Independent Oversight Review of the Savannah River Field Office Tritium Facilities Radiological Controls Activity-Level Implementation

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Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Assisted Hazard Analysis
ALARA	As Low As Reasonably Achievable
ARM	Area Radiation Monitor
CFR	Code of Federal Regulations
CRAD	Criteria, Review, and Approach Document
DOE	U.S. Department of Energy
DOE-SR	DOE Savannah River Operations Office
fpm	Feet per Minute
FR	DOE Facility Representative
FTE	Full-Time Equivalent
FY	Fiscal Year
HANM	H-Area New Manufacturing
HSS	DOE Office of Health, Safety and Security
LSC	Liquid Scintillation Counting
NNSA	National Nuclear Security Administration
OFI	Opportunity for Improvement
PPE	Personal Protective Equipment
RBA/RMA	Radiological Buffer Area/Radioactive Material Area
RCI	Radiological Control Inspector
RITS	Respirator Issuance Tracking System
RPD	Radiological Protection Department
RPP	Radiological Protection Program
RWP	Radiological Work Permit
SME	Subject Matter Expert
SRFO	NNSA Savannah River Field Office
SRID	Standards/Requirements Identification Documents
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
SRWP	Standing Radiological Work Permit
SS	Secondary Stripper
STAR	Site Tracking, Analysis and Reporting
TEF	Tritium Extraction Facility
TF	Tritium Facilities
VSDS	Visual Survey Data System

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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 the radiological protection program (RPP) at the Savannah River Site (SRS) Tritium Facilities (TF), implemented at the activity level by Savannah River Nuclear Solutions, LLC (SRNS) and its subcontractors. The review was performed by the HSS Office of Safety and Emergency Management Evaluations 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 U.S. Department of Energy (DOE) sites that have hazard category 1, 2, and 3 facilities. The purpose of this set of facility-specific Independent Oversight targeted reviews 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. To meet the goals of the targeted review, Independent Oversight performs assessments that are primarily driven by activity-level observations. Once all facility-specific reviews are completed, Independent Oversight will compile and analyze the data and develop a report on radiological control performance throughout the DOE complex.

This targeted review was performed at SRS from June 24 to July 12, 2013. This report discusses the background, scope, methodology, results, and conclusions of the review; findings and opportunities for improvement (OFIs); and items identified for further follow-up by Independent Oversight.

2.0 SCOPE

The scope of this review consisted of a review of activity level implementation of radiological control activities associated with National Nuclear Security Administration (NNSA) Savannah River Field Office (SRFO) TF operations conducted under the SRNS RPP. Key observations and themes from this review are presented in Section 5.0.

3.0 BACKGROUND

SRS is a 310 square mile (198,344 acre) site, located south of Aiken, South Carolina. SRS encompasses parts of Aiken, Barnwell, and Allendale counties and is bordered on the west by the Savannah River and the state of Georgia. SRFO tritium program operations are conducted at facilities located in the SRFO Tritium Complex. The facilities included in this review consist of two main active process buildings:

- H-Area New Manufacturing (HANM)
- Tritium Extraction Facility (TEF).

The primary missions performed at the TF are the reclamation of previously used tritium reservoirs; receipt, packaging, and shipping of reservoirs; recycling, extraction, and enrichment of tritium gas in support of the maintenance of the nuclear weapons stockpile; and limited-life component exchange reservoir surveillance. 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 SRNS RPP is documented in SRNS-RP-2008-00019 Rev. 1, *Savannah River Site Radiation Protection Program for 10 CFR Part 835 Occupational Radiation Protection*. The SRNS RPP is approved by the Manager of the Savannah River Operations Office (DOE-SR). SRNS defines the scope of applicability for the RPP as any activity carried out on behalf of DOE by SRNS, Savannah River Remediation LLC, Wackenhut Services Incorporated-Savannah River Site, the University of Georgia, their subcontractors and suppliers, or anyone engaged in activities that are not covered by a separate RPP and that could result in occupational exposure (as defined in 10 CFR Part 835.2) to ionizing radiation during direct onsite access at SRS. The SRFO tritium program operations reviewed during this assessment are such activities and are subject to the SRNS RPP.

4.0 METHODOLOGY

During this review, Independent Oversight reviewed the effectiveness of the flowdown of occupational radiation protection requirements to work planning, control, and execution processes at the SRFO TF. The scope and effectiveness of DOE's oversight of these activities were also evaluated. The principal radiological control criteria used for the evaluation were based on the lines of inquiry associated with activity-level work control contained in Sections A, B, and C of HSS Criteria, and Review Approach (CRAD) 45-35, *Occupational Radiation Protection Program Inspection Criteria, Review Approach, and Lines of Inquiry*. Independent Oversight also used applicable elements of HSS CRAD 45-21, Rev. 1, *Feedback and Continuous Improvement Inspection Criteria and Approach – DOE Field Element*, to collect and analyze data on field office oversight activities. Results of this review are based on a sampling of data and work that is ongoing at the time of the review and are not intended to represent a full programmatic review of the site RPP.

