Independent Oversight Review of the Savannah River Site, Salt Waste Processing Facility, Construction Quality of Piping & Pipe Supports

September 2012

Office of Safety and Emergency Management Evaluations
Office of Enforcement and Oversight
Office of Health, Safety and Security
U.S. Department of Energy

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Acronyms

ASME	American Society of Mechanical Engineers
ASP	Alpha Strike Process
CGD	Commercial Grade Dedication
CGDP	Commercial Grade Dedication and Material Upgrade Package
CMTR	Certified Material Test Report
CPA	Central Process Area
COC	Certificate of Conformance
CR	Condition Report
CRAD	Criteria and Review Approach Document
Cs	Cesium
DC	Dark Cells
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DOE-SR	DOE-Savannah River Operations Office
FWCL	Field Welding Checklist
HVAC	Heating, Ventilation, and Air Conditioning
ITP	Inspection and Test Plan
MRIR	Material Receiving Inspection Report
NCR	Nonconformance Report
NDE	Nondestructive Examination
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
PC	Performance Category
PMI	Positive Material Identification
QCIR	Quality Control Inspection Report
QDP	Quality Data Package
QA	Quality Assurance
QC	Quality Control
RICP	Receiving Inspection Criteria Packages
S/CI	Suspect/Counterfeit Item
Sr	Strontium
SRS	Savannah River Site
SWPF	Salt Waste Processing Facility

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1.0 PURPOSE

The Office of Enforcement and Oversight (Independent Oversight), within the Office of Health, Safety and Security, conducted an independent review of construction quality at the U.S. Department of Energy (DOE) Savannah River Site (SRS) Salt Waste Processing Facility (SWPF). The focus of the review, performed on site between May 14 and 18, 2012, was piping and pipe supports. The review team also observed installation of two tanks in the dark cells (DCs). Subsequent to the onsite review, procurement records were reviewed for quality-related piping and piping system components.

2.0 SCOPE

The scope of this review encompassed various topics relating to installation of piping and pipe supports, including procurement activities; storage of piping and piping system components; and review of the inspection procedures, drawings, and specifications for installation of piping and pipe supports. The review team evaluated a sample of nonconformance reports (NCRs) and condition reports (CRs) identified by the support contractor (Parsons) under its corrective action program. Surveillance activities performed by the Parsons quality assurance (QA) staff were also reviewed.

Independent Oversight reviewed various construction quality documents and conducted several construction site walkthroughs, concurrent with Parsons engineers and DOE Savannah River Operations Office (DOE-SR) staff. During the walkthroughs, Independent Oversight examined 20 pipe supports, observed placement of two tanks in the DCs, and examined storage of piping and piping system components. Independent Oversight reviewed the procurement and receipt inspection program for piping and piping system components, and drawings, specifications, and procedures that control installation of piping and pipe supports, installation of mechanical equipment (tanks/vessels), and welding activities.

3.0 BACKGROUND

The overall mission of the SWPF is to separate and concentrate the radioactive cesium (Cs), strontium (Sr), and actinide contaminants from the high-curie salt solutions that are to be removed from the liquid waste tanks in the F- and H-Area Tank Farms at SRS. The concentrated Sr, actinide, and Cs waste slurry containing most of the radioactive contaminants will be sent to the Defense Waste Processing Facility for immobilization in a glass formulation by a vitrification process. The decontaminated salt solution left after removal of the highly radioactive contaminants will be sent to the Saltstone Production Facility for immobilization in a grout mixture and disposal in grout vaults at the Saltstone Disposal Facility.

The SWPF is divided into four areas: the Central Process Area (CPA), the Cold Chemicals Area, the Facility Support Area, and the Alpha Finishing Facility. All radioactive materials are stored and processed in the CPA, which is a 136 foot wide by 235 foot long reinforced concrete structure supported on an 8 foot thick basemat. The CPA is designed to DOE Performance Category (PC)-3 criteria. The remaining SWPF areas are housed in structural steel buildings designed as PC-1 structures.

The CPA contains six rooms, room numbers R191 through R196, which contain processing and holding tanks. These rooms are designated as DCs. The DCs are shielded rooms for which no maintenance or

entry is planned for the 40-year design life of the plant. The DC areas will be inaccessible after plant startup due to high radiation levels. There are some sleeved valves in the DC areas but the valve internals can be sleeved out and replaced from the operating decks. Any moving parts that are expected to fail can be replaced from outside without entry into the DC, and all welded construction is used for the piping and vessels in these areas. All piping and fittings installed in the DC areas are seamless stainless steel. There are nine other rooms that will be inaccessible during normal plant operation due to high radiation levels. These rooms include the North Alpha Strike Process (ASP) Labyrinth areas, Rooms 131A through 131F, and the South ASP Labyrinth areas, Rooms 136A through 136C. The ASP Labyrinth area will be accessible when the plant is periodically shut down for routine maintenance.

Construction work currently in progress includes installation of piping and pipe supports, instrumentation lines, and mechanical equipment. The SWPF is being designed and constructed by Parsons, who will also operate the facility for one year following construction completion. Construction oversight is provided by the DOE-SRS staff in the Salt Waste Processing Facility Project Office.

4.0 METHODOLOGY

This independent review of the SWPF Construction Project was conducted in accordance with the Plan for Review of the Salt Waste Processing Facility Construction Quality of Piping and Pipe Hangers, dated April 24, 2012. Applicable sections of Criteria Review and Approach Document (CRAD) HSS-CRAD-45-52, Construction – Piping and Pipe Supports were used for the review.

