Independent Oversight Review of the Savannah River Site, Waste Solidification Building, Construction Quality of Mechanical Systems Installation and Selected Aspects of Fire Protection System Design

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Acronyms

AISC	American Institute of Steel Construction
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
BCCI	Baker Concrete Construction, Inc.
CFR	Code of Federal Regulations
CGD	Commercial Grade Dedication
CRAD	Criteria and Review Approach Document
DCF	Design Change Form
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
FHA	Fire Hazards Analysis
gpm	Gallons per Minute
GS	General Service
HAW	High Activity Waste
HEPA	High Efficiency Particulate Air
HSS	Office of Health, Safety and Security
HVAC	Heating, Ventilation, and Air Conditioning
LOI	Line of Inquiry
MFFF	Mixed Oxide Fuel Fabrication Facility
NDE	Nondestructive Examination
NFPA	National Fire Protection Association
NICET	National Institute for Certification in Engineering Technologies
NNSA	National Nuclear Security Administration
NQA	Nuclear Quality Assurance
PC	Performance Category
PDSA	Preliminary Documented Safety Analysis
P&ID	Piping and Instrumentation Diagram
PS	Production Support
psi	Pounds per Square Inch
PVV	Process Vessel Ventilation
QA	Quality Assurance
QAM	BCCI Quality Assurance Program Manual
QC	Quality Control
SDD	System Design Description
SRNS	Savannah River Nuclear Solutions
SRS	Savannah River Site
SS	Safety Significant
TSR	Technical Safety Requirement
WSB	Waste Solidification Building
WPS	Welding Procedure Specification

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1.0 PURPOSE

The Office of Enforcement and Oversight (Independent Oversight), within the U.S. Department of Energy (DOE) Office of Health, Safety and Security (HSS), conducted an independent review of construction quality and selected aspects for fire protection system design at the DOE Savannah River Site (SRS) Waste Solidification Building (WSB). The review was performed on site between September 24 and 27, 2012, focusing on the WSB process vessel ventilation (PVV) system and the fire protection active and passive systems.

2.0 SCOPE

The scope of this review encompassed various topics relating to installation of PVV system safety significant (SS) components and the WSB fire protection system. The review included the inspection procedures, drawings and specifications for installation of piping, pipe supports, valves, and heating, ventilation, and air conditioning (HVAC) system supports, and the program used to maintain welder qualifications and monitor welder performance. Qualifications of quality control (QC) inspectors, records documenting welding controls and inspections of pipe support and HVAC support welds, and assessments of contractor performance completed by National Nuclear Security Administration (NNSA) WSB Project Office personnel and Savannah River Nuclear Solutions (SRNS) personnel were also reviewed. The WSB fire hazards analysis (FHA), technical baseline documentation, and design requirements for the fire protection system were evaluated.

Independent Oversight reviewed various construction quality documents and conducted several construction site walkthroughs with NNSA and SRNS engineers. During the walkthroughs, Independent Oversight examined six PVV pipe supports and the storage of piping and piping system components. Independent Oversight also reviewed various aspects of the fire protection system, including fire protection design piping and support drawings and fire protection technical and project documentation.

3.0 BACKGROUND

The purpose of the WSB is to treat specific high and low activity liquid waste streams from the Mixed Oxide Fuel Fabrication Facility (MFFF). The MFFF processes surplus plutonium oxide from disassembled nuclear weapons and blends it with depleted uranium oxide to produce mixed oxide fuel that will be used in commercial nuclear reactors. As part of the plutonium disposition mission at SRS, the WSB processes the MFFF liquid stream waste stream into a disposable waste form. Liquid waste streams enter the WSB via a dedicated underground transfer line from the MFFF and/or from a dedicated tank transfer system that will receive waste from other SRS locations. The liquid waste is processed and converted into solid waste forms acceptable for disposal as transuranic waste or low level waste. The design life of the facility, which will support MFFF operations, is 30 years.

The WSB is a two-story reinforced-concrete structure that is classified as a hazard category 2 nuclear facility in accordance with DOE Standard 1027-92. The WSB is designed to DOE performance category (PC)-3+ criteria, which constitute enhanced PC-3 criteria that use the seismic response criteria from

Nuclear Regulatory Commission Regulatory Guide 1.60. The WSB contains a high activity waste (HAW) process facility, a low activity waste process facility, an analytical laboratory, a control room, electrical components, and locker rooms and other various support facilities. The HAW is separated from the rest of the facility by a seismically-designed, reinforced-concrete, three-hour-rated fire wall. The mechanical and electrical systems within the HAW, including the interior fire protection sprinkler system, are classified as SS and are designed to PC3+ criteria. The fire wall also serves as a containment barrier to prevent the spread of airborne contamination and will shield the direct doses associated with the HAW process. The emergency diesel generator is also classified as SS. There are also some components within the HAW that are classified as safety class. Most of the components in the balance of the WSB are either classified as general service (GS) or production support (PS).

Activities carried out within the WSB include waste receipt, waste concentration, waste neutralization, and waste cementation. Cementation is performed in 55 gallon drums that have sacrificial paddles to blend cement with liquid waste. In addition to the WSB, the site also contains a covered pad for temporary storage of waste containers, as well as such additional facilities as the emergency diesel generator, electrical substation, steam boiler building, and tanks for storage of cold chemicals.

The WSB was designed by SRNS, the management and operations contractor for SRS. SRNS also serves as project manager for the WSB contract. Baker Concrete Construction, Inc. (BCCI) is the general contractor for the WSB. Several subcontractors are working under BCCI to install electrical, mechanical, fire protection, and instrumentation systems. Augusta Fire Protection, the subcontractor for the fire protection system, is installing the fire alarms, fire detection system, and piping and pipe supports associated with fire protection. Intermech, Inc., the mechanical subcontractor for the project, is responsible for fabricating and installing piping and pipe supports for all piping systems on the project, except for the fire protection system. Intermech is also fabricating and installing the HVAC system and installing mechanical equipment.