5.0 RESULTS

SRNS RPP Organization and Administration

SRNS was found to have an effective radiation protection infrastructure staffed by qualified and experienced personnel. The SRNS RPP is managed by the Radiological Protection Director, who reports directly to the SRNS Senior Vice President, Environment, Safety, Security, and Health. The Radiological Protection Director is supported by field radiation protection managers at key facilities, as well as technical support staff who manage the radiation protection infrastructure in such areas as health physics services (dosimetry, institutional procedures and documentation, etc.) and analytical services (e.g., laboratory analyses). A number of SRNS radiation protection managers and staff have professional certifications and/or advanced degrees in health physics or related disciplines, as well as years of applied radiation protection experience. At the TF, overall responsibility within SRNS for radiation safety belongs to the Manager of Radiological and Industrial Safety, who reports directly to the Savannah River Tritium Enterprise Director, Business Planning and Integration and is matrixed to the SRNS Radiation Protection Director. This Manager is a certified health physicist and has various radiological support staff, including a radiation protection facility manager, several Radiation Protection first-line managers, and field radiological control inspectors (RCIs).

Overall, the SRNS document hierarchy is appropriately comprehensive and includes radiological protection manuals, site-level procedures, and technical basis documents. The document hierarchy is effectively linked to the SRNS RPP through the standards/requirements identification document (SRID) process and a formal 10 CFR 835 compliance assessment. Through the SRID process, SRNS has developed a comprehensive 10 CFR 835 compliance matrix that includes clear flowdown of each requirement to the specific implementing mechanisms within the overall document hierarchy. This SRNS practice is consistent with the implementation guidance of DOE Guide 441.1-1C, *Radiation Protection Programs Guide,* Section 3.1.

Radiological Work Planning, Exposure, and Contamination Control

Engineering controls at the TF are robust and are used extensively to mitigate radiological hazards associated with operations. Tritium containment devices are the principal engineered controls and include gloveboxes in all process areas, as well as radiological and chemical hoods in various locations. During the review, a major system outage was in progress to replace the secondary stripper (SS) zeolite beds and recirculation blowers in the HANM. This activity included breaching the glovebox and dismantling certain glovebox components to access the interior to facilitate performance of the necessary maintenance. Prior to this work, a large containment hut was erected around the glovebox to control and contain airborne tritium releases and contamination during the work. The hut was designed to be maintained at a negative pressure, and facility Kanne air monitoring systems were reconfigured and strategically placed at various locations in and around the hut to ensure adequate monitoring of airborne tritium throughout the outage.

While engineered controls in the TF are robust and effective, administrative controls and personal protective equipment (PPE) are also necessary to adequately protect workers during many work activities. Postings and access controls are evident throughout the facilities and were found to be appropriate and effective in controlling access to radiological and process areas. TF also makes effective use of several site automated tools and databases to aid in efficiency and administration of radiological controls. For example, the ProRad system used for RWP development and implementation is a comprehensive and integrated radiological tracking system that interfaces with site databases to automate checking of such parameters as worker qualifications, bioassay, and dose history before an individual is granted entry on an RWP. ProRad will not authorize RWP entry if a worker is found to be delinquent in radiological training or bioassay required by the RWP. Another system, the Respirator Issuance Tracking System (RITS), is used to verify respirator issue and worker respiratory and medical qualifications before respiratory protection equipment is issued. RITS also correlates respirator issuance with the RWP number or work document number.

Other administrative controls include the use of work instructions, procedures, safe work permits, RWPs, and related documents. These controls are developed through use of institutional work planning processes and procedures, such as assisted hazard analysis (AHA), RWP, and as low as reasonably achievable (ALARA) review. Independent Oversight observed that for some work, including the replacement of the SS zeolite beds and recirculation blowers (hereafter referred to as the SS hut work), work planning did not include sufficiently systematic and rigorous application of institutional work planning requirements. Also of concern was a lack of full integration of radiological work planning with the AHA process, including consideration of non-radiological hazards in the radiological work environment. Independent Oversight identified a number of cases in which institutional requirements were not specifically followed during work planning, resulting in incomplete work planning, missed hazards and/or incomplete controls in AHAs, work instructions, and/or RWPs. As examples: (See **Finding-1**.)

- There was a lack of required integration between the ALARA review and AHAs performed during the SS hut work in the HANM, particularly with respect to work performed within the containment hut. Procedure 8Q-122, *Task Level Hazard Analysis*, requires a team AHA to be performed for radiological work that requires a formal ALARA review. Contrary to this requirement, no team AHA was performed for any of the SS hut work packages or work observed by Independent Oversight. As one example, during the review the Team questioned whether using a mechanical lifting device to remove and replace 1000-pound blowers in the glovebox might constitute a "critical lift," as defined by TF procedures, and whether the lift had been properly evaluated. The ALARA review checklist for this work activity identified lifting and rigging as an ALARA hazard but did not elaborate (see the additional ALARA review concern in the second bullet, below). Thus, it was not possible to know whether the lifting hazard in the ALARA review was related to the blower replacement, the zeolite bed replacement, or something else. Since a team AHA was not performed, the opportunity to reconcile and evaluate these types of questions in a team forum was missed.

