Independent Oversight Review of K Basin and Cold Vacuum Drying Facility Found Fuel Multi-Canister Overpack Operations

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Office of Safety and Emergency Management Evaluations
Office of Enforcement and Oversight
Office of Health, Safety and Security
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Acronyms

CGI	Commercial Grade Item
CHPRC	CH2M-Hill Plateau Remediation Company
CSB	Canister Storage Building
CVDF	Cold Vacuum Drying Facility
DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operations Office
EMO	Enhanced Management Oversight
HSS	Office of Health, Safety and Security
MCO	Multi-Canister Overpack
MCS	Monitoring and Control System
OCRWM	Office of Civilian Radioactive Waste Management
ORP	Office of River Protection
SAR	Safety Analysis Report
SNF	Spent Nuclear Fuel
SOM	Shift Operating Manger
TSR	Technical Safety Requirement

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1.0 PURPOSE

The purpose of this independent oversight review by the U.S. Department of Energy (DOE) Office of Enforcement and Oversight (Independent Oversight), within the Office of Health, Safety and Security (HSS) was to observe the operations associated with processing a Multi-Canister Overpack (MCO) of "found fuel" (small quantities of spent fuel discovered during cleanup of the reactor burial grounds) at the Cold Vacuum Drying Facility (CVDF). The found fuel MCO was transported from the K West Basin on the Hanford Site to the CVDF for processing.

HSS conducted the review from April 16 to 18, 2012, to examine the ability of CH2M-Hill Plateau Remediation Company (CHPRC) to safely and effectively process the found fuel MCO at the CVDF. The primary goal of the review was to determine the effectiveness of the procedures and operational conduct with respect to DOE requirements.

The HSS review was conducted in accordance with the HSS *Office of Safety and Emergency Management Evaluations Protocol for Small Team Oversight Activities*, dated May 2011.

2.0 BACKGROUND

The DOE Hanford Site sits on 586 square miles in the desert of southeastern Washington State. The area is home to nine former nuclear reactors and their associated processing facilities, which were built beginning in 1943. The reactors were used to produce plutonium, a manmade, radioactive chemical element that was needed for atomic weapons associated with America's defense program during World War II and throughout the Cold War.

At present, the Hanford Site is undergoing extensive cleanup, overseen by two local DOE offices. The DOE Richland Operations Office (DOE-RL) oversees the projects associated with cleaning up the reactors, the soil, the groundwater, and the solid waste burial sites, and also manages the demolition of facilities and the disposition of the plutonium remaining on the Hanford Site. The Office of River Protection (ORP) is tasked with managing the liquid and semi-solid nuclear and chemical waste that is currently stored in 177 underground tanks on the Site. ORP is also in charge of constructing the Waste Treatment and Immobilization Plant, a massive complex of structures centrally located on the Hanford Site that will combine the wastes from these tanks with glass-making materials in a process called vitrification.

The nine plutonium production reactors cited above, were placed along the Columbia River so they could use the river water to cool the reactors during operation. Associated with these production reactors are numerous solid and liquid waste sites. At present, cleanup work is under way to preserve and protect the Columbia River, including cleanup of these disposal sites. During cleanup at the reactor burial grounds, small quantities of spent fuel ("found fuel") have been discovered. All found fuel is transferred to K Basins for consolidation with other single-pass reactor fuel. In the K Basin, found fuel is placed in an MCO for drying at CVDF. Following CVDF processing, the found fuel MCO is transported to the Canister Storage Building (CSB) for interim storage.

The CVDF was designed to remove free water from metallic uranium spent nuclear fuel (SNF) and to prepare the SNF for storage in an inert atmosphere of helium. The SNF is packaged into water-filled

MCOs and removed from the 105-K West Basin fuel storage basin. Removal of free water is necessary to halt water-induced corrosion of exposed uranium surfaces, allow the SNF MCOs to be transported safely to the CSB, and reduce the risk of hydrogen gas generation, which could pressurize the MCO while in interim storage.