Subpart A of 10 CFR Part 830, *Quality Assurance*, establishes quality assurance (QA) requirements for contractors constructing DOE nuclear facilities. This regulation requires contractors to submit a QA program to DOE for approval and to conduct work in accordance with the QA program. The current, approved BCCI QA program is documented in the BCCI Quality Assurance Program Manual (QAM), Revision 4, dated January 19, 2011. All WSB subcontractors and suppliers work under the BCCI QAM.

Construction work currently in progress includes installation of piping and pipe supports, instrumentation lines, the fire protection system, electrical cables, and mechanical equipment. Construction is 60 percent complete, with an estimated completion date of 2014. Construction oversight is provided by NNSA staff in the NA-26 WSB Integrated Project Division, assisted by SRNS.

4.0 METHODOLOGY

This independent review of the WSB construction project was conducted in accordance with the Plan for Review of the Waste Solidification Building Construction Quality, dated September 2012. Applicable sections of the following HSS Criteria and Review Approach Documents (CRADs) were used for the review: HSS-CRAD-45-52, *Construction – Piping and Pipe Supports*; HSS-CRAD-45-53, *Construction – Mechanical Equipment Installation*; and HSS-CRAD-64-34, *Fire Protection*.

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, findings in Section 7, items for follow-up in Section 8.0, and opportunities for improvement in Section 9.0.

Storage of Piping. Independent Oversight examined storage of bulk piping and pre-fabricated spool pieces in several designated outdoor storage areas near the WSB facility. These areas meet the requirements for Level D storage areas as defined in American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1, *Quality Assurance Requirements for Nuclear Facility Applications*, and are covered with sandy soil that should provide adequate drainage. The storage areas are clearly identified with barriers. Timber cribbing is provided to support the piping to prevent it from being in direct contact with the ground. This method of storage permits air circulation and keeps the piping from being immersed in water. However, it was noted that several spool pieces were in contact with the ground.

The end of the pipes and piping spool pieces are required to be covered to maintain internal cleanliness of the piping. A number of piping and spool pieces in the storage areas were observed not to be capped, and some of the pipe ends were covered with what appeared to be duct tape that had dried out and shrunk so that it no longer covered the entire end of the spool pieces. Contaminants could enter the pipe spool pieces through gaps in the tape.

The SRNS engineer who accompanied Independent Oversight on the walkdown indicated that he would notify the contractor to have the observed issues corrected. Discussions with the SRNS engineer and other SRNS personnel disclosed that storage of pipe spool pieces has improved since concerns about their storage were identified in surveillances conducted by SRNS.

Independent Oversight also examined the storage of piping in the HAW areas inside the WSB. Pipe caps were installed over the ends of the spool pieces, but a number of spool pieces were not stored on cribbing and were in direct contact with the concrete floor. Although the floor was dry, this method of storage does not permit air circulation, and the pipe spool pieces could come in direct contact with moisture if the floor becomes wet in these areas (for example, during flushing or hydrostatic pressure testing of piping systems). SRNS engineers will continue to monitor the storage of pipe spool pieces.

Review of Drawings and Procedures for Installation and Inspection of Pipe Supports. Pipe supports at WSB are classified as generic pipe supports, and their fabrication and construction details are shown on a series of controlled drawings titled *Generic Pipe Support Details*. Fabrication details include member types and sizes, weld details, detail for the attachment of the support to the building structure, and the type of hardware to be used to attach the pipe to the support. Some members on these generic supports can be lengthened or shortened to accommodate various configurations and locations. Allowable support loads shown on these drawings are used to determine maximum span lengths of the members whose length can be adjusted. The piping design isometric drawings depict the layout of the piping, showing pipe length, type, and size; location of bends and elbows; type and location of valves, reducers, tees, and other hardware; and location and types of pipe supports. Each pipe support shown on the isometric drawing has a unique location number and a reference to a particular generic pipe support detail specified by the design engineer for that location. The isometric and generic pipe support detail drawings are controlled by SRNS, the design engineering organization, and SRNS must approve changes to these drawings.

A drawing titled *Pipe Support Detail*, hereinafter referred to as a "sketch," is prepared by SRNS Engineering for each individual support location shown on the isometric drawing. The support locations are numbered in sequence. The number for the individual pipe support detail sketch references the piping isometric drawing number, sheet number, generic pipe support detail, and the unique support location number. The sketch shows the point of attachment to the pipe, a bill of materials with a description of the parts required to fabricate the support, plan, elevation and isometric views of the support, and reference notes. The reference notes state that the details shown on the sketch are for reference only, that the dimensions shown are nominal, and that the sketch is not to be used for support fabrication. The reference notes on the sketch state that the support is to be fabricated in accordance with the controlled Generic Pipe Support Detail drawings. The sketches are apparently considered construction aids to show support orientation and the point of attachment to piping and to the building structure. The sketches are not dated and do not have a revision number. The revision number in the sketch title block is "Working."

The piping design isometric drawings, the generic pipe support detail drawings, and the pipe support detail sketches are placed in construction work packages, which construction craftsman use when they install the pipe supports. The work packages contain general construction work instructions, safety requirements, references to construction specifications, work instructions, and QC procedures that specify requirements and controls for installation and inspection of pipe supports. The drawings, instructions, and procedures in the work packages are controlled in accordance with the BCCI QAM.