The SS hut work and its associated RWP met several thresholds identified in SRS Manual 5Q1.1, Procedure 505, *ALARA Review Procedure*, that require an ALARA review, including non-routine complex work, airborne radioactivity concentrations, and infrequent or first-time activities. As discussed, conduct of an ALARA review also requires performance of a team AHA, per Procedure 8Q-122. However, the ALARA review was not performed until after the original RWP and many of the work packages were developed. This sequence of actions could explain why team AHAs were not initially performed, but it also indicates a problem with recognizing when ALARA review thresholds may be met and then following the associated work planning requirements as part of integrated work planning. As stated in Procedure 5Q-505, ALARA reviews are intended to provide a way to perform systematic reviews of work to appropriately incorporate radiation exposure and contamination controls into the work planning process. Completing the RWP and work instructions prior to performing an ALARA review is inconsistent with this intention. Although the RWP was later modified to indicate that an ALARA review had been completed, the process was not completed properly, since team AHAs were not subsequently performed.

- The radiological staff's process for conducting the ALARA review noted above, 13-TRI-107A/00, for the SS hut work was also not consistent with the requirements of Procedure 5Q-505, and the resulting ALARA review was deficient and incomplete. For example, while the pre-job ALARA review checklist identified a number of considerations applicable to the work to be addressed, Section III of the ALARA checklist did not discuss the implementation of each item checked in Sections I and II, as required in Section 5.3 of the procedure. For example, "hoisting and rigging" is checked, but Section III contains no information about what task was involved and what controls were required. (See the discussion of the critical lift, above.) None of the checked items included the required supporting discussion in Section III, which contains only a generic description of the work and personnel qualifications. Consequently, the ALARA review was incomplete and results and specific controls that would be expected to arise from the formal ALARA review were not documented and used in subsequent work planning efforts as expected.

- During the same SS hut work, construction pipe fitters and insulators were installing new pipe insulation on components within the gloveboxes. According to the construction superintendent, work was being performed under Work Document 1180382-04 and AHA No. TRI-27078 RO, "Insulate on Pre-Heater and SS-ZBeds." Independent Oversight observed pipe fitters and insulators within the hut using sharps (cutting tools and metal ties) and saws to cut the insulation material, and working at elevated heights on ladders, scaffolds, and teletowers. The work crew wore breathing air and plastic suits. Although hazards and controls associated with plastic suit work, saws and sharps, scaffolding, and fall hazards are included in the AHA hazard tree, none of these hazards or controls were identified on the AHA for this work activity. In addition, some of the controls identified in the AHA for this work activity, such as "this activity requires a non-routine job specific RWP" or "this activity requires some form of containment," were identified in the "hazards" section of the AHA rather than the “controls” section.

- During observation of a line break and mass spectrometer filament replacement, the work area was draped with plastic as a contamination control measure; this control was not listed in the RWP or work instructions. As the task evolved, one of the workers’ shoe covers came loose from the worker’s plastic suit being worn as PPE. As the feet of the suit billowed out because of the worker’s supplied breathing air, the two workers attempted to replace the shoe covers with new ones. However, there were no sitting surfaces for the workers, so they had to kneel, crawl, and sit on the ground while trying to restore the shoe covers, potentially challenging the integrity of the plastic suits and air lines. Also, during the same job, one worker was observed sitting on the floor while a second worker completed a monitoring task, again potentially challenging the integrity of the plastic suit and air line.

In addition to the SS hut work, which involved the use of a job-specific RWP, Independent Oversight noted that standing RWPs (SRWPs) govern most routine work activities in TF. In general, scopes of work defined by these RWPs were too broad or open ended to permit task specific hazard analysis and tailoring of controls to specific work being performed, consistent with ISM principles. Specifically, RWP job descriptions and controls in SRWPs were often vague, including such open ended language as: (See **Finding-1.**)

- “Routine work in Tritium Processing Building”
- “Work includes but is not limited to”
- “Other radiological work activities may be approved by RPD”
- “Additional PPE may be required by RPD”
- “Gloves prescribed per RPD or Facility Material Program.”

Because work scope definitions are so broad, it is not always possible for a worker to determine by reading the RWP job description which RWP is intended to be used. The intended RWP is also not listed in work instructions or procedures that govern most work in TF. For instance, during the pre-job briefing of a work package to perform a loop check of a tritium air monitor within a radiological buffer area/radioactive materials area (RBA/RMA), it was verbally conveyed that RWP 13-TEF-004 was to be used for this job. The job description for RWP 13-TEF-004 states: “Routine work within Remote Handling Building RBAs. Includes handling radioactive material and gloveport work except where gloveboxes exceed 0.1 μCi/cc tritium. Open hood door work is allowed for the penetration air hood when contamination levels are <20 dpm alpha, <200 dpm beta-gamma, and <10,000 dpm tritium/100cm^2.” The actual work was to conduct the loop check of the tritium air monitor using a voltage calibrator/ picoammeter source. It is not clear from the RWP job description that this RWP is intended to cover the activity performed, and the work instruction did not provide any linkage to this specific RWP. Many of the procedures and work instructions that Independent Oversight reviewed refer only to following the “appropriate” RWP, with no other identifier. (See **Finding-1**.)