The CSB is a large, 42,000 square foot facility at the Hanford Site that stores SNF packaged in MCOs, which are stored in carbon steel tubes within a below-grade concrete vault. The MCOs will be safely stored in the tubes until they are permanently placed in a national repository.

DOE Policy 226.1B, *Department of Energy Oversight Policy*, establishes DOE expectations for the implementation of a comprehensive and robust oversight process that enables the DOE mission to be accomplished effectively and efficiently while maintaining the highest standards of performance in safety and security. The policy expectation is that DOE oversight is performed effectively by line management, both DOE Headquarters and field, as well as by independent oversight organizations, including HSS. Collectively, effective assurance systems and oversight programs are intended to provide reasonable assurance that mission objectives are accomplished without sacrificing adequate protection.

3.0 SCOPE

The HSS review was performed in accordance with DOE Order 227.1, *Independent Oversight Process*, and applicable HSS Office of Safety and Emergency Management Evaluations guides, as well as HSS Criteria Review and Approach Document 64-17, *Nuclear Facility Safety System Functionality Inspection Criteria, Inspection Activities, and Lines of Inquiry*. The HSS review included examination of the contractor's operational procedures and specific documents and observation of control room and bay operations. The HSS reviewer participated in discussions with operations personnel and managers at the CVDF and K Basin and the assigned CHPRC oversight observers. Additionally, HSS observed MCO transport operations in the K Basin Loadout Bay and pre-job briefings, both in the K Basin and CVDF.

Appendix A lists the documents that were reviewed.

4.0 RESULTS

The overall operation was well planned and conducted. The operators were thoroughly trained and knowledgeable of their responsibilities and operating conditions and procedures.

Control Room Conditions

On the first day of operations, control room decorum and formality were not representative of the usual high standards expected at CVDF, but thereafter were acceptable. Possibly contributing to the short-term lapse were the long hiatus since actual operational processing of an MCO with SNF and the ambient temperature conditions in the control room. The control room becomes quite warm with all the electronic equipment and computers operating, so the control room door was left open to improve air circulation; this likely contributed to degraded control room decorum. This essentially expanded the control room environ to the administrative spaces where non-operational discussions in the control room doorway emanated into the control room proper, possibly creating a distraction. In addition, the control operator was observed in the hallway outside the control room and not "at the controls". A factor in the uncomfortably warm control room temperature was that the temperature sensor input to the air conditioning unit had been moved from the original as-built, design location in the control room to the administrative spaces so as to improve personnel comfort in the administrative spaces. The Facility

Representative suggested that a removable chain or rope barrier to the control room could be installed when the control room door is left open.

There were a number of observers during the CVDF MCO operations, in addition to the HSS site lead. CHPRC had elected to establish 24-hour work control observers, in addition to planned Enhanced Management Oversight personnel (EMOs). The work control observers and EMOs were very experienced and knowledgeable CHPRC personnel. Although the augmented CHPRC observation team added value to the CVDF operation, it led to some difficulties. Some observers, who were knowledgeable but possibly lacking in operational experience, seemed to interfere when they asked questions during the shift turnover process and when non-routine operations arose. The HSS site lead did not observe any significant negative impact on CVDF operations, although the additional oversight may have increased the operators' stress level. After the initial operational evolutions, CHPRC elected to curtail the EMO, but continued the work control observation. (See OFI-1.)

Valve Position and Qualification

As the MCO was processed at CVDF, HSS identified a concern about how two important valves to the vacuum drying process are verified as shut. During the execution of Technical Procedure OP-94-008V, "Process MCO/CASK In Process Bay 5 (OCRWM)," the procedure requires the Shift Operating Manager (SOM) to ensure that one of the two valves (He-GOV-1502 and He-GOV-1506) remains closed during the entire time that the demineralized water hose line used in the demineralized water rinse (DI-QD-5110) is connected. Verification that either He-GOV-1502 or He-GOV-1506 remains closed during that time provides assurance that no water is inadvertently added to the MCO, as specified in Administrative Control 5.19, Prevention of Inadvertent Water Addition. The control room approach to satisfy this requirement was to observe a computer screen showing a graphical presentation generated by the Monitoring and Control System (MCS). The procedure does not specify how this verification is to be accomplished. (See OFI-2.)

