

**Independent Oversight Review of the
Hanford Tank Farms
Safety Management Program Implementation for
Hoisting and Rigging**



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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

DOE	U.S. Department of Energy
FR	Facility Representative
HIHTL	Hose in Hose Transfer Line
HSS	Office of Health, Safety and Security
ISM	Integrated Safety Management
MARS	Moveable Arm Retrieval System
MSA	Mission Support Alliance
ORP	Office of River Protection
SMP	Safety Management Program
WRPS	Washington River Protection Solutions, LLC

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1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Enforcement and Oversight (Independent Oversight), within the Office of Health, Safety and Security (HSS), conducted an independent review of the implementation of the safety management program (SMP) for hoisting and rigging at the Hanford Tank Farms. The review was performed by the HSS Office of Safety and Emergency Management Evaluations and was carried out to assess the effectiveness of management programs that ensure the safety of workers, the public, and the environment. This review was conducted concurrently with a review conducted by the Office of River Protection (ORP). The Independent Oversight review was conducted within the broader context of ongoing reviews of SMPs at DOE sites with hazard category 1, 2, and 3 nuclear facilities. This review focused on evaluating the implementation and effectiveness of the SMP at the Hanford Tank Farms to ensure continued safe work performance in accordance with the principles of integrated safety management (ISM) described in DOE Policy 450.4A, *Integrated Safety Management Policy*, which enable the Department's mission goals to be accomplished efficiently while ensuring safe operations at all Departmental facilities and activities.

2.0 BACKGROUND

ORP was established in 1998 to manage the 56 million gallons of liquid or semi-solid radioactive and chemical waste stored in 177 underground tanks at the Hanford Site. ORP serves as DOE line management for two functions: the Tank Farms, which maintain the 177 underground storage tanks; and the Waste Treatment and Immobilization Plant, which is under construction and will be used for retrieval, treatment, and disposal of the waste stored in the underground tanks. The Tank Farms are managed and operated by Washington River Protection Solutions, LLC (WRPS) under contract to ORP. The ORP Tank Operations Division provides Tank Farm oversight.

The HSS independent oversight program is designed to enhance DOE safety and security programs by providing DOE and contractor managers, Congress, and other stakeholders with an independent evaluation of the adequacy of DOE policy and requirements, and the effectiveness of DOE and contractor line management performance in safety and security and other critical functions as directed by the Secretary of Energy. The independent oversight program is described in and governed by DOE Order 227.1, *Independent Oversight Program*, and a comprehensive set of internal protocols, operating practices, inspectors' guides, and process guides. The program is implemented by two subordinate offices: the Office of Security and Cyber Evaluations and the Office of Safety and Emergency Management Evaluations.

The Office of Safety and Emergency Management Evaluations evaluates safety policies and programs throughout DOE, with a particular emphasis on evaluating worker and public protection from the nuclear hazards that exist at many DOE sites. This office accomplishes its mission through two primary mechanisms: (1) a network of staff site leads who are assigned to monitor activities at DOE sites with nuclear facilities or activities and coordinate office appraisal activities at those sites; and (2) a program of targeted reviews that evaluate selected functional or topical areas at multiple sites across the DOE complex. Appraisal activities are selected, prioritized, and planned based on such factors as risk to workers and the public, facility operational status, and performance history.

3.0 SCOPE

Independent Oversight selected the C Tank Farm for this hoisting and rigging review and coordinated its activities with ORP oversight activities scheduled in the ORP Integrated Assessment Plan. Hoisting and rigging is required for worker protection, as well as for protection of the lifted equipment and the equipment over which the hoisted load travels.

This review evaluated the effectiveness of implementation of hoisting and rigging safety at the C Tank Farm, including implementation of the ISM core functions. Processes for work planning and control, including identification and control of hazards (including isolation of energy sources and use of personal protective equipment), and post-job evaluation and feedback of lessons learned, were areas selected for this review. The review also evaluated the effectiveness of ORP oversight related to hoisting and rigging safety at C Tank Farm.