Construction details for the fire protection system pipe supports installed in the HAW area are shown on drawings titled Fire Protection Supports Generic Details, Sheets 1 through 4. The functional classification of these supports is SS and PC-3+. Much of the hardware for these supports consists of standard catalog items, such as U-bolts, beam clamps, and hanger rods that are attached to building steel or generic fire protection pipe supports. Seismic wire rope/cable restraints, wire seismic bracing, and seismic longitudinal restraints are also required to be installed to specific tolerances. The acceptance criteria for the fire protection pipe support installation are in a note on Sheet 1 of the drawings, which states, "Install piping supports/hangers and sway braces in accordance with National Fire Protection Association (NFPA) Codes NFPA 13, NFPA 14, and design documents." Augusta Fire Protection is responsible for installing the supports for the fire protection piping, and BCCI QC inspectors will perform the QC acceptance inspections for the fire protection piping and supports installed in the HAW area. Discussions with BCCI QA/QC supervisors indicated that as of September 27, 2012, BCCI QC inspectors had not performed any acceptance inspections for SS fire protection system piping and pipe supports.

Installation of the fire protection system has been in progress for almost a year. Some areas may become inaccessible, and deficiencies, if any, identified during inspections may be difficult to repair. Also, if there are errors in any installation work, failure to identify the errors early could allow the same errors to recur, resulting in increased rework. **(See OFI-1)**

Specification G-SPP-F-00006, *Waste Solidification Building*, which was prepared by SRNS, contains the contract and technical requirements for construction of the WSB. Specification Section 15100, *Piping and Tubing*, specifies the technical and quality requirements for piping materials, fabrication, and installation. Paragraph 3.1 G of Section 15100, *Supports*, states, "Install in accordance with Section 05500," but that section, titled *Metal Fabrications*, does not cover pipe supports. When questioned, BCCI QA/QC personnel stated that pipe supports are considered commodity supports, which are covered by Specification Section 05120, *Structural Steel*. Paragraph 3.2C.4 of Specification Section 05120 states, "Fabricate and install process vessel vent piping system (HV3) per C-CL-F-0038, C-CL-F-0039, C-CL-F-0040, C-CL-F-0041, C-CL-F-0042, and C-CL-F-0076 in the location and support types specified on the Contract Drawings." Drawing numbers C-CL-F-0038, C-CL-F-0039, C-CL-F-0040, C-CL-F-0041, C-CL-F-0042, and C-CL-F-0076 are the Generic Pipe Support Detail drawings. Paragraphs 3.2.C.1, 3.2C.2, 3.2.C.3, and 3.2C.5 through 3.2C.10 of Specification Section 05120 reference the contract drawings for

installation of electrical conduit and equipment supports, cable tray supports, HVAC supports, instrument supports, fire protection piping supports, and tube supports. Paragraph 3.6 of Specification Section 05120 specifies the requirements for inspection, examination, and testing of erected structural steel and references American Institute of Steel Construction (AISC) 303, contract drawings, and shop drawings for inspection requirements. These instructions are very general and do not contain specific acceptance criteria or specific attributes for construction craftsman or QC inspection personnel to install and inspect commodity supports. For example, Section 8 of AISC 303, *Quality Control*, in part, states the steel fabricator and erector shall maintain a quality control program to ensure the work is performed in accordance with the Code, AISC Specification, and the contract documents There are no specific requirements for inspecting structural steel in AISC 303. AISC 303 does not specify which attributes require inspection, such as welding, bolting, or verification that proper structural steel shapes were erected. Paragraph 1.2 of AISC 303 references AISC 360, *Specification for Structural Steel Buildings*, which references AISC N690, *Specification for Safety-Related Steel Structures for Nuclear Facilities*. Chapter N of AISC 360 and AISC N690, Quality Control and Quality Assurance, specify minimum inspection requirements for inspection of structural steel which are more detailed than those listed in Paragraph 3.6 of Section 05120. However AISC 360 and AISC N690 are not referenced in Section 05120.

In summary, Sections 05120 and 15100 of Specification G-SPP-F-00006 do not address all aspects of construction and inspection requirements for pipe support installation. For example, inspection of attributes such as U-bolt installation, clearances/tolerances between the piping and structural steel, and installation of spring cans, seismic restraints, and other pipe support hardware items shown for various support types on Drawing number C CI F 2673, sheets 1 through 3, are not discussed in Specification G-SPP-F-00006. Furthermore, Specification G-SPP-F-0000 6 and the contract drawings lack sufficient detail and instructions to ensure that pipe supports and associated hardware are properly installed and inspected to meet design requirements. Instructions for installation of pipe support hardware are implied through references to various manufacturer catalogs. The Specification and drawings do not include or reference appropriate quantitative or qualitative acceptance criteria for determining that the pipe supports have been installed in accordance with design requirements (See **FINDING 1**.)

Procedures for QC Inspection of Pipe Supports. BCCI has prepared a series of inspection plans to prescribe the inspection activities to be performed by QC inspectors to verify that hardware and construction work activities conform with specification, drawing, and contract requirements. Independent Oversight reviewed *Inspection Plan Structural Steel G-SPP-F-00006, Section 05120* and *Inspection Plan Piping and Tubing G-SPP-F-00006, Section 15100.* The inspection plans reference paragraphs in Specification Sections 05120 and 15100 and prescribe the inspection activities to be performed to ensure that the installed hardware meets specification and drawing requirements. As stated above under "Review of Drawings and Procedures for Installation and Inspection of Pipe Supports," Sections 05120 and 15100 lack sufficient details and instructions to ensure that pipe supports and associated hardware are properly installed to meet design requirements. Attachment 2 of *Inspection Plan Piping and Tubing G-SPP-F-00006, Section 15100* does not address inspection of pipe supports. *Inspection Plan Structural Steel G-SPP-F-00006, Section 05120* lists the field inspections to be performed on structural steel. Item 2 in Attachment 2, which is listed as a BCCI Hold Point, states, "After steel erection, inspect erected steel to assure compliance with the dimensional and tolerances requirements as required on Contract Drawings, shop drawings, and AISC 303. Document inspection results as required by Article 3.6A on the reference QVDR (QVDR 9707-05120-1)." Item 5 in Attachment 2, also listed as a BCCI Hold Point, states, "Inspect all welds in accordance with AWS [American Welding Society] D1.1/D1.1M (Section 05120 Article 3.6 D.1)."