TF RWPs adequately define PPE requirements for working in a particular area based on its radiological status. However, for the filament replacement job discussed above, other radiological controls used, such as the need for plastic draping and establishment of a contamination area around the work, were not contained in either the work instructions or RWP . (See **Finding-1**.) The filament job also used local exhaust ventilation, which was not on the RWP but was identified in a work instruction written to control the work. Per Procedure 5Q-504, *Radiological Work Permit*, alternative formal mechanisms such as work instructions may be developed (in conjunction with or in lieu of an RWP) detailing the work activities and required radiological controls. However, the RWP procedure requires alternative mechanisms to be approved by the radiation protection facility manager and to meet all other requirements of the RWP procedure. The work instruction was developed in the automated system

(Passport), and electronic concurrence was given by the Radiation Protection first-line manager, but not by the radiation protection facility manager as required by the RWP procedure. It is also unclear what level of involvement the Radiological Protection Department (RPD) had in work instruction development. The RWP procedure requires alternative mechanisms meet all requirements of the RWP procedure but the work instruction did not meet these requirements or otherwise provide any linkage to the intended RWP to be used to meet these requirements such as specification of PPE, expected radiological conditions, suspension limits, etc. (See **Finding-1**.)

During the observation of work within the SS hut, Independent Oversight had an opportunity to review the breathing air system, since all of the workers inside the hut were on breathing air support due to the potential for airborne tritium exposures. Eleven breathing air lines were available at a common "ice barrel" header within the TF near the SS hut to provide supplied air to the workers within the hut. Five of the lines were provided via the TF installed breathing air system, and six lines were provided via a portable breathing air compressor outside and on top of the facility, with air hoses feeding through the roof penetrations installed for this purpose. A worker in the hut could not tell whether his/her supplied air originated from the portable compressor or the installed system. Plastic suit users are trained on how to respond to events involving loss of the breathing air supply, which is the same when either system is being used. However, the quality of controls and requirements for operating the two systems are quite different: the installed breathing air system is operated, calibrated, and maintained by formal documented procedures (as required for work and systems in a hazard category 2 nuclear facility), whereas the portable system is operated by trained workers without procedures or checklists, using skill of the craft, as is customary for similar equipment operated by the construction crafts. Of concern to Independent Oversight was whether operating the portable compressor as a skill-of-the-craft activity was consistent with the expectations of performing work within a hazard category 2 nuclear facility.

Independent Oversight was also concerned by a previous event on December 12, 2012, when a similar breathing air compressor at the SRS 2F Evaporator was shut down improperly by a construction operator due to a communications error, when he thought "he heard a verbal command to shut down the compressor." The operator then proceeded to shut down the compressor before confirming and acknowledging the request with the assigned breathing air manifold (ice barrel) attendant, and the resulting shutoff of the breathing air supply to the workers led to an emergency evacuation of the workers on the breathing air system. At the SS hut, although the portable breathing air system operator was instructed verbally to notify the control room for permission before shutting down the compressors, there are no documented procedures, operator guides, or instructions in the SS hut work packages to direct either the portable breathing air system operator or the ice barrel attendant in responding to abnormal events. The system operator appeared knowledgeable of the breathing air system but also indicated "what he would do personally" in an abnormal situation. The operator received one-time training on the breathing air system in May 2010 and operates the unit based on skill of the craft, with no procedures or instructions except an out-of-date, unapproved, three-page operator guide that was inside the breathing air compressor station. On the other hand, the 233-H breathing air system is supported by a series of Use-Every-Time (UET) procedures for operation, abnormal operation, and alarm response. Manual 2S, Procedure 1.1, page 37 UET procedures should only be considered for complex activities, where steps must be performed in sequence with no omissions, where data taking is required after certain steps, where the user is required to document completion of critical steps, and where an error during performance of the activity would result in unacceptable conditions. The operation of the portable breathing air system as skill of the craft and without procedures (particularly for actions to be taken under abnormal operating conditions) is inconsistent with the requirements for procedures described in the SRNS 2S Manual. (See **Finding-2**.)

Radiological Surveys and Monitoring

Radiological survey and monitoring systems in use at TF are comprehensive and take advantage of state-of-the-art technology, allowing for quick and effective evaluation of airborne tritium activity and surface contamination levels. For documentation, TF also take advantage of the site's Visual Survey Data System (VSDS) radiological survey documentation software for the creation, review, approval, and retrieval of radiological surveys; this system places the field data in a relational database. The system features include digital drawings and pictures, electronic signatures, search capability, pull-down data entry lists, data trending, and attachments. VSDS output is coordinated with site software so that official record copies of completed, approved surveys in pdf format are automatically transferred to Records Administration, where they are put in the Electronic Document and Workflow System.

At the facility level, tritium air monitoring is accomplished through an elaborate system that consists of a network of sampling heads located in and around all tritium processing areas. The sample heads draw air through Kanne air monitoring chambers to provide real-time readout of tritium concentrations. The system offers both local and remote readout as well as alarm functions. The Kanne system is also supplemented by portable Scintrex tritium air monitors that are available for RCIs to use during non-routine monitoring, such as maintenance evolutions or other areas that require more representative sampling.

