

**Independent Oversight Review
of the Hanford Tank Farms
Radiological Controls Activity-Level
Implementation**



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**Office of Safety and Emergency Management Evaluations
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Acronyms

| | |
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| ACES | Access Control Entry Station |
| ALARA | As Low As Reasonably Achievable |
| AOP | Abnormal Operating Procedure |
| ARA | Airborne Radioactivity Area |
| CA | Contamination Area |
| CFR | Code of Federal Regulations |
| CRAD | Criteria, Review, and Approach Document |
| DOE | U.S. Department of Energy |
| FR | Facility Representative |
| GM | Geiger-Mueller |
| HCA | High Contamination Area |
| HSS | Office of Health, Safety and Security |
| HPT | Health Physics Technician |
| JHA | Job Hazards Analysis |
| MDA | Minimum Detectable Activity |
| ORP | Office of River Protection |
| PAM | Portable Alpha Monitor |
| PPE | Personal Protective Equipment |
| RBA | Radiological Buffer Area |
| RCT | Radiological Control Technician |
| RPP | Radiological Protection Program |
| RWP | Radiological Work Permit |
| TWD | Technical Work Document |
| WRPS | Washington River Protection Solutions, LLC |

Independent Oversight Review of the Hanford Tank Farms Radiological Controls Activity-Level Implementation

1.0 PURPOSE

This report documents an independent review by the Office of Enforcement and Oversight (Independent Oversight) within the Office of Health, Safety and Security (HSS) of radiological protection program (RPP) activity-level implementation at the Hanford Tank Farms. The review was performed by the HSS Office of Safety and Emergency Management Evaluations and was carried out within the broader context of an ongoing program of targeted assessments of radiological control programs, with an emphasis on the implementation of radiological work planning and control across the U.S. Department of Energy (DOE) complex at sites that have hazard category 1, 2, and 3 facilities. The purpose of this Independent Oversight targeted review effort is to evaluate the flowdown of occupational radiation protection requirements, as expressed in facility RPPs, to work planning, control, and execution processes, such as radiological work authorizations, including radiological work permits (RWPs) and other technical work documents (TWDs). Independent Oversight accomplished this review by performing assessments that included activity-level observations.

This targeted review was performed at the Hanford Site during the period of October 22-26, 2012. This report discusses the background, scope, methodology, results, and conclusions of the review, as well as items identified for further follow-up by HSS.

2.0 BACKGROUND

The DOE Office of River Protection (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. Tank Farm oversight is provided by the ORP Tank Operations Division.

Title 10 CFR Part 835, *Occupational Radiation Protection*, explains the requirements for developing, implementing, and maintaining an RPP. Title 10 CFR 835.101(a), *Radiation Protection Programs*, states that “A DOE activity shall be conducted in compliance with a documented radiation protection program (RPP) as approved by the DOE.” Each DOE site that works with radiological material has developed an RPP and supporting implementing procedures for radiological control.

The WRPS RPP is documented in HNF-MP-5184, Washington River Protection Solutions, LLC. Radiation Protection Program, which covers any DOE activity conducted by WRPS, its subcontractors and suppliers, or any company or individual under formal agreement to perform radiological activities under the WRPS RPP on behalf of DOE. It encompasses implementation of radiological controls during operation and management of the Hanford Tank Farms, which was the focus of this assessment.

3.0 SCOPE

For this review, Independent Oversight reviewed the documented WRPS processes for planning radiological work and establishing radiological hazard controls, and observed work activities to verify the effectiveness of overall implementation of these processes at the Tank Farms. During this review, Independent Oversight observed work activities at the AN Tank Farm, which consisted of replacement of a waste tank pump and slurry distributor, as well as excavation and installation of associated instrumentation. Independent Oversight also interviewed a selection of key personnel responsible for the radiological controls subject area.