5.0 RESULTS

Activities examined by Independent Oversight during the review are discussed below. Each activity is briefly described, followed by a discussion of the review performed by Independent Oversight. Conclusions are summarized in Section 6, and Items for Follow-Up in Section 7. Opportunities for improvement (OFIs) are listed in Section 8.

Pipe Welding Program Review

In anticipation of the planned May 2012 Construction Quality Review, on April 11 and 12, 2012, Independent Oversight participated in a review with the Defense Nuclear Facilities Safety Board (DNFSB) Staff of the pipe welding program at SWPF. The purpose of the review was to address DNFSB questions identified in the DOE Environmental Management SWPF Construction Project Review Report, dated January 30, 2012. The questions concerned: (1) the welder training program; (2) the program for making welds in confined spaces; (3) the weld reject rate; (4) weld repairs; and (5) confidence that welds on stainless steel piping not examined by volumetric techniques are acceptable.

During the review, the following topics were discussed:

- The welder training program
- Use of orbital welding machines in areas with limited access
- Weld inspection requirements, including types of inspection (surface and volumetric) and inspection frequency
- Welding inspection reject rates and types of defects causing rejection
- Program for retraining welders with unacceptable weld inspection reject rates
- Weld repair procedures and post-weld repair inspections

- Qualifications and experience of the welding engineering staff
- Welding inspector qualifications.

Visual inspection is required for all piping and vessel welds on the SWPF project. In addition to visual inspection, 100 percent of the welds in the DC areas are subjected to volumetric nondestructive examination (NDE) inspections, either radiographic examination or ultrasonic examination. In other areas within the SWPF, a minimum of 5 percent of the welds are subjected to volumetric NDE inspections, per the requirements of American Society of Mechanical Engineers (ASME) B31.3, *Process Piping Code*. The NDE requirements are summarized in Attachment 2 to Specification Section 15111, *Pipe Fabrication*.

Independent Oversight and DNFSB personnel reviewed a typical three-dimensional piping model in the DCs, walked down the SWPF CPA structure with a focus on the DCs to examine the locations of the DCs and typical spacing for making of piping to vessel welds, and examined completed welds on piping. During the walkdown, Independent Oversight observed that the weld identification (number) and the identification of the welder who completed the piping welds were inscribed on the pipe spool piece adjacent to the weld. Traceability of the source of the spool piece was also maintained by marking the heat number on each individual spool piece in a piping run.

Activities in the pipe fabrication shop were observed. Tools used on stainless steel piping were clearly marked. Faces of vices and clamps used to secure stainless steel pipe during fabrication and shop welding were covered with low chloride tape suitable for stainless steel to prevent the stainless piping from being contaminated with carbon steel particles. Controls for storage and issue of welding filler materials were examined. Filler materials are stored in sealed containers. After the containers were opened, the identification of the weld filler materials was maintained by use of color codes. Stainless steel and carbon steel electrodes were stored separately. Coated weld rods were stored in heated holding ovens with temperature controls that maintain storage conditions in accordance with manufacturer's recommendations. Separate ovens were used to store stainless steel and carbon steel weld rods. The holding ovens were clearly marked to indicate contents. All weld filler materials are issued to welders from the rod issue room. The type of weld filler, the heat number, and the identification of the welder are recorded on a two-part weld issue slip (white and yellow copy). After removal from holding ovens, coated rods are stored in portable ovens.

There were no unresolved issues or open items resulting from the DNFSB review. Independent Oversight concluded that the onsite pipe welding program was adequate.

Procurement and Receipt Inspection Programs

Independent Oversight reviewed the procurement and receipt inspection programs for piping system components, which include pipe spool pieces, pipe supports, and other materials used in piping systems at the SWPF project. Examples of other materials include bolts, weld filler materials, grout, concrete expansion anchors, and elbows. Included in this review were the Nuclear Quality Assurance (NQA)-1 procurement program, commercial grade dedication (CGD) program, positive material identification (PMI) testing process, and the receipt inspections performed by quality control (QC) inspection personnel. Procedure DP-QC-4803, *QC Material Receiving Inspection*, describes the process for performing and documenting QC material receiving inspections. The receipt inspection program includes review of documentation, such as certified material test reports (CMTRs) or certificates of conformance (COC) furnished by suppliers or manufacturers, dimensional checks, and testing to demonstrate delivered materials meet project quality requirements. In addition, the QC inspectors review quality data packages (QDPs) prepared by the suppliers or manufacturers to verify that QDPs contain the applicable quality records to support the verification of the item's quality.

The requirements for QC receipt inspection of hardware and materials to be installed in the SWPF are specified in Receiving Inspection Criteria Package (RICP) instructions. These instructions are prepared by engineering staff in accordance with Procedure PP-EN-5024, *Preparation of Receiving Inspection Criteria Packages*. The RICPs list an item's physical characteristics, identification requirements, applicable codes and standards, certification documentation, and all characteristics and features that engineering staff designates as minimum requirements to be verified by the receipt inspectors. There are more than 200 RICPs that specify receipt inspection instructions for various hardware and components when they are received on site. The instructions in the RICPs also require performance of CGD reviews and reviews for suspect/counterfeit items (S/CI).

Procedure PP-EN-5023, *Replacement Item Evaluation/Commercial Grade Item Dedication*, provides instructions for engineering staff to prepare Commercial Grade Dedication and Material Upgrade Packages (CGDPs). The instructions include review of CMTRs to verify that the data on the CMTRs shows that hardware or components meet specification requirements, inspection of other physical characteristics, and performance of independent PMI testing to verify the materials used to fabricate the components meet specification requirements. PMI testing to determine chemical composition of materials is performed on site by QC inspectors in accordance with Procedure DP-QC-4804, *Positive Material Identification Equipment Operation*, and Specification Section 11817, *Positive Material Identification*. The number of samples in each lot to be PMI tested is specified by engineering staff. The results of the PMI tests are documented in PMI reports. Mechanical testing to determine characteristics, such as yield and ultimate tensile strength, is performed off site at various approved testing laboratories.