The above inspection instructions are very general and do not provide clear inspection and acceptance criteria. For example, Item 5 in Attachment 2 to the Inspection Plan should reference BCCI QWI 9707-

10.01-2, *Visual Examination* for weld inspection and acceptance criteria. Also as stated in Review of Drawings and Procedures for Installation and Inspection of Pipe Supports, Specification Sections 05120 and 15100 do not address all aspects of construction and inspection requirements for pipe support hardware installation. The inspection plans do not include or reference appropriate quantitative or qualitative acceptance criteria for determining that the pipe supports have been installed in accordance with design requirements (See **FINDING 1**.)

Drawings and Procedures for Installation and Inspection of HVAC Supports. Independent Oversight reviewed Section 15800 of Specification G-SPP-00006, *Ductwork and Accessories, Inspection Plan Ductwork and Accessories G-SPP-F-00006, Section 15800*, and a sample of contract Drawings titled *HVAC Supports Generic Details*, to determine whether the installation and inspection requirements for SS HVAC supports were adequate. Several discrepancies were identified in the documents reviewed:

- Paragraph 2.3A of Specification Section 15800 specifies that ductwork hangers and support materials and fabrication shall be in accordance with requirements of Section 05120, *Structural Steel*. However, the construction/installation requirements in Paragraph 3.2H of Section 15800 states, "Ductwork hangers and supports shall be in accordance with Section 05500." Specification Section 05500, *Metal Fabrications*, does not discuss HVAC hangers and supports.
- Paragraph 2.3D of Specification Section 15800 specifies the requirements for coatings for HVAC hangers and supports. The last sentence in this paragraph states, "For coatings refer to Section 05500." No specific requirements for coatings are specified in Section 05500 except for a reference to Section 05120 in Paragraph 2.1H.1of Section 05500.
- In Attachment 2, Field Inspections, of *Inspection Plan Ductwork and Accessories G-SPP-F-00006, Section 15800*, one sub-item listed under the inspection and acceptance criteria for Item 1 is "Hangers and Supports Article 3.2H - in accordance with SpecificationG-SPP-F-00006 Section 05500." As stated above, HVAC hangers and supports are not discussed in Section 05500.
- In Attachment 2, Field Inspections, of *Inspection Plan Ductwork and Accessories G-SPP-F-00006, Section 15800*, one sub-item listed under the inspection and acceptance criteria for Item 1 is "Nuts, Bolts, Washers Article 3.2B - provided by the supplier and installed per manufacturer's instructions." This statement conflicts with the inspection/examination/testing criteria in Paragraph 3.4B.1.e of Section 15800 of Specification G-SPP-00006, which states, "Proper bolting materials, alignment, and bolt tightness (torque or snug tightness)." Engineering is responsible for designating the method to be used for tightening bolts.
- Specification Section 15800 and the Inspection Plan do not provide installation requirements and inspection criteria for the hardware required for attaching HVAC ductwork to the HVAC supports and hangers. Instructions for installing HVAC support hardware are implied through references to various manufacturer catalogs.

Specification Section 15800 and the inspection plan do not include or reference appropriate quantitative or qualitative acceptance criteria for determining that installation of HVAC hangers and supports have been satisfactorily attained. The inspection and acceptance criteria in Inspection Plans do not specify inspection and acceptance criteria for determining that installation of HVAC hangers and supports are satisfactory. (See **FINDING 1**)

Procedures for Installation and Inspection of Valves. Independent Oversight reviewed the following documents to determine whether the installation and inspection requirements for SS valves were adequate: (1) Section 15100 of Specification G-SPP-F-00006, *Piping and Tubing;* (2) Section 15110 of Specification G-SPP-F-00006, *Valves*; (3) *Inspection Plan Piping and Tubing G-SPP-F-00006, Section 15100;* and (4) *Inspection Plan Valves G-SPP-F-00006, Section 15110*.

Paragraph 1.1C of Section 15100 states that valves shall be installed in accordance with Section 15100, but provided per Section 15110. Paragraph 3.1E of Section 15100 states that valves are to be purchased per Section 15110 and installed per contract drawings, ASME B31.3, manufacturer instructions, and this Specification Section. The inspection plan for Section 15100 does not address inspection requirements or acceptance criteria for installation of valves.

In Attachment 2, Field Inspections, of the inspection plan for Section 15110, Item 1 is a designated BCCI Hold Point. One of the inspection and acceptance criteria for Item 1 is "Inspect the Installation of all valves to assure compliance with Section 15110 3.2B." Paragraph 3.2B of Specification Section 15110 states, "Perform field inspections to verify Safety Significant equipment is installed." The inspection plan has no inspection or acceptance criteria for installation of valves and does not address the inspection requirements for the valve leakage class testing required by Paragraph 2.3C of Specification Section 15110.