4.0 METHODOLOGY

The execution of this review was guided by HSS Criteria, Review, and Approach Document (CRAD) 45-35, Rev. 1, *Occupational Radiation Protection Program Inspection Criteria, Approach, and Lines of Inquiry*. This targeted review area assesses contractor implementation of RPP radiological work planning and control commitments by observing the conduct of work activities involving radiological hazards. Observed radiological work activities and practices are reviewed against site radiological control implementing procedures, the RPP, and 10 CFR 835, as indicated in HSS CRAD 45-35, Rev. 1.

This review was closely coordinated with ORP oversight schedules and was conducted concurrently with planned radiological field surveillance activities conducted by the DOE ORP Facility Representatives (FRs) at the Tank Farm work locations. The FRs documented the results of their oversight in three surveillance reports.

5.0 RESULTS

Observations associated with the observed radiological work are discussed below. Conclusions are summarized in Section 6, opportunities for improvement are listed in Section 7, and items for follow-up are discussed in Section 8.

5.1 DOE ORP oversight of contractor performance is conducted in a systematic and appropriate manner. Independent Oversight accompanied the ORP FRs performing operational awareness surveillances during this review. The scope of the ORP scheduled surveillance selected by HSS was to evaluate radiological work practices at the AN Tank Farm, which was addressing the highest risk radiological work at the time of the Independent Oversight site visit. The FR followed a formally published radiological work practice surveillance guide during his assessment. A formal surveillance report was issued. ORP FRs also conducted two reactive surveillances during the period of the HSS review, one in response to an off-normal ventilation upset at AN Farm, and the other resulting from questions raised by both the ORP FRs and Independent Oversight during observation of hand trenching work. From these three surveillance, the FRs documented two findings and three opportunities for improvement, which are further discussed below (See Results Statement 5.3) in the context of this Independent Oversight report.

5.2 Pre-job briefings associated with observed radiological work were thorough and adequately tailored to the specific work being planned for the day. Pre-job briefings for the AN pump replacement were held each morning before work was performed. These briefings were well attended, and the field work supervisor conducted them in a professional and formal manner. Adequate direction on work scope and methods of performance was provided. The field work supervisor also reviewed the applicable hazards and controls from the job hazards analysis (JHA) and presented other information and

lessons learned from the prior day's work shift. The lead radiological control technician (RCT) for the job provided a review and reading of information from the RWP. A few questions and concerns were raised, and these were thoroughly addressed during the briefing.

5.3 The observed Tank Farm operations were supported by comprehensive health physics job coverage. Health physics technician (HPT) staffing was sufficient, and HPTs were observed taking sufficient exposure rate and fixed and removable contamination measurements throughout the work. Donning and doffing practices were performed appropriately, and HPTs assisted each other and workers with respiratory protection, lapel samplers, and related radiological personal protective equipment (PPE) required for the work. The instruments that were used were source-checked and within the required calibration dates. Both grab and lapel air sampling were conducted in accordance with the RWP. Rigorous use of Access Control Entry Station (ACES) stations was also viewed as a positive control to ensure that workers were up to date on required training and qualifications for the tasks delineated in the RWP (i.e., radiological worker training, bioassay, and respiratory protection).

5.4 Weaknesses and insufficient rigor in application of some radiological requirements, particularly in contamination control, were observed during work evolutions at the AN Tank Farm (See Section 7.0, OFI-1). The following are examples of ineffective application of requirements and commitments of the WRPS RPP:

- Workers exiting a Contamination Area (CA) and Airborne Radiation Area (ARA) doffed their PPE, but the HPTs did not perform a thorough whole body contamination survey due to high background before the workers traversed the Radiological Buffer Area (RBA) on the way to the change trailer for a final automated whole body survey for contamination. During later discussions, WRPS radiological control management felt that this evolution was not performed in accordance with expectations, that the work planning process should have accounted for the high Geiger-Mueller (GM) background reading based on the nature of the work being performed, and that a designated monitoring location should have been established nearer the work.
- During execution of Abnormal Operating Procedure (AOP)-021, *Response to Tank Farm Ventilation Upset*, dressed-out workers from the CA and street-clothed workers from the RBA evacuated along the same path of travel before splitting off to different areas for their contamination surveys. RBA workers were subject to hand and foot surveys with GM detectors only. These frisks were performed too quickly for effective detection of cross-contamination, and alpha contamination surveys of the hands and feet were not performed. The AN pump replacement work was considered to have alpha potential, since alpha activity was recently detected during the work.
- There was insufficient contamination monitoring of items and equipment that were released from the CA during normal egress from the CA (not associated with AOP-021 event). The released items included electronic pocket dosimeters and hard hats, several of which were released after only a cursory direct frisk with a portable alpha meter (PAM) and/or GM. Technical smears were not consistently taken, and those that were taken were not counted for the proper time period defined in TF-RC-010, *Portable Alpha Meter (PAM) Operation and Source Checks*. In one instance, a piece of masslin cloth rather than a technical smear was used to wipe a hardhat, followed by a very short count on the PAM. Masslin is not generally an acceptable medium for an alpha technical smear because of self absorption. Technical smears were also taken along the equipment table, but they were counted in a qualitative manner for an inadequate period of time, generally less than 15 seconds. Another item released after qualitative survey was a cloth backpack with personnel vapor monitoring equipment that was worn on the outside of a worker's PPE. Because of its porous nature, this item may not meet the WRPS free release requirements.

- Workers were observed performing ground leveling with shovels under RWP CO-007, but HPTs did not perform alpha surveys as required by the RWP, which states that alpha surveys are required during all excavation activities. According to the work planner, the RWP statement was interpreted to refer to alpha surveys during the initial excavation activity; if no alpha was detected during that evolution, alpha surveys would not be necessary for subsequent evolutions. Nevertheless, the lack of alpha surveying appeared to be a direct violation of an RWP requirement, and WRPS management and the DOE ORP FR agreed that alpha surveys should have been performed to maintain compliance with the RWP as written. Survey records for the initial excavation work on October 18, 2012, show that alpha measurements were taken. However, the records contain only three entries, and they do not convey the extent of surveys performed in support of the work, locations of measurements taken, or the specific equipment that was surveyed and released.
- Some workers' lapel air samplers were not properly placed to ensure collection of a sample representative of the breathing zone, as is needed for proper evaluation of results. A number of workers' samplers were placed under loose-fitting hoods that could obstruct sampler effectiveness or in locations away from the breathing zone.

The FRs identified and forwarded to WRPS the following weaknesses related to concurrent observation of radiological work activities at the AN Tank Farm:

- There was inadequate survey of workers exiting a CA during the AN-101 pump installation (Finding).
- In regard to the excavation work at the AN Tank Farm, surveys for radiation, contamination, and airborne radioactive materials should be performed as specified in TWDs and RWPs (Finding).
- General housekeeping in the AN Tank Farm should be improved (Opportunity for Improvement).
- AOP-021, *Response to Tank Farm Ventilation Upset*, contains ambiguous requirements regarding actions to ensure that personnel are cleared from the Farms (Opportunity for Improvement).
- Greater care should be practiced in segregating personnel upon evacuation from a radiological area (Opportunity for Improvement).

5.5 Some WRPS Radiological Controls procedures lack sufficient direction, clarity, and/or linkage to related procedures to ensure effective implementation by HPTs in the field (See Section 7.0, OFI-2). These include:

- AOP-021, *Response to Tank Farm Ventilation Upset*, was implemented during work observations at the AN Tank Farm due to a loss of Farm vapor exhausters. Based on personnel and HPT response, Independent Oversight and the Facility Representatives felt that this AOP did not adequately convey several radiological requirements that must be formally addressed when radiological work is in progress and the Tank Farm must be evacuated due to loss of exhausters. Under the AOP, workers are instructed to exit the Tank Farm before doffing their anti-contamination PPE. However, no radiological control procedure, including AOP-021, fully addresses the specific radiological requirements for posting and radiological control for RBAs that may have become contaminated during an evacuation. For example, while the Area Manager maintains Tank Farm access control to limit vapor concerns, the Area Manager must also meet and understand the specific radiological posting and access control requirements. RBA and change trailer areas that personnel traverse while