4.0 METHODOLOGY

This Independent Oversight review evaluated the effectiveness of implementation of the *Hanford Site Hoisting and Rigging Manual*, DOE/RL 92-36, September 21, 2012, at the C Tank Farm. The review consisted of an evaluation of the work control procedures used to perform the lifts; evaluation of the job hazard analyses supporting the work, including the critical lift plans when required; observation of the pre-job briefings for observed work; interviews with craft workers and supervisors; and walkdowns of the work areas with the ORP Facility Representatives (FRs) assigned to the C Tank Farm. The review did not evaluate the adequacy of the *Hanford Site Hoisting and Rigging Manual*, but rather focused on the implementation of the program. ORP oversight of hoisting and rigging safety was also evaluated.

Selected objectives and criteria from the following sections of HSS Criteria, Review and Approach Document 64- 10, Rev. 2, *Performance Based Inspection of Worker Safety and Health Utilizing the ISM Core Functions*, were used to define the scope of this targeted review:

- Define the Scope of Work (Section 5.1)
- Analyze the Hazards (Section 5.2)
- Develop and Implement Controls (Section 5.3)
- Perform the Work Within Controls (Section 5.4)
- Feedback and Improvement (Section 5.5)

5.0 RESULTS

Independent Oversight was able to observe three different hoisting and rigging activities during this review:

- Hot water skid lift from a tractor trailer to a prepared gravel bed with steel pads for skid leg reinforcement adjacent to the C Tank Farm
- Installation of the Moveable Arm Retrieval System (MARS) on the C-105 tank large riser
- Removal of Hose in Hose Transfer Lines (HIHTLs) between the 241-AN and the 241-C farms.

Two of the observed lifts were critical lifts. The hot water skid delivered to the C Tank Farm weighed in excess of 34,000 pounds. The MARS Platform/Turn Table Assembly weighed almost 44,000 pounds and was categorized as an engineered lift – a critical lift with additional controls beyond those specified for a critical lift, as required by the *Hanford Site Hoisting and Rigging Manual*. This lift involved the suspension by crane of a 44,000 pound load over the top of the tank. The HIHTL lifts were simple, small

lifts ranging from a few hundred pounds to the thousand pound range. The installation of the MARS assembly on the C-105 large riser required opening the riser, potentially allowing tank vapors to rise into the work area. Similarly, the movement of HIHTLs that had carried tank liquids created the possibility of tank vapors in the work area. The industrial hygiene sampling plans developed for these work activities addressed the possibility of tank vapors and need to protect workers from tank fumes.

5.1 Define the Scope of Work

The hot water skid delivery and installation of the MARS System on the C-105 tank involved heavy lifts, with the MARS being suspended over and mounted on a hazardous waste tank. In each case, the scope of work was detailed step by step for each part of the rigging installation and load movement. The HIHTL removal involved simple lifts of small loads and was described as such in the work instructions.

Hot Water Skid Delivery

This delivery was an assembled hot water supply to the C Tank Farm area. The assembled skid weighed in excess of 34,000 pounds and was delivered on a low boy tractor trailer. A crane lift was required to hoist the skid assembly from the low boy trailer and then move the assembly horizontally by crane rotation to the adjacent prepared gravel pad with installed steel plates to support the skid legs. Due to the weight of the assembly to be lifted, the activity was correctly categorized as a critical lift in accordance with the *Hanford Site Hoisting and Rigging Manual*.

Installation of the MARS on the C-105 Tank Large Riser

Installing the MARS on the C-105 tank large riser involved lifting a 44,000 pound assembly, in a congested work area, over the top of the underground hazardous waste tank. This was categorized as a critical lift in accordance with the *Hanford Site Hoisting and Rigging Manual*. Additionally, a second crane was used to lift auxiliary components required for the large assembly installation while the main crane supported the MARS assembly. Such a lift, requiring coordination between two cranes, is classified as an engineered lift in accordance with the *Hanford Site Hoisting and Rigging Manual*. This installation was correctly categorized as a critical engineered lift.

Removal of HIHTLs

Removing inactive HIHTLs involved using a crane for lifting; the hose weighs on the order of 10 pounds per foot of length, so removing the hose in lengths of several tens of feet at a time resulted in lifts requiring mechanical assistance. The weights involved were substantially lower than the capacity of the motor crane, and HIHTL removal was accomplished as part of the work order using normal lifting procedures. This was neither a critical lift nor an engineered lift.