The MCS is a general service (non-safety class) system that serves as the building and utility system monitor for the CVDF and functions as the controller for the SNF MCO processing. The MCS receives input from the Safety Class Instrumentation and Control (SCIC) system for the MCO process bays. On the other hand, He-GOV-1502 and He-GOV-1506 are classified as safety significant. Using a non-safety class system to verify a safety significant valve position represents a vulnerability. It is a further vulnerability that the local valve closure indication for He-GOV-1502 and He-GOV-1506 have not been tested, verified, and documented to ensure that the MCS properly displays the true valve positions. HSS was unable to discover any verification of closure for these valves. (See OFI-3.)

In response to these issues concerning the verification of safety significant valve position with a non safety class system, the site engineering staff indicated that "we take no credit for it verifying a safety significant function". This is contrary to the actual practice followed in processing an MCO in accordance with OP-94-008V. The engineering staff further expounds that prior to each operational process of an MCO that OP-94-012V, "Verify Process Bay 5 is Ready to Use" is implemented to ensure that each valve's operability is verified. HSS reviewed OP-94-012V procedure during the evaluation period and found the procedure did not provide for verification of He-GOV-1502 and He-GOV-1506 valve position using the MCS.

HSS also reviewed the safety qualifications of the pneumatically operated valves, He-GOV-1502 and He-GOV-1506. The valves were procured under a commercial grade item (CGI) dedication process, which specifies testing to maintain the critical function before and after the design seismic event so that the valve would be able to open or close after such an event. The documentation shows that during some aspect of the procurement process, the contractor elected to forgo the specified seismic trials and conduct

a similarity analysis, and thus directed the subcontractor to deliver the procured valves without seismic testing. The similarity analysis was not evident in the CGI dedication and procurement documents that HSS reviewed. Typically, seismic testing or analysis should be conducted for the specific response spectra for the CVDF site, valve mounting and orientation and valve configuration as installed in CVDF. HSS requested the pertinent procurement and CGI documentation, including seismic documents for He-GOV-1502 and He-GOV-1506. CHPRC provided detailed documents in response, but none that pertained specifically to seismic testing of He-GOV-1502 and He-GOV-1506.

In response to questions concerning the commercial grade dedication process, the site engineering staff indicated that the seismic similarity analysis was conducted for additional equipment and spare item procurements. In a file memo dated August 20, 2003, entitled, "FLUOR HANFORD CONTRACT 2588 PROCESS HOOD and 2697 SAFETY CLASS HELIUM SYSTEM", the site contractor directs the vendor to send the CGI dedication submittals without completion of the seismic requirements. Further, the memo indicates that the draft subcontractor seismic similarity analysis should be sent. The draft (or final as the case may be) seismic similarity analysis was not found in the documentation provided to HSS by CHPRC.

The "Specification for Fabrication, Acceptance Testing, and Shipment of the Cold Vacuum Drying Facility Process Hood, Seal Ring, and Piping Assemblies (W-441-P4)" provides for the seismic testing criteria among other procurement specifications. This specification indicates for seismic testing of He-GOV-1502 and He-GOV-1506 valves "shall be given a signal to close between 1 & 2 seconds after initiation of the seismic trial. Verify by visual inspection immediately after seismic test that valve has closed.", and "All fittings, connections, and attachments should be checked after the trial to verify their integrity. Failure of any fittings, connections and attachments constitutes a nullification of the test results." Seismic response testing for He-GOV-1502 and He-GOV-1506, in accordance with this procurement specification (based upon IEEE- 344-1987 and ASME B31.3 - 1996), was not demonstrated by CHPRC during the review.