wearing anti-contamination clothing must be considered and controlled as CAs until the exhausters are returned to service, Farm re-entry is authorized, and the areas are surveyed and downposted. Under the WRPS RPP, the Tank Farm Area Manager can be formally assigned responsibility for radiological posting and control for up to eight hours, at which point an actual CA posting would have to be established if the exhausters were still not functional. The AOP does not define such considerations, nor does any procedure fully address the specific survey requirements that HPTs are expected to follow when downposting or otherwise re-establishing an RBA. TFC-ESHQ-RP_Mon-C-18, *Radiological Posting*, addresses downposting, but only in a very general sense. It does not include specific guidance on the type of surveys required (fixed, removable, transferability) and the frequency of survey points (number of measurements per unit area). Survey records following this event show that only direct frisks with a walking stick for beta-gamma and random static measurement for alpha were performed for the gravel path used to evacuate the Farm. The frequency and locations of measurements were not recorded on the survey forms, and no removable or transferability surveys were taken. Following the evacuation event at AN Tank Farm, WRPS initiated Problem Evaluation Report Number WRPS-PER-2012-1796 to identify deficiencies in AOP-021. The WRPS corrective action management process should result in improvements to this procedure.

- Survey records in support of the AN Tank Farm work and the AOP-021 event used a 67% confidence level for evaluation of survey results. The use of a 67% confidence level for evaluation of technical smears is authorized by TFC-ESHQ-RP_MON-C-23 *Release Surveys for Material and Equipment*, when there is low potential for contamination, based on item history and answers to a series of questions presented in the procedure. Otherwise, a 95% confidence level is required. While the procedure provides some guidance, the ultimate determination as to “low potential” for contamination is subjective and left to the discretion of the RCT. WRPS contends that because many areas at Tank Farms are posted based only on potential and not actual contamination levels, it can be appropriate to consider items being released from posted CAs as having low potential for contamination. However, at the AN Tank Farm, the same 67% confidence level was used for evaluation of surveys on items and material being released from posted High Contamination Areas (HCAs) and ARAs; WRPS concedes that it would be difficult to justify a “low potential for contamination” status for these items and materials.
- Several WRPS procedures associated with radiological surveys and monitoring contain incomplete linkage, as well as conflicting and confusing information. TFC-RC-021, *Analyzing Air and Smear Samples for Alpha and Beta Emissions*, states that its purpose is to provide instructions to HPTs for analyzing air and smear samples for alpha and beta emissions. The scope and required use of this procedure for this purpose seems reasonable given industry standard practices, which typically use stationary scalers coupled to appropriate detectors that provide consistent smear geometry to support minimum detectable activity (MDA) calculations and validity of results. However, current practices at the Tank Farms use portable instrumentation for evaluation of technical smears, but not air samples, so the expectations for compliance with and use of TFC-RC-021 are unclear. These practices are based on a documented technical basis that, in theory, marginally supports the capability to achieve the required sensitivities afforded by traditional counting methods. Additional uncertainties and propagation of error inevitably introduced by human factors associated with use of the portable instruments are not included in the technical basis and sensitivity calculations (i.e., inconsistent geometry and count times), making them potentially inadequate under field conditions.

The procedures also present conflicting and confusing information on the use of portable equipment for smear counting (TFC-ESHQ-RP_Mon-C-23, *Release Surveys for Material and Equipment*; TFC-RC-010, *Portable Alpha Meter (PAM) Operation and Source Checks*; and TFC-RC-031, *Ludlum Model 2360 and 43-93 Probe Operational Checks and Use*). The Release Survey procedure

authorizes the use of the PAM and Ludlum procedures for evaluating fixed and removable contamination measurements at both the 67% and 95% confidence levels. However, contrary to this procedure, the Ludlum procedure does not allow use of the 95% confidence level without a release survey plan, nor does it contain any information for 95% confidence level surveys; only the PAM procedure for alpha contains both 67% and 95% confidence level instructions and tabular values, without any requirement for a release survey plan. The scope and broad base of information in these procedures, including the various confidence level values for achieving different detection sensitivities, would make execution by an HPT difficult if not impossible under field conditions unless the HPT had the procedure in hand, as evidenced by the work observations noted above indicating ineffective counting protocols and confidence level determinations. The difficulty in implementation, coupled with the additional statistical uncertainty introduced by human factors noted above, raises questions about the actual detection sensitivity, reproducibility and validity of results of technical smears evaluated through the use of these procedures instead of TF-RC-021.

