues related to the development of the design basis ground motion and overall seismic design for the facility.

Some of the key issues were :

• Assessment of soil site response based on randomized soil profiles that were inconsistent with site-specific soil data
• Accounting for geotechnical-input to the soil-structure interaction (SSI) analysis, including issues related to strain-compatible soil properties
• The adequacy of the time histories used for the SSI analysis
• Seismic interaction criteria that allowed large permanent deformations in certain cranes, which could impact structural adequacy
• The adequacy of using mechanically anchored reinforcing bars As a result of significant efforts made by the Department of Energy's Idaho Operations Office (DOE-ID) and the IWTU structural designer, Simpson, Gumpertz & Heger (SGH), all issues were resolved, and appropriate changes to the design were made . Both DOE-ID and SGH are to be commended for resolving these issues in an expeditious manner .

Two key actions were responsible for the successful resolution of these Board issues.
First, SGII incorporated conservatism into the original design of the Performance Category 3 process and packaging cells . As a result, the process and packaging cells design was able to accommodate a substantial increase in design basis ground motion without demands exceeding structural capacity . Second, the project formed a geotechnical and SSI peer review panel (named the Blue Ribbon Panel) that provided critical advice on incorporating appropriate soil properties into the SSI analysis . The panel provided an essential peer review process that went a long way toward strengthening the technical credibility of the IWTU design . The Board believes the use of peer review panels would benefit all DOE design efforts .

HYDROGEN SAFETY STRATEGY IN DEFENSE NUCLEAR FACILITIES

Table 2 Unmitigated Consequences of Deflagration in Selected Defense Nuclear Facilities

Table 2 Unmitigated Consequences of Deflagration in Selected Defense Nuclear Facilities

Facility	Event	M OI [3]	Worker Consequences	References
Tritium Extraction Facility (SRS)	Earthquake induced multiple room fire (extremely unlikely)	1.6 REM	Prompt fatality Acute life threatening or permanently disabling injury >100 REM	WSRC-SA-1. 2-Vol4 Rev O Aug 2005
Tank Farm s (SRS)	Waste Tank Explosion (extremely unlikely)	>25 REM	>100 REM	Wsrc-SA-2002-00007 Rev 3
PDCF (SRS)	Seismic induced three room fire	>25 REM	>100 REM	S-PAS-F-00001 , Rev B July 21, 2004
IWTU (INL)	CRR Vessel Deflagration	0. 00024 REM	1.5 REM @ 100m	SAR- 219 Rev 3
H Canyon (SRS)	Dis solver hydrogen deflagration	>5 REM	>25 REM @600m potential prompt death	WSRC-SA-2001-00008 (Rev 6)

a Maximum Exposed Off-Site Individual

b Pit Disassembly and Conversion Facility

c Integrated Waste Treatment Unit pg14

Maximum Exposed Off-Site Individual
Pit Disassembly and Conversion Facility
Integrated Waste Treatment Unit
1 4
Facility Event MOl a Worker
Consequences
References
IWTU` (INL) CRR Vessel
Deflagration
0.00024 REM 1.5 REM @100m SAR-219 Rev 3