The scope of work described in the work instructions for each of the three observed hoisting and rigging activities was appropriate.

5.2 Analyze the Hazards

Hot Water Skid Delivery

Due to the weight of the assembly to be lifted (more than 34,000 pounds); the activity was correctly categorized as a critical lift in accordance with the *Hanford Site Hoisting and Rigging Manual*. The lift was performed in a non-contaminated area free of obstructions. Access to the area was controlled during the lift. No additional or unusual hazards were identified other than the weight of the assembly lifted.

Installation of the MARS on the C-105 Tank Large Riser

This lift was correctly categorized as a critical engineered lift in accordance with the *Hanford Site Hoisting and Rigging Manual*. The lift was almost 44,000 pounds in a congested area over a buried hazardous waste tank. The lift plan contained in the work instructions included coordination between the primary crane and second crane, which was used to lift auxiliary components for the large assembly installation while the primary crane supported the MARS assembly.

Installing the MARS on the C-105 tank large riser required opening the riser while workers were near and directly over the riser. The job hazard analysis appropriately identified the potential for hazardous vapors from the riser and high radiation exposure. A seasonal hazard at Hanford, also correctly identified, was heat stress, since the Tank Farm workers wear anti-contamination protective clothing in a potential contamination area and work outside in the sun and ambient air, rather than in a shaded, air-conditioned process facility.

Removal of HIHTLs

Removing inactive HIHTLs involved no unusual hazards resulting from use of a motor crane. The lifts were of a few hundred pounds at a time. The work instructions addressed this activity as normal crane usage not requiring special controls, consistent with the *Hanford Site Hoisting and Rigging Manual*. The job hazard analysis identified hazards from possible residual liquids in the sections being removed; the residual liquids (and solids that may have plated out on the interior of the hose) present both radiological and chemical hazards. As noted, heat stress was correctly identified as a seasonal hazard at Hanford, since the Tank Farm workers wear anti-contamination protective clothing while working outside in the sun and ambient air.

Hazards were correctly identified for the three activities observed during this review.

5.3 Develop and Implement Controls

Hot Water Skid Delivery

The delivery and placement of the hot water skid involving a critical lift plan, as noted above, was accomplished outside a contamination area or radiation area. Access to the work area was controlled during the lift. The area was free of obstructions. No additional hazards requiring special controls other than the weight of the assembly being lifted were identified. As discussed in Section 5.4, an error was made during the initial rigging. The error was quickly identified and corrected, and the lift was completed in accordance with the lift plan.

Installation of the MARS on the C-105 Tank Large Riser

The C-105 MARS installation was accomplished in accordance with the engineered lift plan developed for the work. No problems were encountered in coordinating the two cranes. Occupational safety representatives monitored the work to ensure that workers were attentive to avoiding overhead hazards. The work over the C-105 tank required opening of the large riser to remove previously installed equipment and install the MARS equipment. Industrial hygiene specified extensive monitoring equipment at specific points around the work area to monitor for tank fumes. Workers were required to wear respirators until industrial hygiene determined that no hazardous vapors were present over the C-105 tank during equipment installation. Similarly, health physics technicians set up multiple monitors and restricted access in the potentially high radiation area until it was determined that dose rates were within radiation area limits and did not approach high radiation area thresholds.

The MARS installation was expected to take an entire shift with a relatively large crew and two cranes (requiring an engineered lift plan). Because of the anticipated work restrictions related to heat stress, the contractor, with worker agreement, shifted the operation to start at midnight, thus ensuring cool temperatures that would allow the work to continue without interruption. This control worked as intended. Given weather conditions at the Hanford Site and the requirement for anti-contamination clothing to perform the work, moving the work to night time was appropriate.

The pre-job briefing for the MARS installation was observed as part of this review. Since the MARS work was scheduled for the middle of the night, the pre-job briefing was conducted earlier, during normal work hours, before the workers left the site to rest before returning for the midnight work start. The afternoon pre-job briefing was detailed and comprehensive. When the workers regrouped at midnight to perform the work, a second pre-job briefing was conducted to again highlight job hazards and controls.