Independent Oversight also reviewed implementation of DOE Guide 414.1-3, Suspect/Counterfeit Items Guide for Use with 10 CFR 830 Subpart A, Quality Assurance Requirements, and DOE Order 414.1C, Quality Assurance: Section 4.1.4, *Purchase Orders, Contracts, and Quality Clauses*, U.S. Department of Energy, Washington, D.C., November 3, 2004. Procedure number PL-QA-4703, *SWPF Suspect/Counterfeit Item Prevention Plan*, and Procedure number PP-QA-4713, *Suspect/Counterfeit Item Procedure*, implement the SWPF site requirements for S/CI. These procedures require that applicable technical and quality clauses are incorporated into contract documents to prevent introduction of S/CI into the SWPF project. Engineering staff are responsible for developing critical characteristics and attributes for purchased items, QA criteria, testing requirements and methods, and inspection criteria for QC receipt inspectors. Receipt inspection criteria are incorporated into RICPs and CGDPs. The procedures require training of all SWPF procurement, engineering, QA, and QC personnel involved in the S/CI program to identify, prevent, detect, and control introduction of S/CI into the SWPF project.

Independent Oversight reviewed procurement specifications, RICPs, and CGDPs for selected components and materials used in safety significant piping systems. Independent Oversight also reviewed QC material receiving inspection reports (MRIRs) and a sample of documentation furnished by manufacturers and suppliers, such as CMTRs, COCs, and inspection and test results demonstrating materials and components supplied met the procurement requirements. Records reviewed are listed below.

<u>Stainless Steel Pipe</u>

Specification Section 15114, *General Piping Material Procurement*, and Specification Section 15116, *Pipe Procurement*, list the technical requirements for stainless steel piping for the SWPF project. The criteria for performing QC receipt inspections for piping are specified in RICP number 1040, *Piping, Stainless Steel*, and CGDP number M-CGD-J00051, *Pipe (includes nipples)*: Various diameters ranging from ¼" – 12", seamless austenitic low carbon stainless steel type 304L for pipe specified as schedules 5S, 10S, 40S, and 80S. The criteria for performing QC receipt inspections for piping elbows are specified in RICP number 1043, *Elbows, 90 Degrees, Butt Weld, Seamless Austenitic Stainless Steel, Type 304L*,

and CGDP Number M-CGD-J00052, *Elbows, 90 Degrees, Various Diameters, Seamless Stainless Steel, Type 304L*.

Independent Oversight reviewed receipt inspection records and material test reports for 304L seamless stainless piping. The review team examined records for randomly selected piping spool pieces and bulk piping identified by Independent Oversight during walkdowns in the storage areas. The following records were reviewed:

- MRIR 01183 for receipt inspection for 6" diameter seamless schedule 40 stainless steel pipe, heat number 528696. Other documents reviewed included CMTRs and corresponding PMI test report, number PMI-243.
- MRIR 4803-00499 for receipt inspection for 2" diameter seamless schedule 40 stainless steel pipe, heat number 522875. Other documents reviewed included CMTRs; corresponding PMI test report, number PMI-087; and ultrasonic piping wall thickness measurements.
- MRIR 00819 for receipt inspection for 1/2" diameter seamless schedule 40 stainless steel 90 degree elbows, heat number 24747. Other documents reviewed included CMTRs and corresponding PMI test report, number PMI-168.
- MRIR 4803-00353 for receipt inspection for bulk piping, various diameters of seamless schedule 40 stainless steel pipe, various heat numbers. Other documents reviewed included CMTRs and corresponding PMI test reports, numbers PMI-022, PMI-027, and PMI-028.

Pipe Supports

The requirements for fabrication of pipe supports are specified in Specification Section 15060, *Hangers and Supports*. Qualification of pipe supports is through a CGD program. Criteria for performing QC receipt inspections for pipe supports are specified in RCIP-1275, *Stainless Steel and Carbon Steel Pipe Support Kits*, and CGDP number M-CGD-J00104, *Various Pipe Support Kits that Include Stainless Steel and Carbon Steel Plates, Hollow Structural Sections, Wide Flange W Shapes, Angles, and Unistruts, and Pipe Pieces*.

Independent Oversight reviewed several MRIRs, material test reports, and inspection records for materials used to fabricate pipe supports and hardware such as U-bolts supplied by several suppliers. In addition, results of tension tests performed at an independent test laboratory on stainless and carbon steel members used in fabrication of pipe supports were reviewed.

Weld Filler Material

The requirements for weld filler material are specified in Part 2 of Specification Section 15125, *General Welding Specification*. Qualification of weld filler material (wire) is through a CGD program with PMI testing performed on a sample from each heat, in addition to mechanical testing performed at an offsite independent test laboratory. Criteria for performing QC receipt inspections are specified in RCIP 1025, *Weld Filler/Filler Material for GTAW, FCAW, & SMAW Applications*, and CGDP Number C-CGD-J00001, *Weld Filler Materials for GTAW, FCAW, and SMAW Welding for AWS Filler Material Classifications E308L, E308LT, E309L, E309LT, ER309L, ER316L, ER70S-2, E8018-C3, E8018-C1, E71T-1, E6010, E6013, and 7018*.