The possible presence of tritium contamination on surfaces is evaluated in accordance with facility-specific routine habitability survey requirements as well as during RCI job coverage. Smear samples are taken in representative locations and evaluated by liquid scintillation counting (LSC). Due to the low beta energy of tritium, LSC is the only technologically feasible option for evaluating tritium contamination; direct surface measurements for tritium beta particles are not generally possible or effective with handheld survey instruments because the low-energy beta particles cannot penetrate the window of the handheld detector. For a large quantity of smears, smear counting at TF can be accomplished using traditional multi smear LSC counting systems. Of note, however, is that TF also has state-of-the-art portable LSC systems (Triathler Smear counters) that can be used in the field to obtain rapid results without having to wait for laboratory analysis. RCIs were observed to provide effective job coverage and documentation for work with the potential for changing radiological conditions. Radiological survey records associated with RCI job coverage and routine surveys were found to be legible and complete.

Weaknesses were also identified in some areas with respect to radiological surveys and monitoring. For example, Independent Oversight identified a number of inaccuracies in the *SRNS Radiation Monitoring Technical Basis Manual* (WSRC-IM-2006-00003) concerning the area radiation monitoring systems (ARMs) installed in the TEF. During the observation of a quarterly surveillance of the TEF ARMs, Independent Oversight noted that the ARMs equipment manual located in the TEF Radiation Protection Office listed the energy response range of the six installed low-range ARMs (DA1-6) as 60 keV to 1 MeV. However, according to the TF Radiation Protection staff, the dominant nuclide of interest for these ARMs is Co-60, which has two photon peaks that are outside this energy range (i.e., 1.17 MeV and 1.33 MeV). Independent Oversight initially considered that these were the wrong detectors for this application; however, on further review, the SRNS Radiation Protection radiation monitoring subject matter experts (SMEs) indicated that there was a "typo" in the technical basis manual and the upper energy response boundary for the DA1-6 detector should be 1.25 MeV, not 1 MeV. Upon further investigation, Independent Oversight identified a number of additional errors in this technical basis manual and other SRNS radiation monitoring procedures. For example, the SRNS technical basis manual states that the energy response range of the high-range ARM in the TEF (a DAI-8 ion chamber) is 40 keV to 2.5 MeV, whereas the true range (according to the manufacturer) is 50 keV to 1.25 MeV. Similarly, in another SRNS Procedure, 5Q1.7, *Eberline Area Radiation Monitor RMS3 Manual*, Independent

Oversight identified another error in that the DA1-1 radiation range is listed as 0.01 to 3000 mR/h, whereas the manufacturer lists the radiation range for this detector as 0.01mR/h to 100 mR/h. (See **Finding-3**.)

A similar lack of a well-documented technical basis was also identified in the use of standard laboratory hoods for containment of both radioactive materials and hazardous chemicals, such as in the TF laboratory for the evaluation of metallurgical samples. Within this laboratory, laboratory hoods are used for both the confinement of potential low activity tritium samples and the confinement of vapors from strong acids, solvents, resins, and epoxies. SRNS Procedure 4Q-401, *Laboratory Hoods and Local Exhaust Systems Used for Control of Hazards*, Attachment 8.1, specifies minimum and maximum average hood face velocities of 80 linear feet per minute (fpm) to 125 fpm for chemical lab hoods, and 100 fpm to 200 fpm for radioactive material lab hoods, respectively. However, Note 4 in Attachment 8.1 indicates that "laboratory hoods approved for radioactive materials … may be used for chemicals since the latter requires lower face velocity values for controls." Therefore, in practice, the SRNS Air Flow Surveillance Group allows average face velocities up to 200 fpm when using hazardous chemicals in these radiological hoods, and there is no documented technical basis for this decision. For example, of the two tritium facility hoods observed by Independent Oversight in which hazardous chemicals were used, average hood face velocities were measured by the Air Flow Surveillance Group to be 129 linear fpm and 139 fpm. If those hoods were designated as chemical hoods only, SRNS procedures would require them to be tagged as out of service. However, since radiological materials may also be present in the hoods, these same hoods were designated as radiological hoods, thereby permitting a higher flow rate.

There is no well documented technical basis for using hazardous chemicals within these hoods at face velocities up to 200 fpm, as is the current practice in the TF. In fact, due to the presence of turbulence, eddy currents, and potential backflow out of the hood, most technical basis documents referenced by SRNS do not support this practice. For example, Section 5.1.1 (Design Considerations) of SRNS Procedure 4Q-401 states that "the design basis for laboratory hoods and local exhaust ventilation systems is based on the requirements identified in the American Conference of Governmental Industrial Hygienists (ACGIH) Industrial Ventilation Manual and site-specific evaluations." However, Section 3.7.1 of the ACGIH Industrial Ventilation Manual for ventilation of radioactive and highly toxic processes states that "If an enclosure is not complete and an operator must be located at an opening, such as in front of a laboratory hood, the maximum control velocity should not exceed 125 fpm. Air velocities higher than this value will create eddies in front of the operator which may pull the contaminant from the hood into the operator's breathing zone." Similarly the National Research Council's *Prudent Practices in Laboratories*, which is listed as a reference in SRNS Procedure 8Q-26, *General Laboratory Safety Rules*, states that for laboratory fume hoods, "face velocities approaching or exceeding 150 fpm should not be used, because they may cause turbulence around the periphery of the sash opening and actually reduce the capture efficiency of the fume hood." An SRNS interoffice memorandum dated February 16, 2010, "Evaluation of the 4Q-401 Guidance for Laboratory Hoods with Respect to Tritium," appears to support the importance of 100 fpm for the minimum face velocity for tritium, but discourages the use of higher velocities. Furthermore, based on no reported activity in many of the tritium air samples in the laboratory and negative bioassays for workers in the room, there is no basis to conclude that the radiological hazards are the predominant hazard of concern as assumed by TF staff interviewed by Independent Oversight. (See **Finding-3**.)