Specification Sections 15100 and 15110 and the inspection plans for these sections do not include or reference appropriate quantitative or qualitative acceptance criteria for determining that installation requirements for valves and valve leakage inspection criteria have been satisfactorily attained. The inspection plans do not sufficiently specify inspection requirements and acceptance criteria. (See **FINDING 1**)

Welding Program. Welding at nuclear facilities is classified as a special process. The QA requirements at WSB for controlling special processes such as welding and nondestructive examination (NDE) of welds, are specified in Section 9 of the BCCI QAM, *Control of Special Processes.* The basic requirements for special processes require that these activities be performed by qualified workers using qualified procedures in accordance with specified requirements. BCCI procedure QAP 9707-9.01, *Controlling Special Processes*, implements the program for controlling special processes at WSB. The requirements for control of welding at the site are specified in Attachment 1, Welding Control, of QAP 9707-9.01. Other procedures that control welding activities are OWI 9.01-2, *Weld Filler Metal Control*; OWI 9.01-3, *Weld Repair*; and QWI 9707-10.01-2, *Visual Examination.*

With the exception of the fire protection system, Intermech fabricates and installs all piping for the project. Intermech has an offsite facility where bulk piping is received and fabricated into spool pieces for installation on the project. Work at the Intermech offsite facility is performed under the BCCI QAM, and the Intermech welders are qualified in accordance with the requirements of QAP 9707-9.01. Intermech QC inspectors perform visual inspections of all welds completed at the offsite facility and all welds on piping and all types of supports installed on GS and PS systems at the WSB project site. BCCI QC inspectors perform visual inspections for all welds on SS components, including the fire protection system piping and supports installed in the HAW area.

ASME B31.3, *Process Piping*, requires performance of volumetric exams on 5 percent of the piping welds completed by each welder. Radiography, a volumetric exam method, is normally used to verify weld quality; ultrasonic testing is an alternative method. The first two welds completed by each welder are examined by radiography, and if a defective weld is identified, two additional welds are examined. If one of these is defective, 100 percent of the welds in the lot are examined volumetrically. The volumetric exams are performed by URS, under a subcontract to BCCI. URS is an SRS site contractor who performs NDE and other inspection activities on several projects at the SRS site.

Independent Oversight reviewed the qualification and certification records for five Intermech welders and the records documenting the pipe welds performed by each one. For each welder, these records identify the weld and the weld type, location, and number; results of inspections; and whether any repairs were required due to welds not meeting acceptance criteria. A weld log is maintained in a computer database

that shows all welds completed by each welder and documents the NDE results. Independent Oversight verified that at least 5 percent of each welder's welds were examined using radiography, as required by ASME B31.3.

Installation of Pipe Supports. Independent Oversight examined six pipe supports in the HAW for the SS PVV piping system. The welds on these supports had been inspected and accepted by BCCI QC inspectors. Inspection results were documented on Form No. 9707-10-01-7, Weld Inspection and Test Record. The welds were the correct size and length. However, Independent Oversight determined that the installed supports at locations 128 and 129 on Drawing number P-PI-F-04224, Rev. 2, Piping Design Isometric F-236003-PVV-3770-PS200B-6, Sheet 45 of 88 were not the type specified by the drawing. The isometric drawing specified that generic pipe supports detail type PS 1 & 6 supports were to be installed at these locations, but the support installed at Location 128 was a Detail PS 1 & 4 type support, and the support installed at Location 129 was a Detail PS 1 & 19 type support.

Independent Oversight reviewed construction work package number SS-12-9707-PVV01-M-4224-27-1, which controlled the work activities for installation of the supports discussed above. The drawing had been revised by Design Change Form (DCF) P-DCF-F-00715, Rev. 0 Sheet 29 of 47, issued on April 30, 2012, to update pipe support details. This DCF changed the pipe supports at location 128 and 129 to detail type PS 1 & 6. Although the supports at locations 128 and 129 were installed on June 19, 2012, more than 45 days after the DCF was issued, the pipe support detail sketches for locations 128 and 129 had not been revised to show the DCF changes. It is important that all drawings and sketches included in work packages show the current design requirements. All drawings and sketches in work packages should be revised when design changes are made to clearly show installation requirements. Failure to maintain drawings and sketches current could result in installation and QC inspection errors. **(See OFI-2)**

The pipe support detail sketch in the work package for Pipe Support Number 04224-45-PS1&4-128 (for location 128 shown on drawing number 04224 Sheet 45) shows a detail type PS 1 & 4, which was the type actually installed. For location 129, the pipe support detail sketch in the work package for Pipe Support Number 04224-45-PS1&4-129 shows a detail type PS 1 & 19, which was the type installed. In each case, the wrong type of support was installed because the pipe support detail sketches in the work package were not updated when the DCF was issued.

Detail PS 1 shows the installation of a U-bolt to attach/restrain the pipe to the pipe support. Detail PS 6 shows the pipe support configuration. For support Detail PS 6, a W4 x 13 structural steel member welded to either a base plate or building steel supports the attached pipe. The Detail PS 1 & 4 support installed at location 128 was a 3 x 3 x 3/8 angle welded to a base plate, instead of the W4 x 13 required. The Detail PS 1 & 19 type support installed at location 129 was WT 4 x 10.5 welded to a base plate, instead of the W4 x 13 required. The incorrect supports were installed at locations 128 and 129 because Drawing number P-PI-F-04224, Rev. 2 was not updated when the DCF was issued. (See **FINDING 2**)