Independent Oversight reviewed records documenting receipt inspection, document review, and PMI testing for the following weld filler materials:

- MRIR 01216 for ER 308L Weld Wire, Heat Numbers 525258 and 739050, the CMTR, and PMI Report, number PMI -254

- MRIR 00597 for ER 309L Weld Wire, Heat Number E90063, the CMTR, and PMI Report, number PMI -123.

- MRIR 01306 for ER 308L Weld Wire, Heat Number 526661, the CMTR, and PMI Report, number PMI -271

- MRIR 4803 - 00240 for ER 308L Weld Wire, Heat Number E71196, the CMTR, and PMI Report, number PMI -046.

Weld filler materials from heat numbers 525258, 739050, and E90063 were used to fabricate and install pipe supports examined by Independent Oversight.

Concrete Expansion Anchors

Concrete expansion anchors are used to attach some of the pipe supports to the building structure. The requirements for concrete expansion anchors are specified in Part 2.5 of Specification Section 15060, *Hangers and Supports*. Concrete expansion anchors are procured from a supplier with an NQA-1 procurement program. Independent Oversight reviewed the supplier's CGD work instruction which outlines the requirements for engineering evaluation, procurement, and verification of critical characteristics for dedication and acceptance of concrete expansion anchors in safety significant installations at the SWPF. The receipt inspection activities performed by the Parsons QC inspectors are specified in RICP-1023, *PL-2 and PL-3 Items Received from NQA-1 Suppliers*.

Independent Oversight reviewed the MRIRs and CMTRs for stainless steel concrete expansion anchors purchased from the NQA-1 supplier. Records examined were as follows: MRIR 01237 for 3/8" by 3 3/4" long and ¾" by 10" long anchors; MRIR 01254 for 3/8" by 7" long and 1/2" by 7" long anchors; and MRIR 01250 for ¾" by 10" long anchors. The appropriate CMTRs were included with the MRIRs.

Grout

Non-shrink grout is used to provide a full bearing surface under pipe support base plates; under supports for pumps, motors, and other mechanical equipment; and under base plates for other equipment such as instrument racks. The grout is purchased in bags that contain a proportioned mix of sand, cement, and other admixtures. The grout is prepared for placement by adding a measured quantity of water and mixing for a specific time designated by the manufacturer. The shelf life of the bagged grout is specified by the manufacturer and is stamped on each bag, along with a lot number. Independent Oversight reviewed RICP-1015, *Non-shrink Grout*, and CGDP Number C-CGD-J00002, *Non-shrink Cementitious Grout*, which specify the requirements and critical characteristics for acceptance of grout for the SWPF project.

Independent Oversight reviewed MRIR 00999, which included the reviews required by RICP-1015 and CGDP C-CGD-J00002, and the results of unconfined compression tests performed on samples of the grout by an independent test laboratory. The test results showed that the grout met the specification requirements. The inspection records showed that the shelf life of the bagged grout was evaluated during the receipt inspection process.

Summary and Conclusions – Procurement and Receipt Inspection Program

Independent Oversight concluded that the SWPF procurement program was adequate. Procedures that control procurement of piping system components include requirements for CGD and review for S/CI. Specifications used for procurement of piping system components contain appropriate technical and quality requirements. The receipt inspection program includes a detailed process for independent measurement and testing of piping system components.

Storage of Piping, Pipe Support, and Piping System Components

Independent Oversight examined storage of bulk piping and pre-fabricated spool pieces in several designated outdoor storage areas. The areas were well drained, gravel covered, located away from construction activities and traffic areas, and clearly identified with barriers. The storage areas met the requirements for Level D storage areas as defined in ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*. The piping and spool pieces were supported on cribbing which permitted air circulation and avoided trapping of water. The piping and spool pieces were clearly identified by tags or an identification method that will be legible until installation in the CPA. Nonconforming materials were stored in a designated holding area and were clearly identified. With few exceptions, the piping and spool pieces were capped to maintain internal cleanliness. The flange on one spool piece was in contact with the gravel. The DOE-SRS engineer who accompanied Independent Oversight on the walkdown contacted Parsons to have these minor deficiencies (missing caps and one flange in contact with the ground/gravel) corrected.

Independent Oversight also examined warehouses where piping system components, such as valves, motor operators, fasteners, air operators, and weld filler materials, were stored. The warehouses were weather tight, well ventilated, had paved floors, and controls to maintain the temperature in the warehouse storage areas between 40 and 140 degrees Fahrenheit. The warehouses meet the requirements for Level B storage areas as defined in NQA-1. Items in the warehouse were stored on pallets or shelving that permit air circulation. Weld filler materials were stored in sealed containers. Fasteners were stored in containers supplied by manufacturers or vendors. Valves, instrumentation, and air operators were capped to prevent internal contamination. Motors, motor operators, and various other components to be installed in or connected to piping systems were stored in the original shipping containers or on pallets or shelving and covered with protective wrapping, if required. All items in the warehouse were clearly identified with tags. A system was in place to control the shelf life of materials, such as bagged grout. Nonconforming materials or items pending receipt inspection were segregated from conforming materials as required. Several items that did not comply with project requirements were marked for return to the manufacturer or supplier. Independent Oversight concluded that storage of piping system components was adequate.

Review of Procedures Controlling Installation and Inspection of Pipe Supports

Pipe support fabrication details are shown on controlled drawings which specify member types and sizes, weld details, method of attachment to the building structure, and details for attachment of the pipe to the support. Section 2.5 of Procedure number DP-CS-7318, *Fabrication/Installation of Process Piping and Pipe Supports*, specifies the requirements for installation of pipe supports. Pipe supports used at the SWPF are classified as either standard or engineered. Standard supports are used at multiple locations to support a variety of piping sizes and configurations. The length of some members on standard supports can be adjusted to accommodate for various configurations and locations. The fabrication details are shown on generic support drawings, which show the maximum and minimum lengths of members that can be adjusted. Engineered supports are uniquely designed and fabricated for a specific location.