DOE Oversight

Independent Oversight reviewed the DOE field element oversight processes for the SRNS occupational radiation protection program. DOE oversight is provided primarily by NNSA SRFO, augmented by DOE Savannah River Operations Office (DOE-SR) and NNSA Albuquerque Complex. A memorandum of agreement, SV-MOA-001, *Agreement on Safety Management at the Savannah River Site,* documents the joint responsibility between SRFO and DOE-SR for radiation protection; DOE-SR has overall responsibility for the site-level program, and SRFO is responsible for ensuring implementation within the TF. SRFO procedure SV-PRO-011, *Assessment and Oversight Program*, adequately describes the DOE field element oversight processes. SRFO line oversight includes a review of the contractor assurance system, operational awareness, shadow assessments, formal assessments, self-assessments, and external assessments. The procedure addresses the qualification of assessors; assessment planning; conduct of assessments (including the need to conduct performance-based assessments); reporting of assessment results; categorization of deficiencies and findings; and the process for handling deficiencies, including effectiveness reviews.

SRFO utilizes written plans and schedules for planned assessments, focus area reviews for operational oversight, and reviews of the contractor's self-assessment of processes and systems. The assessment planning process, as documented in SV-PRO-028, *Assessment Planning Process*, uses a graded approach that considers past performance, the contractor's self-assessment program, external assessments, and program risk. Staff members are responsible for completing an assessment planning form in accordance with instructions provided in the procedure; the form includes a consideration of past performance, focus areas, risk level, assessment type, etc. An assessment planning form (F-SV-PRO-028) was completed for the RPP functional area for fiscal year (FY) 2013, which resulted in a status of "non-mandatory" and a risk rating of 6 (medium). The form included a discussion of the assessment requirements, stating that there is no requirement for DOE/NNSA to conduct an RPP assessment, and that DOE evaluates the SRNS self-assessment. Even though not required, SRFO included a triennial assessment of the SRNS RPP to be performed by the NNSA Albuquerque Complex. Independent Oversight reviewed the annual assessment plans, SV-PLN-002, R9 and R10, which were issued in 2011 and 2012, respectively, and covered the upcoming fiscal year and the next two years. The plans include the assessment schedules and the process for revising the schedules, if needed. The RPP triennial assessment identified in the assessment planning form was included in the annual assessment plan for FY 2013-2015 and was completed in May 2013. The annual assessment plan does not include the oversight provided by the DOE-SR SME.
The annual assessment schedule is disseminated through a monthly assessment plan. The DOE Facility Representative (FR) Monthly Assessment Plan for July 2013 included operational awareness and functional area assessments.. Independent Oversight reviewed operational awareness activities and formal assessments of the RPP. Operational awareness activities included routine day-to-day monitoring of work performance through facility tours/ walkthroughs, work observations, and similar activities. Independent Oversight accompanied two of the FRs on a walkthrough of their assigned areas, which included attending the shift turnover and plan of the day meetings, pre-job briefings, review of log books (including RPP logs), walkthrough of their assigned areas, and observation of work in progress. The FRs demonstrated a sound understanding of the RPP (including systems, instruments, alarms, practices, etc). Operational awareness activities are documented in a weekly report format in the Site Tracking, Analysis and Reporting (STAR) system as OP-01/02 type assessments. The lines of inquiry for the OP-1/OP-2 reports specifically address radiological controls, including the review of instrument operability and alarm status, and worker adherence to radiological control procedures. Independent Oversight reviewed six OP-1/OP-2 reports documenting oversight of the RPP, including observations of work being performed. Although most of the issues were identified by the contractor, the FRs identified a concern about excess items stored in an RBA/RMA, and poor contamination control practices. SRFO's routine day-to-day monitoring of work performance provides effective operational awareness in the area of radiological controls.

Formal assessment of the radiation protection functional area, as outlined in the annual assessment plan, is limited to a triennial review of 10 CFR 835 compliance conducted by the NNSA Albuquerque Complex. Independent Oversight reviewed the final reports for the 10 CFR 835 compliance assessments issued in February 2009, March 2010, and June 2013. These reviews focused on program flowdown of requirements into policies and procedures, with a limited review of implementation. The reviews found that the RPP was a mature program, and no findings were identified in any of these assessments; however, two observations were noted in the 2010 assessment, addressing survey logbooks and radiological controls. Observation of work planning, control, and execution was limited: none in the 2009 report; an emergency drill in the 2013 report; and an emergency drill, pump bagout, and daily instrument and air sampling checks in the 2010 report. Although not included in the annual assessment schedule, the DOE-SR SME also performs some oversight of the TF RPP as an element of the SRNS site-level program. Independent Oversight reviewed the results of two assessments performed by the DOE-SR SME, one an assessment on April 20, 2012, and the other a management field observation on April 11, 2013. The assessment was a tour/walkdown that included observation of radioactive packages being prepared for shipment, and also some post-job smears being taken in a glovebox room. The management field observation was a tour of facilities with senior level managers. No other documented assessments were provided by the DOE-SR SME, who indicated that his duties as the RPP SME for the rest of SRS limited his availability and also that he did not have unescorted access to the TF. Per the annual workforce analysis and staffing plan report dated January 17, 2013, the site office needs 0.25 full-time equivalent (FTE) for radiation protection and relies on DOE-SR and the NNSA Albuquerque Complex to supplement this support. The oversight provided by the SMEs, from both the NNSA Albuquerque Complex and DOE-SR, is significantly less than 0.25 FTE, has focused primarily on the programmatic aspects of the RPP, and does not provide detailed reviews of RPP work planning, control, and execution. DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, states that "oversight processes must evaluate contractor programs based on … assessments of facilities, operations and assessments." The SME assessments of the contractor's radiological operations have been insufficient, in both the amount of time spent on oversight and the depth of reviews, to identify RPP technical issues and the issues in radiological work planning and associated documentation identified in this report. (See **Finding-4**.)