5.6 The WRPS RPP lacks clarity and linkage to the specific implementing procedures and technical basis documents that satisfy the commitment basis for each requirement (See Section 7.0, OFI-3). The following is excerpted from the DOE Guide 441.1-1C, *Radiation Protection Programs Guide*, Section 3.1:

The approved RPP details how a DOE activity shall be in compliance with 10 CFR 835 and should identify the functional elements appropriate for that activity. Additional documentation should be developed and maintained to supplement the approved RPP to demonstrate that an RPP can be effectively managed and administered to achieve compliance with 10 CFR 835. This documentation typically includes a site radiological control manual developed to the guidance contained in the RCS [Radiological Control Standard, DOE-STD-1098-99], as well as detailed implementing procedures, appropriate management policy statements, and technical basis documentation. While this documentation need not be part of the RPP, it should be clearly linked to the compliance commitments contained in the RPP.

WRPS has developed appropriate documentation in support of its RPP and radiological control manual, including detailed implementing procedures, management policy statements, and technical basis documentation. Section VII of the WRPS RPP contains a compliance matrix that includes each 10 CFR 835 element and identifies a reference showing how it is to be addressed by WRPS. Page 35 of the RPP states that the column entitled “Other Implementing Provisions” is intended to include clarifications, supplemental policy statements, references to technical basis documents, and any other supplemental information used to clearly define WRPS’s commitment basis. However, this column is mostly blank and/or contains no reference or linkage to the supporting procedures and technical basis documents, as suggested by the implementation guide. Thus, the compliance matrix does not provide a comprehensive roadmap for requirements flowdown that identifies where each requirement is implemented in the overall document hierarchy comprising the RPP.

6.0 CONCLUSIONS

Independent Oversight determined that Tank Farm radiological control practices were generally adequately covered by written work authorizations that define required radiological controls and DOE ORP provided appropriate and effective oversight of the observed activities. Pre-job briefings were formal and comprehensive, and the level of health physics job coverage was appropriate for the work being performed. However, radiological control implementation was found to be ineffective with respect to performing adequate whole body surveys of personnel exiting a CA, and releasing material from a CA. Some programmatic concerns were also noted in radiological control procedures governing abnormal

operations and radiological release surveys, as well as the comprehensiveness of RPP flowdown and linkage to WRPS implementing mechanisms.

7.0 OPPORTUNITIES FOR IMPROVEMENT

Both ORP and Independent Oversight have similar definitions for opportunities for improvement. Independent Oversight identified the following opportunities for improvement. These recommendations are not intended to be mandatory. Rather, they are offered to the project to be reviewed and evaluated by the responsible line management organization and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

OFI-1 Consider strengthening WRPS's rigor and application of radiological and contamination control requirements. Specific actions to consider include:

- Retrain HPTs and workers on survey requirements for comprehensive whole body frisks of personnel exiting CAs to an RBA. Particular emphasis should be placed on workers' understanding of the regulatory requirements that drive the expectation for a whole body frisk before the use of the Automated Whole Body Counter in the change trailer. Also, provide periodic reminders to HPTs of the need to allow alpha and beta gamma instruments enough time to respond to contamination when performing hand and foot and whole body frisks.
- Evaluate the adequacy of personnel frisking practices by performing periodic targeted self-assessments.
- Retrain HPTs on survey requirements for materials and equipment being released from posted CAs. Particular emphasis should be placed on the proper use and evaluation of direct measurements and technical smears, particularly for alpha contamination assessment.
- Evaluate the adequacy of material and equipment release practices through periodic targeted self-assessments.
- Evaluate HPTs' understanding of, and the degree to which they comply with, TF-RC-010 and TF-RC-031. The evaluation should include interviews and performance tests to determine whether strict adherence to these procedures in a field environment (traffic, noise, etc.) is possible.
- Mitigate the potential for introduction of human error in the evaluation of technical smears by using TF-RC-021, coupled with the use of portable scalers with consistent geometry and count time (i.e. Ludlum 2929 or equivalent). Alternatively, at a minimum, consider using smear holders and timers that can be attached to portable instrument probes.
- Train workers and HPTs on proper placement of lapel samplers to ensure representative sampling when RWPs authorize different types of respiratory protection.