Document Number PL-GN-0003, *Pipe Support Fabrication, Installation, and Acceptance Plan*, describes the process for pipe support fabrication, installation, final qualification, and acceptance as permanent

supports. The plan specifies that Engineering will prepare and issue isometric drawings that are "red lined" showing the location and type of pipe supports to be installed. These drawings are classified as sketches because the final piping stress analysis has not been completed and the type and location of the pipe supports are based on a preliminary stress analysis and engineering judgment. These sketches are prepared in accordance with Instruction Number DI-EN-031, *Engineering Sketches in Support of Pipe Support Fabrication, Installation, and Acceptance Plan*. Since the results of the final stress analysis may require some supports to be relocated or modified, the pipe supports are classified as temporary.

Inspections of pipe supports are controlled by inspection and test plans (ITPs) which are prepared in accordance with Procedure PP-QC-4802, *Quality Control Inspection*. The ITPs list inspection requirements, inspection references, inspection attributes, and inspection criteria. Independent Oversight reviewed: ITP Numbers IPP-05055, Section 05055, *Welding, Structural,* and ITP Number IPP-05120-0001, Section 05120, *Structural Steel*, Rev. 3, P-CH-J-0101, *SWPF Special Pipe Supports at Steel, Notes, Typical Sections & Details*, Rev. 0 (General Inspection Requirements for Pipe Supports Welding) which specify the inspection requirements for pipe supports. Inspection results are documented on Quality Control Inspection Reports (QCIRs).

Independent Oversight concluded that the procedures for installation and inspection of pipe supports were adequate and met the requirements of the SWPF QA plan.

Installation of Pipe Supports

Independent Oversight examined approximately 20 pipe supports in the North ASP Labyrinth #4, Room 131C; North ASP Labyrinth #3, Room 131D; and North ASP Labyrinth #1, Room 131F. These supports included standard pipe supports and engineered pipe supports. These supports had been inspected and accepted by Parsons QC inspectors. Independent Oversight compared the installed pipe supports to the details shown on controlled pipe support drawings that specify member types and sizes, weld details, and method of attachment of the supports to the building structure. Independent Oversight verified that welds were proper type, size, and length, and the size, type, and length of support members and the support configuration were in accordance with design drawing requirements. The pipe supports examined by Independent Oversight were installed at the locations indicated on the "red lined" isometric drawings (sketches). No deficiencies were identified. Independent Oversight concluded that the pipe supports were fabricated and installed in accordance with details shown on the design drawings.

Review of Quality Records

Independent Oversight reviewed records documenting fabrication and inspection of pipe supports. The inspection records reviewed included those associated with Work Packages WP-0605, WP-0530, and WP-0532. Records examined included QCIRs, piping support checklists documenting installation of concrete expansion anchors, welder qualification logs, and field welding checklists (FWCLs). The FWCLs document all data associated with the welds, including location, drawing numbers, welding procedure specification, inspection requirements and procedures, preheat requirements, and weld filler materials requirements. Other data shown on the FWCL include identification of the welder, weld filler material and heat number used for the weld, identification of the QC inspector who inspected the weld, and inspections results.

Pipe support fabrication details are shown on controlled drawings that specify member types and sizes, weld details, method of attachment to the building structure, and details for attachment of the pipe to the support. Drawings showing the location and type of pipe supports to be installed are based on a preliminary stress analysis and engineering judgment. These drawing are classified as sketches. Although the pipe supports are constructed in accordance with the support fabrication drawings and are

installed at the locations indicated on the sketches, the supports are classified as temporary. Inspections of the supports were performed by QC inspectors and are documented on QCIRs. The QCIR numbers are referenced on the sketches. However, none of the installation job steps in the work packages are signed as complete by construction personnel. Most of the work packages are very large, containing in excess of 200 installation steps, which are designated as job steps in the work packages. Also, with the exception of the concrete expansion information, none of the other attributes on the piping support checklists are completed. Discussions with Project personnel disclosed that since the supports are classified as temporary, the work package installation job steps will not be signed until the stress analyses are completed, final isometric drawings are issued, and pipe slopes are verified to be in accordance with those shown on the isometric drawings. For all practical purposes, the supports are complete, have been installed in accordance with the details shown on the design drawings, and have been inspected and accepted by QC. It may be necessary to modify or relocate some supports after the final isometric drawings are issued. Adjusting the pipe slopes may also require some minor support modifications. However, these changes will require design modifications, including either issuing a new work package to perform the work or adding additional job steps to an existing work package to properly control the work. Independent Oversight questioned the process the project plans use to complete sign-off of the work packages. Delaying closeout of the individual job steps in the work packages until the final isometric drawings are issued could result in a large backlog of "incomplete" work packages which could delay performance of startup testing and project completion. Since many of the individuals responsible for completion of the original support installation may no longer be employed at the site, it may be necessary to perform a re-verification walkdown to determine if each individual job step has been completed. Some of the supports may be inaccessible or require installation of scaffolding to examine completed supports. Another concern is the potential for misplacement or loss of records. (See OFI-1)