Quality Records. Independent Oversight reviewed records documenting welding controls and visual inspections of welds for completed pipe and HVAC supports. These records, recorded on Weld Inspection and Test record Form No. 9707-10.01-7, identify the welder who performed the weld; the welding procedure specification (WPS) used; the weld rod or wire size, type, and heat number of weld filler material for the weld; weld inspection results; and the QC inspector who performed weld inspection. The weld inspection and test records showed that typically there was a single entry for each support, regardless of the number of welds on the support. Some supports only have one weld, and for some others, all the welds on the support were completed by one welder using the same WPS and weld filler material. However, for some supports, two or more welders, each using a different weld filler material, performed the welding on a support with multiple welds. The weld inspection and test record for these supports identified the welders who completed the welds, the WPS used, and the weld filler material used

for the welds. For example, weld inspection and test record report number 05120-04-0753, dated July 25, 2012, documented welding activities for SS Supports 3 and 4 in work package number SS-12-9707-HVAC05-M-EXH-WDP-1043. Three different welders used three different filler materials to complete the four welds on each support. The record showed that the same WPS was used for all four welds but does not provide sufficient information to trace the identification of the welder and weld filler material to a specific weld on the support. Therefore, the welder/weld traceability requirements specified in Paragraph 3.2.6.3 of BCCI Procedure QWI 9707-10.01-2, *Visual Examination*, were not complied with. (See **FINDING 3**.)

Qualification of QC Inspection Personnel. Section 2.5.2 of the BCCI QAM specifies the qualification requirements for personnel performing acceptance inspections/tests to verify quality. Section 2.5.2A of the QAM requires individuals who perform visual inspections of welds to be qualified and certified in accordance with American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A, *Personnel Qualification and Certification in Nondestructive Testing*. Section 2.5.2B of the QAM states that the initial capabilities of personnel performing inspections tests are determined by an evaluation of the individual's education, experience, and training, along with either test results or demonstration of capability.

Independent Oversight reviewed the following BCCI WSB Project procedures that implement the requirements of the QAM for training, qualification, and certification of BCCI QC inspection personnel: QAP 9707-2.01, *Co-Worker Qualification and Certification*; QAP 9707-2.02, *Co-Worker Indoctrination and Training*; and QWI 9707-2.03-1, *Discipline-Specific Qualification Categories*. Procedure QAP 9707-2.01 indicates that use of test results or capability demonstration may be used as part of the certification process for QC inspectors, whereas the BCCI QAM requires that either test results or a capability demonstration is required as part of the certification process. This procedure was approved by SRNS on January 27, 2011.

The qualification and certification records of five Intermech QC inspectors who perform visual inspections of piping and pipe support welds were reviewed by Independent Oversight. Records reviewed for the Intermech inspectors included education, experience, training, written exam results, and annual vision acuity exams. The inspectors were all certified as Level II Inspectors in accordance with SNT-TC-1A. The certifying official was a Level III Inspector, as required by SNT-TC-1A.

Independent Oversight also reviewed the training and qualification records for the BCCI mechanical QC inspector and the BCCI electrical QC inspector. The records showed that on his first day of employment at WSB, the electrical QC inspector was certified as a Level II Electrical Inspector, qualified to perform inspections in all areas of the electrical discipline, and as a Receiving Inspector for electrical material receiving. The records contained no documentation that this individual had been trained on the site quality procedures, or even read them, before being certified. The mechanical QC inspector was certified as a Level II Mechanical QC inspector on his third day of employment at the site. After his first day was spent at an offsite training facility in a general employee training course, this individual was certified in the areas of Mechanical (All Inclusive), Structural (Connection, Erection, Welding), and Receiving (Mechanical & Structural Material). Again, there was also no documentation that this individual had been trained on the site quality procedures, or even read them, before being certified. No written examinations were administered as part of the qualification process for either individual, and there is no documentation showing that capability demonstrations were performed. The certification process was apparently based on interviews and a review of the individuals' resumes.

The mechanical QC inspector is certified as a welding inspector and a welding educator by the American Welding Society (AWS). However, the records do not document that BCCI verified his AWS certification. (Note: After the onsite review, Independent Oversight verified the individual's certifications

on the AWS website.) Section 3.1.2 of Procedure QWI 9707-2.03-1 defines the discipline-specific qualification categories for Mechanical QC inspection personnel, which include welding, HVAC, piping, and NDE. As stated above, the mechanical QC inspector is certified as Mechanical (All Inclusive), which includes HVAC installation and system testing, even though his resume shows no experience in inspecting installation or testing of HVAC systems. Paragraph 3.1.2.1 of QWI 9707-2.03-1 defines visual welding inspections, including performance of visual inspections in accordance with ASME. ASME NQA-1 requires qualification of NDE inspection personnel performing visual inspections of welds to meet the requirements of SNT-TC-1A, which requires that qualification of inspection personnel be based, in part, on results of written and practical examinations that are evaluated (for a Level II Inspector) by a Level III Inspector. No written exam was administered, and the records do not show that the Level II Inspector was evaluated by a Level III inspector

The qualification records and certification documents for the BCCI electrical and mechanical QC inspectors were submitted to and approved by SRNS. Although both individuals had extensive experience prior to their employment at WSB, the process used to certify them does not meet the requirements of the BCCI QAM. In addition, the process used to certify the mechanical QC inspector as a Level II Inspector qualified to perform visual weld inspections in accordance with ASME does not meet the requirements of SNT-TC-1A. (See **FINDING 4**)

There are currently only four BCCI QC inspectors (two civil, one electrical, and one mechanical), plus one additional inspector in training, on the project staff. With the increasing installation of SS hardware in the HAW area, the need for an increase in the number of QC inspectors should be evaluated. (See **OFI-3**)

Protection of Stainless Steel Piping from Galvanic Corrosion. The construction specification requires segregation of stainless steel piping from carbon steel piping during storage, handling, and fabrication, and prohibits use of tools on stainless steel piping that were previously used on carbon steel materials. The specification also requires submittal of representative samples of various materials to SRNS for corrosion evaluation. However, the pipe support and piping drawings show that for the PVV piping system, the PVV stainless steel piping will be in direct contact with carbon and galvanized steel materials. When Independent Oversight questioned whether direct contact between stainless steel piping and carbon or galvanized steel could result in corrosion of the stainless steel, the project provided a copy of an e-mail from the SRS Materials Science and Technology Group, responding to a question from WSB Project Design Engineering regarding the need for a dielectric barrier between galvanized steel conduit attached to stainless steel frames, and stainless steel ductwork supported by galvanized steel supports in dry, indoor locations. The Materials Science and Technology Group stated that the risk of galvanic corrosion is minimal if the application is indoors and no moisture is present. However, the e-mail further states that "if the environment is humid or moisture is present, then all bets are off." The concluding sentence in the e-mail states that if moisture is present, material in contact with stainless steel should be low chloride.