Removal of HIHTLs

The HIHTL lifts were routine, did not require a special lift plan, and were carried out during normal daytime work hours. The work was performed under a radiological work permit. The pre-job briefing for the HIHTL removal was observed as part of this review and was performed in accordance with site expectations. The briefing satisfactorily addressed identified hazards and controls implemented to protect workers from those hazards during the activity. The movement of HIHTLs that had carried tank liquids created the possibility of tank vapors in the work area. The industrial hygiene sampling plan addressed this possibility and the need to protect workers from tank fumes. Industrial hygiene also appropriately monitored wet and dry bulb temperatures at the work area to identify needed rest breaks for workers and observe workers for signs of heat related stress.

Appropriate controls were identified and implemented for the three work activities observed during this review.

5.4 Perform the Work Within Controls

Independent Oversight learned during the review that two different groups perform hoisting and rigging operations at the Hanford Tank Farms: Mission Support Alliance (MSA) provides site contractor riggers and crane operators for some hoisting and rigging activities, and construction contractors supply riggers and crane operators, including hoisting and rigging supervision, for construction activities. Both organizations were observed during this review. ORP FRs and Independent Oversight interviewed both MSA and construction contractor rigging and hoisting supervisors and riggers. Both organizations are required to perform hoisting and rigging activities in accordance with the *Hanford Site Hoisting and Rigging Manual*. A specific control required by the manual is that two different riggers inspect all the slings and rigging hardware to ensure that the inspection tags are attached and the inspection dates are current. Both the MSA and construction rigging personnel satisfied this control. The construction supervisor added that on his job, two riggers perform the required inspections, and he performs an additional, independent inspection of the slings and hardware.

Hot Water Skid Delivery

In the first lift observed, the hot water skid was lifted from the bed of a low boy trailer and placed on a gravel bed adjacent to the trailer. This lift was planned to minimize the airborne movement of the skid, which weighed more than 34,000 pounds. The delivery and placement took place on a rainy, overcast day, and heat stress was not a concern. When the skid was raised from the bed of the truck trailer, it was clearly not coming up level; the weight of the load was not correctly balanced. The lift supervisor appropriately halted the lift when the load was only about a foot above the truck trailer and had the load

lowered back onto the truck. On examining the rigging, the riggers and supervision determined that the upper rigging, a spreader beam with offset bridle, was installed backwards. One leg of the bridle was 12 feet long and the other leg was 12 feet six inches long, so installing the rigging backwards caused the center of gravity to be out of alignment with the rigging. The rigging was reinstalled correctly, and the lift and placement of the hot water skid was successfully accomplished as Independent Oversight and the ORP FR watched.

Afterward, the contractor conducted a fact finding to determine what went wrong. The event was determined to be a single error of installing the spreader beam to the crane with the wire rope slings oriented in a manner that was not in compliance with the special lift plan. The contractor identified the impacted barriers as inadequate work instructions to specify the long vs. short sling, marking and labeling deficiencies on the slings, and work environment distractions. ORP determined that the contractor adequately addressed these issues, and Independent Oversight concurs with ORP's determination.

Installation of the MARS on the C-105 Tank Large Riser

The installation of the MARS Platform/Turn Table Assembly and Containment Box on the C-105 large riser involved a large crew, two cranes, and much oversight. Industrial hygiene appropriately provided full-time monitoring of the worker breathing zones. Similarly, multiple, appropriately-assigned health physics technicians monitored the work area and air for radiation and contamination. Workers were not allowed near the open riser without respiratory protection until industrial hygiene and health physics concurred that the air was safe to breathe, and this control was enforced. Independent Oversight and the ORP FRs observing the activity found the industrial hygiene and radiological protection controls implemented for this activity to be appropriate for the identified hazards.

The crane operation was carefully performed and was well supervised, and the activity proceeded without incident. Workers were actively reminded to stay out from under loads. Additionally, occupational safety barricaded the crane swing area to ensure that workers were clear of the crane housing when it rotated. The work was accomplished satisfactorily and in compliance with identified controls.

Removal of HIHTLs

The HIHTL work involved simple lifts of bundled hose or hose insulation. Health physics, industrial hygiene, and occupational safety were present and monitored the work, including (as noted in Section 5.3) wet and dry bulb temperatures to guard against heat stress for workers in anti-contamination clothing working in the sunlit area. The work proceeded in accordance with identified work controls and without incident.