Site engineering staff indicated that a destructive seismic test was performed on one GOV, but again the record of this testing has not been found. Site engineering further indicated that apparently, at some point, the accident and dose consequences analysis were re-analyzed to permit downgrading the safety classification of these equipments from safety class to safety significant.

In addition, micro switch valve position indicators are encapsulated in the pneumatic operator. These indicators are actuated by cams on the globe valve stem to show the valve position. It is not clear whether these indicators were qualified for reliability or underwent alternate failure studies that would adequately demonstrate their functionality after a seismic shock. During MCO processing, a momentary control room alarm indicated that the He-GOV-1502 and He-GOV-1506 valve positions were in disagreement. Apparently, the alarm is actuated when the subject valves are not indicated either both closed or both open. Generation of this alarm may indicate micro switch degradation (including but not limited to unstable contact, actuator damage, contact resistance, contact oxidation, etc.). At the time of this report, CHPRC was continuing to investigate the qualification of He-GOV-1502 and He-GOV-1506 and their associated micro switches. (See OFI-4.)

MCO Transfer

HSS observed the process of transferring the MCO from the K Basin to the CVDF. The transport time from the K Basin until the MCO was vented at CVDF was 21 hours, only 3 hours less than the technical safety requirement (TSR) limit of 24 hours. The MCO was delayed initially in the K Basin Loadout Bay due to alpha contamination on the transport trailer. In past MCO shipments, the MCO trailer was surveyed for possible contamination on the third shift the night before the shipment and decontaminated if

necessary, so the oncoming day shift could immediately begin transport preparations. For this MCO shipment, it appears that a third shift had not been scheduled to survey and decontaminate the trailer. An additional delay occurred because the MCO trailer brakes were engaged in the brake position and were disengaged only after considerable effort. The MCO trailer is maintained under a program conducted at the Canister Storage Building. In addition, the MCO trailer was staged outside the K Basin Loadout Bay, during a period of rainy weather. The facility should consider evaluating the root cause of the brake problem. (See OFI-5.)

As the 24-hour TSR limit approached, there was some discussion of in-place venting of the MCO, but it was not entirely clear whether the in-hand procedure applied to in-place venting of the MCO while it was on the trailer in the K Basin Loadout Bay. Subsequently, HSS reviewed portions of the applicable procedures: OP-70-034W, "Remove MCO/Cask from Basin and Place on Transporter (OCRWM)"; OP-94-005V, "Response to Transportation Delays"; and PS-700, "MCO Cask Transport Related Controls." For delays in transit between K Basin and CVDF, OP-70-034W directs the operator to OP-94-005V, which clearly states that the procedure is not to be used inside K Basin, CVDF, or CSB but does specify an approved venting device and procedure for venting the MCO. PS-700 also addresses process controls for MCO transport from K Basin to CVDF and from CVDF to CSB. None of these procedures provides clear direction with respect to disposition and venting of the MCO in place in the K Basin Loadout Bay when the 24-hour TSR limit is approached. (See OFI-6.)

In addition, OP-70-034W, 4.3.11 states, "Move Cask from load out pit area to transport trailer," and provides an appendix that diagrams the cask travel path. However, the procedure does not specify a height limitation for the cask above the Loadout Bay floor. Likewise, the safety analysis report (SAR) does not specify any height limitations above the Loadout Bay floor when the estimated 60,000 pound MCO travels from the loadout pit to the transport trailer, but indicates that if the MCO cask drops onto the operations deck while being moved to the transport trailer, the MCO could tip and hit the south loadout pit curb, potentially resulting in significant cracking of the south loadout pit wall. The SAR projects a worst case loss of K Basin water level to just below the TSR limit of 15 feet. Discussions in the K-Basin Loadout Bay indicated that the typical practice is to transport the MCO approximately four feet above the bay floor. The facility may consider revising OP-70-034W to include MCO movement specifications in the Loadout Bay, based upon impact calculations in the SAR. (See OFI-7.)