Concrete Expansion Anchors

Concrete expansion anchors are used to attach some of the pipe supports to the building structure. Concrete expansion anchors are also used for attaching instrument racks; heating, ventilation, and air conditioning (HVAC) components; and electrical components to the building structure floors, ceilings, or walls. The location, anchor size (diameter and length), and embedment depth are shown on the design drawings for various types of supports. Several sizes of anchors are being used at the SWPF project. Several types and sizes (length and diameter) of anchors are used in various applications. Several different subcontractors and different crafts (electricians, pipe fitters, iron workers, HVAC installers, etc.) install concrete expansion anchors. Review of the NCR log disclosed that a number of deficiencies have been identified concerning concrete expansion anchor installation. These deficiencies included using incorrect drill sizes to drill holes in the concrete for anchor installation, and installing incorrect size/length anchors at some locations. The project does not have a procedure to specify a step-by-step process for concrete expansion anchor installation. The contractor relies on the skill of the craft to follow the manufacturer's catalog for anchor installation requirements. Copies of the manufacturer's catalog are included in the work packages. The catalog primarily contains information for use by design engineers to determine capacities of various sizes of the concrete expansion anchors. One page in the catalog shows the installation steps, with minimal details. There is also no project procedure specifying the QC inspection requirements, installation hold points, acceptance criteria, or inspection documentation requirements. The method for documenting QC inspection of concrete expansion anchors varies, depending on what the anchor is used for. A QCIR is used to document anchors installed for electrical components. For pipe supports, concrete expansion anchor inspection results are documented on piping support checklists. (See OFI-2.)

Qualification of QC Inspection Personnel

The levels of qualification, duties, and responsibilities for NDE inspection personnel are required by ASME NQA-1 to meet the American Society for Nondestructive Testing, Recommended Practice SNT-TC-1A, *Personnel Qualification and Certification in Nondestructive Testing*. Independent Oversight reviewed Procedures DP-QC-4801, *Quality Control Inspector Certification*; DP-QA-4701, *SWPF NDT Training, Examination and Certification Plan*; and DP-QA-4709, *SWPF Written Procedure for NDE/NDT*, which implement the requirements at SWPF for education, training, experience, and certification of NDE personnel. Independent Oversight determined that the procedures comply with the requirements specified in SNT-TC-1A.

Independent Oversight reviewed the qualification and certification records of ten QC inspectors who perform visual inspections of piping and pipe support welds. Records reviewed included those documenting education, experience, training, written exam results, and annual vision acuity exams. Independent Oversight verified that the ten QC inspectors were qualified and certified in accordance with SNT-TC-1A.

Quality Assurance Surveillance Activities

Independent Oversight reviewed QA surveillance activities. Surveillances are used to complement QA audits. Surveillances are performed by QA personnel of onsite quality-related processes and worker safety activities. For specialized surveillances, subject matter experts are selected to perform surveillance activities. Independent Oversight reviewed the following procedures that control the QA surveillance program: Procedure PP-QA-4701, *Surveillance Program*; Procedure DP-QA-4708, *Supplier Evaluation Program*; and Procedure DP-QA-4712, *Supplier Assessment Process for Surveillance Activities*.

Independent Oversight reviewed 24 surveillances related to piping systems. These surveillances included surveillance report numbers SWPF SR 2476 and SWPF SR 2327, which concerned assessments of supplier performance. The assessments recommended removal of some suppliers of piping system components from the qualified suppliers list for failing to implement contract quality and technical requirements. Surveillance report number SWPF SR 2485, which concerned review of the extent of condition regarding documentation of weld filler materials, was performed by a subject matter expert, the Welding Engineering Manager. This issue was originally documented on NCR numbers 0644 and 0650, which were then upgraded to CR-2011-11. Implementation of the QA surveillance program is adequate.

Corrective Action Program

Procedure PP-AS-1203, *Corrective Action Program*, establishes and implements the SWPF corrective action program to correct and prevent recurrence of issues affecting quality, regulatory compliance, or personnel or operational safety. CRs are used to document issues that affect or have the potential to affect safety or quality. Procedure PP-QA-4703, *Nonconforming Items*, defines the requirements for identifying, documenting, evaluating, and correcting items that are identified as nonconforming with SWPF project requirements. NCRs are issued to document and disposition nonconforming items. The QC Manager is responsible for reviewing and validating the nonconforming condition. The QC Manager determines if a CR is required for the nonconforming condition. Examples of nonconformances are: (1) failure to satisfy technical or design requirements; (2) indeterminate quality of an item: (3) S/CI or documentation; (4) incorrect installation of structures, systems, and components (construction errors); (5) failure of personnel to follow procedures, such as bypassing hold points or improperly performing inspections; or (6) documentation deficiencies. Procedure PP-PR-6021, *Supplier/Subcontractor Deviation, Information, or Nonconformance Request*, provides for documentation and resolution of

nonconformances that are identified in compliance with suppliers or subcontractors approved nonconformance programs.

Independent Oversight reviewed 18 NCRs and five CRs issued by Parsons pertaining to piping and piping system components to determine the type of nonconforming issues that were identified and subsequent mechanisms for resolution. Independent Oversight found that the Parsons engineering organization developed appropriate corrective actions to disposition the identified problems. Corrective actions generally involved rework and/or repair of the nonconforming items. When appropriate, CRs were issued to address nonconforming items initially identified as NCRs.

Independent Oversight performed a review of NCRs and CRs issued between October 2011 and May 2012. Approximately one-half of the NCRs and CRs were issued to document equipment, hardware, and material nonconforming items identified by receipt inspectors. Examples of nonconforming items that can be classified as procurement problems included: (1) hardware/components that were delivered to the site without the required supporting documentation demonstrating compliance with purchase specifications, (2) hardware/equipment that did not comply with project specification requirements, (3) improperly labeled hardware, and (4) missing parts or damage that occurred during transit. Independent Oversight found that the Parsons engineering organization developed appropriate corrective actions to disposition the identified problems. Corrective actions involved rework performed on site, or in some cases, the hardware was returned to the vendor. Implementation of the corrective action program was adequate to address and resolve procurement and construction quality deficiencies.