OFI-2 Consider improving WRPS's radiological control procedures. Specific actions to consider include:

- Revise AOP-021 to include specific expectations for radiological management during Tank Farm vapor evacuations, including personnel segregation, posting requirements, and radiological survey and downposting requirements.
- Clarify the scope and applicability of TF-RC-021, and make it mandatory for evaluation of fixed and removable contamination measurements that are used to demonstrate compliance with 10 CFR 835 requirements, where a 95% confidence level is warranted.
- Establish some linkage and conditions for using either TF-RC-021 or procedures TFC-ESHQ-RP_Mon-C-23, TF-RC-010, and TF-RC-031, the latter three of which allow use of portable

instrumentation for evaluating fixed and removable contamination.

- Revise TFC-ESHQ-RP_Mon-C-23 to include objective criteria for determining when to use the 67% and 95% confidence levels for work in posted radiological areas, such as CAs, HCAs, and ARAs. The current wording provides only for subjective determinations by HPTs.

OFI-3 Consider improving the WRPS RPP compliance matrix to provide more complete linkage to specific implementing mechanisms and technical basis documents that support the commitment basis for each specific requirement. Specific actions to consider include:

- Conduct a gap analysis to identify areas where the WRPS compliance matrix lacks clarity and linkage to the specific WRPS implementing procedures and technical basis documents that are intended to satisfy WRPS RPP commitments.
- Revise the compliance matrix to include appropriate references to implementing procedures and technical basis documents.

8.0 ITEMS FOR FOLLOW-UP

Independent Oversight will continue to follow up periodically on Tank Farm radiological control implementation, including the effectiveness of contamination control requirements and such areas as radiological survey recordkeeping, radiological work planning, and bioassay.

APPENDIX A

Supplemental Information

Review Dates

October 22-26, 2012

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APPENDIX B

Documents Reviewed

- HNF-MP-5184, Washington River Protection Solutions, LLC. Radiation Protection Program
- HNF-5183, Tank Farms Radiological Control Manual
- RPP-44100, Tank Operations Contractor Radiological Source Term Report
- TFC-051 1-FACT-0044, Counting Protocols for portable alpha instruments to achieve MDA of 20 dpm and 70 dpm, at 67% and 95% Confidence.
- TFC-ESHQ-RP_ADM-P-09 Documentation of Radiological Surveys
- TFC-ESHQ-RP_ADM-P-23 Work Place Air Monitoring
- TFC-ESHQ-RP_MON-C-14 Radiologically Contaminated Area Controls
- TFC-ESHQ-RP_MON-C-18 Radiological Posting
- TFC-ESHQ-RP_MON-C-23 Release Surveys for Material and Equipment
- TFC-ESHQ-RP_MON-P-09 Grab Air Sampling
- TFC-ESHQ-RPRWP-C-01 Radiological Risk Screening
- TFC-ESHQ-RPRWP-C-03 ALARA Work Planning
- TFC-ESHQ-RP_RWPC-04 Radiological Work Permits
- TF-RC-010 Portable Alpha Meter (PAM) Operation and Source Checks
- TF-RC-021 Analyzing Air and Smear Samples for Alpha and Beta Emissions
- TF-RC-031 Ludlum Model 2360 and 43-93 Probe Operational Checks and Use
- TF-AOP-021, Response to Tank Farm Ventilation Upset
- TFC-WO-12-1050, AN-101 Remove/Install Pump/SD Work Package, JHA and ALARA Management Worksheet
- RWP CO-730
- RWP-CO-007
- AN Tank Farm Radiological Survey Records Radiological Survey Records