With the exception of the rigging error on the hot water skid lift which was immediately identified and corrected, the three activities observed during this review were accomplished within the identified controls for the activities.

5.5 Feedback and Improvement

The contractor routinely conducts post-job briefings to solicit input from workers on how to improve performance and/or prevent recurrence of identified errors. Post job briefings were not observed during this review, however, Independent Oversight and the ORP FRs did observe the pre-job briefings for the MARS placement and Hose-in Hose removal and noted that lessons learned from previous lifts were discussed in those pre-job briefings. All the work observed during this review proceeded without incident, except for the initial lift of the hot water skid with the spreader bar rigging installed backwards. As noted in Section 5.4, the contractor conducted a fact finding meeting to identify the cause of this error

and determined that the work instructions did not adequately address the differences in the rigging and the rigging labels did not sufficiently highlight the differences in length of the attached bridles. ORP found that the contractor's actions addressing this error were satisfactory, and Independent Oversight concurs with ORP's determination.

Independent Oversight also observed the ORP FRs performing their concurrent review of contractor hoisting and rigging activities. ORP personnel were actively involved in observing the work and reviewing the work planning documents and other relevant documents before the work activities began. The one lift activity that encountered difficulty was observed by both the ORP FR and the ORP Tank Farm Operations Division Director. ORP's oversight of this and the other lifts was effective. ORP identified no deficiencies worthy of a finding or opportunity for improvement. Independent Oversight concurs that the observed activities were performed safely, with no discrepancies.

6.0 CONCLUSIONS

Independent Oversight observed three hoisting and rigging operations conducted by both site contractor personnel (MSA) and construction contractor personnel to evaluate the implementation of the expectations set out in the *Hanford Site Hoisting and Rigging Manual*. In general, the observed work was adequately planned, hazards were correctly identified in advance, and appropriate controls were established to address the identified hazards. For the observed activities, the workers fully followed and implemented the required work controls except for the rigging set up in one lift. In addition, adequate safety support personnel (industrial hygiene, occupational safety, and/or health physics) were present during the work. The work was also well supervised. The one observed lift that did not proceed correctly was immediately halted by the supervisor and the rigging error was corrected, allowing the work to proceed. The contractor appropriately solicits input from workers following completion of work activities. For the lift that required correction, the contractor conducted a fact finding meeting to identify causes in order to prevent similar errors in the future. Overall, Independent Oversight determined that ORP was effective in its oversight of these lifts.

Appendix A Supplemental Information

Dates of Review

Onsite Review: June 18 and July 29-31, 2013

Office of Health, Safety and Security Management

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Appendix B Documents Reviewed

- DOE/RL 92-36-*Hanford Site Hoisting and Rigging Manual*, September 21, 2012
- ORP Facility Representative Program Surveillance Guide CPS 8.1, *Hoisting and Rigging*
- Washington River Protection Solutions (WRPS) Daily Report, Monday July 29, 2013
- WRPS Daily Report, Tuesday July 30, 2013
- WRPS Daily Report, Monday August 5, 2013
- WRPS Daily Report, Thursday August 8, 2013
- Work Order TFC-WO-13-3432, *MARS-V Prep Riser, Install Platform/Turn Table Assembly & Containment Box*
- WRPS Job Hazard Analysis Checklist for TFC-WO-13-3432
- Industrial Hygiene Sample Plan (ISHP)-COPC-RC-08, *C-105 Prep Riser; Install Platform, Turntable, Containment Box, MARS Mast Area, and Long Length Equipment*
- Radiological Work Permit (RWP)-CO-785, C-105 MARS-V Prep Riser, Install Platform/Turn Table Assembly & Containment Box and Associated Work Activities (HRA, RA, HCA,CA,ARA)
- Hoisting and Rigging: Lift Instructions Determination, TFC-WO-13-3432, Special/Engineered Lift
- Work Order TFC-WO-12-5848, Remove HIHTL(s) Between 241-AN & 241-C Farms
- ORP Tank Farms Report 19792, Planned Level 2 Assessment: *Hoisting and Rigging*
- Work Order TFC-WO-12-5765, Hot Water Skid Lift
- WRPS-PER-2013-1075, C Farm Hot Water Skid Lift