Drawing number C-CL-F-0038, *HVAC Supports Generic Details Sheet 1,* was revised by a DCF to require the use of stainless steel materials to construct supports for stainless steel ductwork. The concern regarding potential galvanic corrosion of stainless steel was resolved by the design change but was not adequately evaluated for PVV stainless steel piping. Numerous piping systems in the HAW area could leak and introduce moisture into the area, and since the stainless steel PVV piping is in direct contact with carbon and galvanized steel materials at every support point, there is a high potential for corrosion of the PVV stainless steel piping if any leaks occur. The PVV system is critical to operation of the WSB. If PVV piping corrodes to the extent that it requires replacement, WSB operations would have to shut down until the piping is replaced. Replacing the PVV piping after facility startup would be costly, would impact operations, would generate radioactive waste, and could expose construction/repair personnel to

high radiation levels. In addition, temporary storage facilities would be needed for the waste stream from the MFFF while the WSB was offline for piping replacement. (See **OFI-4**)

QA Surveillance Activities. Independent Oversight reviewed four assessments performed by the NNSA QA staff in the WSB Integrated Project Division and a QA program audit performed by NNSA Headquarters staff. The NNSA Headquarters audit produced three action requests and seven opportunities for improvement, primarily in the areas of installation of the fire protection system and the commercial grade dedication (CGD) program. Three of the WSB NNSA staff assessments included review of the CGD process and records for the standby diesel generator, a sample of records documenting placement and inspection of concrete in the WSB, and the controls for the measuring and test equipment used in production and inspection of concrete. No significant concerns were identified by these assessments. The fourth assessment, which was performed by the WSB NNSA staff in February 2012, involved a review of weekly walkdown reports on installation of the fire protection system. These reports were produced by an inspector certified by the National Institute for Certification in Engineering Technologies (NICET) who is employed by the subcontractor to inspect the work. Observations and concerns identified by this WSB NNSA assessment were based on issues that had been ongoing for several months, dealing with installation drawings that were difficult to follow and drawings that lacked sufficient details and dimensions for installation of fire protection piping and sprinklers.

Independent Oversight also reviewed the SRNS surveillance program. The surveillances performed by the SRNS staff complement the audits performed by the NNSA staff and are based on lines of inquiry (LOIs) prepared by the SRNS staff. Results are documented for each LOI as either satisfactory, an observation, or a finding; an observation is generally classified as an opportunity for improvement, while a finding is a deviation from a procedure or contract requirement. SRNS performed 24 surveillances in 2011 covering concrete, piping, welding, storage, control of measuring and test equipment, fire protection, and electrical construction activities. The 2011 SRNS surveillances identified 76 findings and 24 observations. In 2012, through September 27, the SRNS staff performed 15 surveillances, resulting in 34 findings and 26 observations in the areas of fire protection, electrical records, configuration management, procurement, material control, HVAC ductwork installation, and drilled-in anchor bolt installation. Independent Oversight performed a detailed review of two of the 2012 SRNS surveillances, covering material control at the offsite Intermech fabrication facility and drilled-in anchor bolt installation. Three findings and two observations were identified during the surveillance at the Intermech facility. The findings concerned incomplete information on receipt inspection reports, use of tape to cover stainless steel pipe and fitting openings that had unacceptable chemical content (high chloride), and storage of piping and fittings in direct contact with the floor. These findings were entered into the SRNS corrective action system. Eight findings and two observations were identified during the surveillance of drilled-in anchor bolt installation. These findings primarily related to deficiencies in records documenting inspection of anchor bolt installation and preparation of as-built drawings showing anchor installation details. The corrective action documents show that incomplete and conflicting instructions in the inspection plans and specification may be the cause of most of the findings associated with drilled-in anchor bolt installation.

The QA audits performed by NNSA and the SRNS surveillances included all work activities at the WSB project site, plus those at the offsite Intermech facility. The audits and surveillances appear to be comprehensive and identified a significant number of findings. However, the deficiencies in the BCCI inspection plans identified by Independent Oversight indicate that a detailed review of the BCCI QC inspection procedures and processes is warranted, including implementation. Most Inspection Plans reviewed lacked specific inspection requirements and acceptance criteria. Instead the Inspection Plans reference various sections of Specification G-SPP-F-00006 for inspection requirements. Often the Inspection Plans and the referenced Specification Section simply state to inspect some activity to assure it

complies with the contract drawings, ASME, NQA-1, or the manufacturer's recommendations. Specific inspection details and acceptance criteria are lacking in the Inspection Plans. (See **OFI-5**)