5.0 CONCLUSIONS

The HSS independent review concluded that overall, CHPRC effectively and safely conducted the processing of the found fuel MCO in accordance with procedural requirements and TSRs. HSS identified some potential vulnerabilities in the performance of this process that have need of increased management attention and rigor. These included improvements in control room conditions, valve position and qualification, and specific aspects of the MCO transfer and associated procedures.

6.0 OPPORTUNITIES FOR IMPROVEMENT

The following opportunities for improvement should be evaluated by DOE-RL management in accordance with site issues management processes. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

OFI-1: Consider re-visiting operational observation policy to ensure that the precept of effective

observation does not degrade the execution of the operational activity. For expert individual observers without operational experience, consider providing a pre-briefing on the operational activity that they are assigned to witness, and suggest effective operational interface practices.

OFI-2: Consider reviewing the operational procedures covering MCO cask venting to ensure that they address all situational events.

OFI-3: Consider reviewing the practice of verifying safety significant valve position indication with non-safety system process software at CVDF. Where appropriate, consider adding provisions for direct verification (i.e., visual observation) of the valve position.

OFI-4: Consider reviewing CGI dedication documentation to ensure that He-GOV-1502 and He-GOV-1506 were fully qualified as safety significant valves.

OFI-5: Consider re-examining the CSB maintenance program to ensure that transport trailers are fully operational before operations begin so that MCO transport to K Basin can be completed within the 24-hour TSR limit.

OFI-6: Consider ensuring that appropriate manpower resources are assigned to survey and, if necessary, decontaminate the MCO transport trailer in the K-Basin Loadout Bay so that the 24-hour TSR limit can be conservatively met.

OFI-7: Consider evaluating and defining height restrictions in the K Basin Loadout Bay procedures for the MCO load path to minimize kinetic energy impact in the event of a drop accident.

7.0 ITEMS FOR FOLLOW-UP

HSS plans to continue its operational oversight awareness activities for Sludge Treatment Project. HSS is also considering a review of the site contractor's CGI dedication program.

Appendix A
Documents Reviewed

- 10 CFR 830, Nuclear Safety Management
- DOE Policy 226.1B, Department of Energy Oversight Policy
- DOE Order 226.1B, Implementation of Department of Energy Oversight Policy
- DOE Order 227.1, Independent Oversight Program
- OP-94-008V, Process MCO/CASK In Process Bay 5 (OCRWM)
- OP-94-012V, Verify Process Bay 5 is Ready to Use
- OP-70-034W, Remove MCO/Cask from Basin and Place on Transporter (OCRWM)
- OP-94-005V, Response to Transportation Delays
- PS-520, Cold Vacuum Dryness Test and Particulate Generation Controls (OCRWM)
- PS-700,MCO Cask Transport Related Controls
- Cold Vacuum Drying Facility Hazard and Accident Analysis
- Cold Vacuum Drying Facility Technical Safety Requirements
- Cold Vacuum Drying Facility Master Equipment List
- KW Basin Safety Analysis Report
- Seismic Test Specifications for the CVDF TWLPC to the Transportation Cask (SNF-6864)
- Seismic Analysis of Safety Class Helium System and MCO Valves Support Weldment (MER-2288-S-05)
- Seismic Test Specifications for the SCHe System Panel and PC-3 Components (SNF-4895)
- Seismic Test Specifications for Safety Class CVD Process Hood Components (SNF-4896)
- Specification for Fabrication, Acceptance Testing and Shipment of the Cold Vacuum Drying Facility Process Hood, Seal Ring, and piping Assemblies (W-441-P4) (SNF-5303)
- Specification for Fabrication, Acceptance Testing and Shipment of the Cold Vacuum Drying Facility Safety Class Helium System Equipment (W-441-P5) (SNF-5304)
- Flowserve Worcester Controls, Access Actuator, Pneumatic Automation with Total Process Interface

Appendix B
Supplemental Information

Dates of Onsite Review April 16-18, 2012

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