Installation of Tanks in Dark Cells

Independent Oversight observed installation of Tank numbers 104 and 105 in Room R196 in the CPA, which is classified as a DC. Some minor interferences were encountered during setting of the tanks which prevented the tanks being installed at their final position and orientation during the review. The interferences, a few pipe supports and some reinforcing steel, were temporarily removed. The tanks were installed at the correct locations and orientation subsequent to the site review. QC inspection personnel inspected the stainless steel ring beams that support the tanks. Inspection criteria utilized by the QC inspectors appear in ITP Number 11813-0001, 11813, *Large ASME Vessels (Vessel Skirt to Ring Beam Installations) – Safety Significant*. The results of their inspections were documented in SWPF surveillance report SWPF-SR-2526, dated May 23, 2012. No discrepancies were identified with the ring beams or stainless steel liner plate within the ring beam perimeter. Independent Oversight examined the ring beam and liner for Tank 105 prior to placement of the tank and concurred with the results of the QC inspection. Due to some open supplier NCRs and incomplete or missing documentation issues, the tanks were conditionally released for installation. SWPF- NCR-0696 and -0702 were issued by Parsons to document and disposition the open issues. The issues documented on the NCRs can be corrected with the tanks in place. Hold tags were attached to the tanks pending closeout of the NCRs.

Material Condition and Protection of Installed Equipment and Facilities

Independent Oversight, accompanied by DOE-SR personnel or Parsons engineers, examined ongoing construction activities and protection provided for installed equipment. Overall material condition of installed equipment was good. Instrumentation was wrapped in protective covers, and instrument panels were protected with covers. Openings in pipes, pumps, tanks/vessels, and instrument lines were closed with caps or tape to maintain cleanliness and prevent internal contamination. Mechanical equipment, such as motors and pumps, was protected from construction activities. Drive shafts on pumps and motors were covered with metal shields. Motors were wrapped with protective covers, with energized heat lamps installed under the motor covers to prevent build up of moisture, and with humidity-indicating charts to detect presence of moisture. Independent Oversight examined the humidity-indicating charts on

approximately 12 installed motors. The charts indicated no moisture was detected. Material condition and protection of installed equipment was adequate.

6.0 CONCLUSIONS

Independent Oversight determined that construction quality at SWPF was adequate in the areas reviewed. Parsons had developed appropriate corrective actions to disposition the NCRs and CRs that Independent Oversight reviewed. Storage and procurement of piping, pipe supports, and pipe support components was adequate. Pipe support installation and inspection activities are adequate, although opportunities for improvement were identified in certain aspects of the procedures for inspecting and documenting installed pipe supports and anchor installations.

7.0 ITEMS FOR FOLLOW-UP

Independent Oversight will continue to follow up on inspection of piping and pipe supports and follow up on installation of mechanical equipment.

8.0 OPPORTUNITIES FOR IMPROVEMENT

This Independent Oversight review identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management organizations and be accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

OFI-1: Consider performing an evaluation of the status of installed pipe supports and document work completed to date by completion of a pipe support checklist or by signing the appropriate work package job steps to document completed work.

OFI-2: Consider preparing and issuing a procedure to control concrete expansion anchor installation work and QC inspection.

APPENDIX A
SUPPLEMENTAL INFORMATION

Review Dates

May 14 - 18, 2012

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
John S. Boulden III, Director, Office of Enforcement and Oversight
Thomas P. Staker, Deputy Director for Oversight
William Miller, Deputy Director, Office of Safety and Emergency Management Evaluations

Quality Review Board

William Eckroade
John Boulden III
Thomas Staker
William Miller
Michael Kilpatrick
George Armstrong
Robert Nelson