Oversight results are communicated to the contractor in various ways. The FRs provide immediate feedback as appropriate during their daily walkthroughs, and meet with the contractor on a weekly basis to discuss issues. Independent Oversight observed the FRs' interface with the contractor during the walkthroughs and their follow-up on a concern about the temporary breathing air systems. The FRs' operational awareness reports (OP-1/OP-2) are entered in the STAR system and are provided to the contractor. Findings from assessments are transmitted formally to the contractor for resolution. Additionally, radiation protection is included in the Operations and Work Planning area of the performance evaluation plan. Monthly input is provided to the contractor on performance in this area and is included in the subjective evaluation of operations for the year-end performance evaluation report. Overall, communication of oversight results to the contractor is effective.

FR responsibilities are delineated in the *SRFO Safety, Security, and Operational Management Functions, Responsibilities, and Authorities Manual*, SV-MAN-002, and specifically include stop-work authority and oversight of radiological protection. The FR program is documented in SV-PRO-010, SRSO *Facility Representative Program*, R6, which includes duties, responsibilities, and authorities of FRs, FR qualification/requalification, FR assessment program, FR staffing and coverage, emergency event response and occurrence reporting activities, and FR program performance assessment and feedback. Attachment A of SV-PRO-010 provides the minimum routine FR assessment activities, including determining current facility status, facility conditions (including radiation protection controls), activity observation, safety-related system walkdown/surveillance requirement, and specific administrative controls. Independent Oversight observed two of the FRs assigned to TF. The lead FR was previously qualified in the technical qualification program in the area of radiation protection, and served as the radiological controls SME for the liquid waste tank farms for a period of eight years. He is currently qualified through the technical qualification program as an FR and has ten years' experience as an FR. The other FR came to DOE as a member of the Future Leaders Program in 2006 and qualified as a TF FR in 2009.

Independent Oversight accompanied the two FRs discussed above on their daily walkthroughs, which began with shift turnover briefings (face-to-face turnover) and pre-plan meetings, and a review of logbooks, Limiting Conditions of Operation status board, equipment status, inventory limits, issues, operating orders, etc. The lead FR also reviewed the radiological control electronic log entries. Following the briefings, a tour of the facilities was conducted. Both FRs displayed a thorough knowledge of assigned facilities and processes, and they were knowledgeable of safety systems and management programs, including the RPP. The lead FR appropriately reviewed radiological postings and boundaries, noted an accumulation of waste containers in a special container loading and unloading area, and followed up with RPD personnel. Independent Oversight accompanied the lead FR to observe the annual calibration/loop check of a tritium air monitor. The lead FR ensured that the current and correct procedure was used. During the pre-job briefing, it was determined that the work would be performed under RWP-004. The FR was knowledgeable of the procedure, explaining the various steps as they were conducted. Independent Oversight also attempted to observe another evolution with the lead FR involving the repair of an oxygen monitor. Following the pre-job briefing, the maintenance staff went to the control room to obtain work authorization. Due to higher priority work, authorization was not provided in a timely manner, and the lead FR notified the maintenance work planner of the delay in work. The FR also followed up on a concern about the lack of formality of operation of a portable breathing air compressor station; his follow-up included walking down the station, interviewing the operator, contacting the operator's supervisor, independently verifying operator training, and notifying his management of the concern. The SRFO FRs are well qualified and trained, and they demonstrate the ability to perform effective day-to-day operational oversight of contractor radiological work.

6.0 CONCLUSIONS

Independent Oversight found that SRNS has an effective radiation protection program that is staffed by qualified and experienced personnel and the radiation protection program documentation hierarchy is comprehensive, with appropriate radiological protection manuals, site-level procedures, and most technical basis documents. At TF, engineered containment devices and ventilation systems are robust and are used extensively and effectively to mitigate radiological hazards associated with most operations. Work observed during the review appeared to be performed safely; Radiological work observed during the review was adequately performed to ensure radiation protection; however, the deficiencies noted in process implementation could lead to performance problems. For some work that requires administrative controls, such as RWPs and PPE, there is too much reliance on workers' expertise and knowledge to identify and control hazards rather than systematic and rigorous application of institutional work planning requirements, both with respect to radiological work planning and the site AHA requirements. Concerns were also identified in the rigor and conduct of operations associated with use of breathing air systems and in the technical bases for some fixed radiation monitoring systems and laboratory hoods.