Independent Oversight Site Lead for Savannah River Site

Phillip Aiken

Independent Oversight Team Composition

Phillip Aiken, Lead
Joseph Lenahan

APPENDIX B
DOCUMENTS REVIEWED

- Procedure DP-CS-7318, Rev. 2, Fabrication/Installation of Process Piping and Pipe Supports, June 10, 2011
- Procedure DP-CS-7320, Rev. 0, Installation of Mechanical Equipment, May 11, 2011
- Procedure PP-CS-7320, Rev. 2, General Welding Procedure, September 23, 2011
- Procedure PP-CS-7224, Rev. 4, Construction Field Change Notice, November 16, 2011
- Procedure DP-QC-4801, Rev. 2, Quality Control Inspector Certification, March 18, 2011
- Procedure PP-QC-4802, Rev. 5, Quality Control Inspection, January 17, 2011
- Procedure DP-QC-4803, Rev. 1, QC Material Receiving Inspection, February 2, 2010
- Procedure DP-QC-4804, Rev. 5, Positive Material Identification Equipment Operation, December 12, 2011
- Procedure DP-QA-4701, Rev. 1, SWPF NDT Training, Examination and Certification Plan, March 18, 2011
- Procedure DP-QA-4712, Rev. 1, Supplier Assessment Process for Surveillance Activities, May 12, 2011
- Procedure DP-QA-4708, Rev. 4, Supplier Evaluation Program, June 13, 2012
- Procedure PP-QA-4701, Rev. 5, Surveillance Program, February 22, 2010
- Procedure PP-QA-4703, Rev. 9, Nonconforming Items, December 9, 2011
- Procedure DP-QA-4709, Rev. 1, SWPF Written Procedure for NDE/NDT, March 18, 2011
- Procedure PP-AS-1203, Rev. 7, Corrective Action Program, August 25, 2011
- Procedure PP-PR-6021, Rev. 3, Change 1, Supplier/Subcontractor Deviation, Information, or Nonconformance Request, April 12, 2011
- Procedure PP-CS-7316, Rev. 1, Welder, Welding Operator & Brazer Testing Qualification & Certification Process and Procedure, June 16, 2010
- Procedure DP-CS-7317, Rev. 2, Receipt, Storage and Issuance of Welding & Brazing Filler Materials, August 11, 2011
- Procedure PL-QA-4703, Rev. 0, SWPF Suspect/Counterfeit Item Prevention Plan, October 26, 2010
- Procedure PP-QA-4713, Rev. 0, Suspect/Counterfeit Item Procedure, February 23, 2011
- Procedure PP-EN-5023, Rev. 3, Replacement Item Evaluation/Commercial Grade Item Dedication, December 30, 2010.
- Procedure PP-EN-5024, Rev. 3, Preparation of Receiving Inspection Criteria Packages, December 30, 2010
- ITP Number IPP-05055, Section 05055, Welding, Structural, February 11, 2009
- ITP Number IPP-05120-0001, Section 05120, Structural Steel, Rev. 3, P-CH-J-0101, SWPF Special Pipe Supports at Steel, Notes, Typical Sections & Details, Rev. 0 (General Inspection Requirements for Pipe Supports Welding), February 11, 2009
- ITP Number 11813-0001, Rev. 0, 11813, Large ASME Vessels (Vessel Skirt to Ring Beam Installations) – Safety Significant, May 10, 2012
- Instruction Number DI-EN-031, Rev. 1, Engineering Sketches in Support of Pipe Support Fabrication, Installation, and Acceptance Plan, November 4, 2010
- Specification Section 05055, Rev. 2, Welding, Structural, September 13, 2010
- Specification Section 11817, Rev. 3, Positive Material Identification, March 4, 2011
- Specification Section 15111, Rev. 10, Pipe Fabrication, April 6, 2012
- Specification Section 15114, Rev. 3, General Piping Material Procurement, July 8, 2009
- Specification Section 15116, Rev. 4, Pipe Procurement, June 24, 2011

- Specification Section 15125, Rev. 5, General Welding Specification, September 23, 2011
- Specification Section 15060, Rev. 1, Hangers and Supports, September 20, 2010
- Pipe Support Fabrication, Installation and Acceptance Plan, PL-GN-0003, Rev. 1, January 11, 2011
- Drawing No. P-CH-J-0044, Rev. 3, SWPF Pipe Support Standard U-Bolts for Guides and Supports, (U) March 23, 2012
- Drawing No. P-CH-J-0070, Rev. 2, SWPF Standard Pipe Supports, PS-1000 and PS-1001, (U) March 23, 2012
- Drawing No. P-CH-J-0090, Rev. 1, SWPF Standard Pipe Supports at Concrete, PS-D01 and PS-D04, (U) March 23, 2012
- Receiving Inspection Criteria Package (RICP) 1023, PL-2 and PL-3 Items Received from NQA-1 Suppliers
- RICP-1015, Non-shrink Grout
- RICP 1025, Weld Wire/Filler Material for GTAW, FCAW, & SMAW Application
- RICP 1040, Pipe (including Nipples): Stainless Steel
- RICP 1043, Elbows, 90 Degrees, Butt Weld, Seamless Austenitic Stainless Steel, Type 304L
- RICP 1275, Stainless Steel and Carbon Steel Pipe Support Kits
- Commercial Grade Dedication and Material Upgrade Number C-CGD-J00001, Weld Filler Materials for GTAW, FCAW, and SMAW Welding for AWS Filler Material Classifications E308L, E308LT, E309L, E309LT, ER309L, ER316L, ER70S-2, E8018-C3, E8018-C1, E71T-1, E6010, E6013, and 7018, dated June 21, 2012
- Commercial Grade Dedication and Material Upgrade Number C-CGD-J00002, Non-shrink Cementitious Grout, dated May 13, 2010
- Commercial Grade Dedication and Material Upgrade Number M-CGD-J00051, Pipe (includes nipples): Various diameters ranging from ¼" – 12", seamless austenitic low carbon stainless steel type 304L for pipe specified as Schedules 5S, 10S, 40S, and 80S, dated May 18, 2011.
- Commercial Grade Dedication and Material Upgrade Number M-CGD-J00104, Various Pipe Support Kits that Include Stainless Steel and Carbon Steel Plates, Hollow Structural Sections, Wide Flange W Shapes, Angles, and Unistruts, and Pipe Pieces, dated December 12, 2011
- Commercial Grade Dedication and Material Upgrade Number M-CGD-J00052, Elbows, 90 Degrees, Various Diameters, Seamless Stainless Steel, Type 304L, dated September 18, 2009
- QA Surveillance Report numbers SWPF-SR-1450, -1963, -1954, -2147, -2214, -2216, -2245, -2291, -2327, -2346, -2364, -2389, -2394, -2403, -2412, -2414, -2432, -2452, -2457, -2476, -2485, -2494, -2495, -2498, -2506, and -2526
- Condition Reports numbers SWPF-CR-2011-11, 2011-188, 2011-189, 2012-048, and -2012-059
- Nonconformance Report numbers SWPF-NCR-0322, -0399, -0455, -0458, -0459, -0482, -0492, -0517, -0549, -0602, -0611, -0615, -0626, -0644, -0650, -0660, -0687, -0696, -0699, and -0702,
- SRS Engineering Standard 15060, Rev. 17, ASME B31.3 Additional Requirements for SRS Piping, March 28, 2011