DOE oversight of SRNS is provided by SRFO, which uses appropriately documented plans and schedules for planned assessments, focus areas for operational oversight, and reviews of the contractor's self-assessment of processes and systems. Operational awareness activities include routine monitoring and documentation of work performance, and FRs demonstrated a sound understanding of the facilities and systems to which they are assigned. However, SRFO assessments of the contractor's radiological operations have been insufficient, in both the amount of time spent on oversight and the depth of reviews, to identify radiological program technical issues and issues in radiological work planning and associated documentation.

7.0 FINDINGS

Findings indicate significant deficiencies or safety issues that warrant a high level of management attention. If left uncorrected, such findings could adversely affect the DOE mission, the environment, the safety or health of workers or the public, or national security. Findings may identify aspects of a program that do not meet the intent of DOE policy.

Finding-1: SRNS has not ensured effective implementation of radiological work planning requirements including proper integration with other institutional hazard analysis requirements contained in Manuals 5Q and 8Q, and their associated implementing procedures for ALARA reviews, RWPs and Task Level Hazard Analysis. These shortcomings have resulted in incomplete work scopes, missed hazards, and/or incomplete controls in AHAs, work instructions, and/or RWPs.

Finding-2: Portable breathing air system(s) used to supply breathing air for work performed within the TF during the outage lacked formal and approved operational, abnormal operating procedures, and alarm response procedures as required by the SRNS 2S Manual Procedure 1.1

Finding-3: Some SRNS technical basis documents and institutional requirements in the SRS 4Q Manual are either inconsistent with equipment manufactuer's specifications (e.g. ARM system), or do not support current operations for both chemical and radiological hazards (e.g. local exhaust ventilation hoods).

Finding-4: DOE oversight of the radiological program has been insufficient to identify radiological program technical issues and the issues in radiological work planning and associated documentation identified in this report (DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*).

8.0 OPPORTUNITIES FOR IMPROVEMENT

Independent Oversight identified the following OFIs. These recommendations are not intended to be mandatory. Rather, they are 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: Improve the rigor of work planning, hazard identification, and the integration between radiological and non-radiological components. Specific actions to consider include:

- Provide additional training to RPD staff on the expectations for conduct and documentation of ALARA reviews and integration with the site AHA process.
- Provide additional training to work planners on the expectations for answering AHA pre-screening questions.
- Revise the hazard tree process to ensure that all hazards to be encountered during a given work activity are appropriately identified in the AHA associated with that work activity. The AHA can be used as a control if applicable, but all hazards should be identified.
- Verify that hazards and controls in AHAs are correctly identified as hazards and controls in the appropriate sections of the AHA.

OFI-2: Increase emphasis on improving the clarity and specificity of RWPs by including clearly defined and authorized work scopes and specific radiological controls applicable to the work. Specific actions to consider include:

- Provide specific linkage to the appropriate RWPs in procedures and work instructions, or otherwise create RWP files that link all authorized work tasks allowed under a particular RWP. The RWP job description can reference the RWP file that workers can access to verify the appropriate RWP for their task.

- Revise procedures and the radiological planning guide to prohibit language in RWPs that refers a worker to the discretion of RPD for authorized activities or radiological controls.
- Ensure that there is a clearly defined RPD facility manager approval for all work instructions developed outside of RPD if they contain radiological controls. All other provisions of the RWP procedure must also apply to the development of these work instructions. Alternatively include specific controls in the RWP.

OFI-3: Improve formality of operations (i.e., procedures and/or instructions) for supplemental life support systems in use within a hazard category 2 nuclear facility. Specifically, ensure that all portable breathing air systems in support of work activities within the TF are operated and maintained in accordance with written procedures consistent with conduct of operations requirements for a hazard category 2 nuclear facility.

OFI-4: Improve technical bases associated with radiation monitoring systems and hoods in the TF. Specific actions to consider include:

- Review the SRNS radiation monitoring technical bases for the extent of condition of technical or transcription errors and the potential impact of as-found errors.
- Ensure that technical data provided in all technical basis documentation is consistent with manufacturing data and related site technical reports, memos, and procedures.
- Establish a technical basis for operating laboratory hoods involving the use of hazardous chemicals at face velocities greater than 125 fpm, or ensure that laboratory hoods involving the use of hazardous chemicals do not exceed face velocities of 125 fpm (Procedure 4Q-401), regardless of the presence of radioactive materials.

OFI-5: Improve DOE SME oversight of the RPP. Specific actions to consider include:

- Allow the DOE SME unescorted access.
- Ensure that SME assessments include RPP work planning, control, and execution, as well as technical implementation aspects of the program.
- Include SME assessments in the annual assessment plan.
- Schedule SME support to satisfy the 0.25 FTE staffing analysis

9.0 ITEMS FOR FOLLOW-UP

Independent Oversight will follow up on actions and satisfactory closure of the findings identified in this report.

APPENDIX A
Supplemental Information

Review Dates

June 25 – July 12, 2013

Office of Health, Safety and Security Management

Glenn S. Podonsky, Chief Health, Safety and Security Officer
William A. Eckroade, Principal Deputy Chief for Mission Support Operations
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