Fire Protection Design Piping and Support Drawings. Independent Oversight reviewed the design of the wet pipe sprinkler systems currently being installed and classified as SS. The flow of water is monitored by a paddle-type flow switch for each of the seven sprinkler systems. Piping and instrumentation diagram (P&ID) drawing *Fire Protection System Waste Solidification Building*, M-M6-F-4162, indicates that a flow switch is located in the dry leg of the wet pipe sprinkler system that supplies the open head water spray nozzles in the high efficiency particulate air (HEPA) filter plenum. The current piping arrangement shows flow switch FSH7 installed between a normally closed gate valve (FP-V-4377 and a butterfly valve (FP-V-4378. This configuration is not allowed by NFPA 13, *Standard for the Installation of Sprinkler Systems*, because the paddle-type flow switch is exposed to a potential surge pressure of water that could damage the switch. The code states, "Paddle-type water flow indicators shall only be installed in wet pipe systems." (See **FINDING 5**)

System design description (SDD) document G-SYD-F-00023 states that "the SS boundary has been established at the first indicating type control valve inside the WSB." Currently, the wet pipe sprinkler system design does not show a listed indicating type control valve inside the building at the first flange connection. NFPA 13 requires each sprinkler system to be provided with a listed indicating valve in an accessible location. In addition to the SDD, the *Operability Determination of Fire Water Supply System in F-Area to Support Safety Significant Fire Suppression Systems in Building 772-F, 772-1F and the Waste Solidification Building (WSB)* also indicates the isolation valve to be inside the building, as noted in Table 1 of that document, titled *Compliance, Non-compliance or Equivalency*. The compliance statement in Table 1 states that "the boundary of the GS fire water supply system starts at the water source and includes all components necessary to deliver the required fire water demand to the control valve (first valve inside the building) of the SS water based fire suppression systems in Buildings 772-F, 772-1F and WSB." Locating the control valve at the functional classification boundary between the GS underground and SS interior sprinkler system may benefit the facility with complying with the DSA/TSR [documented safety analysis/technical safety requirements] and implementing Specific Administrative Controls (SAC). (See **OFI-6**)

Independent Oversight conducted several facility walkdowns focused on the installation of sprinkler systems, passive fire protection, and life safety features. The handrails in the stairways located in the Low Activity Process room leading up to the mezzanine level are not continuous and therefore are not in compliance with NFPA 101, *Life Safety Code*. One of the life safety features for handrails is continuity, requiring handrails to continue for the full length of each flight of stairs. (See **FINDING 6**)

This stairway is currently being used by construction personnel. Personnel using this stairway and others without continuous handrails during construction should be made aware of the added risk of ascending and descending stairways without continuous handrails until the handrails on affected stairways have been modified. (See **OFI-7**)

DOE Order 420.1B, *Facility Safety*, requires that where ventilation ductwork passes through any two- or three-hour rated barrier, a two- or three-hour fire rated damper must be provided. An alternative to installing a two-hour fire damper within the plane of the barrier is to provide fire wrapping of the ductwork, extending at least ten feet beyond either side of the wall in accordance with a tested and approved configuration, as allowed by DOE-STD-1066-99, *Fire Protection Design Criteria*. Currently, WSB has two- and three-hour fire rated penetrations in credited fire walls that are not protected as required to maintain the integrity of the rating of the WSB walls. Independent Oversight attended project design review meetings and observed that several issues are being addressed, including the interpretation of wrapping of ductwork. An engineering evaluation, *Duct Wrap for Waste Solidification Building*, F-

ESR-F-00163, was written to provide additional guidance for applying the requirements of DOE-STD-1066-99 and NFPA 91, *Standard for the Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Non-Combustible Particulate Solids*. The engineering evaluation states that "the fire rated wrap material will be installed in the fire barrier or attached to the fire barrier, and will extend outward in a 10 linear feet radius from the penetration in the plan of the barrier encapsulating all ductwork. Hangers, supports, or stiffeners within that 10 linear foot radius will be protected to the same fire rating as the barrier and include the entire length of the hanger, support, or stiffener." Because the project did not adequately address this added complexity during the design stage, the costs of meeting the requirements for the designed fire barrier have increased and have impacted the schedule. The project self-identified this issue and is working on a solution. Independent Oversight will perform a follow-up review of this issue.

Fire Protection Technical and Project Documentation. The *Project Fire Hazards Analysis for Waste Solidification Building* was issued in 2008 and has not been updated to reflect the consequences of risks associated with fire as required by *Management and Preparation of Fire Hazard Analysis* (ref. WSRC-SCD-10, Rev. 7), Section 9.2, Project Fire Hazard Analysis. Independent Oversight reviewed two key documents that need to be incorporated into the FHA or referenced by the FHA (as a stand-alone document): *CHA Fire Scenarios for 236-F* and *Operability Determination of Fire Water Supply Systems in F-Area to Support Safety Significant Fire Suppression Systems in Buildings 772-F, 772-1F and the Waste Solidification Building (WSB).* These documents contain a significant amount of information regarding the facility and the specific risks posed by various fire scenarios that has not been integrated into the FHA. (See **FINDING 7**)

Independent Oversight reviewed the FHA to evaluate the installation and design of the passive and active fire protection systems. Currently, an open head deluge sprinkler system is installed in the ductwork upstream of the HEPA filter enclosure located in the Exhaust Fan/HEPA Filter Room. This fire suppression system is designed to protect the HEPA filter banks by limiting heat and smoke movement in the ductwork. When this system is manually activated, all four spray heads will be flowing water. The FHA describes the installation and operation of this system but has not analyzed the collection of contaminated water resulting from the activation of the system. NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials*, requires that "drainage or containment of radioactive water due to fire suppression systems be analyzed and sized to accommodate the largest credible volume as determined by the fire hazards analysis." (See **FINDING 8**)

The WSB interior sprinkler system is classified as SS and is credited in the preliminary documented safety analysis (PDSA) to mitigate the consequences of fire for four events (ref. HAL-1-001, CEM-1-001, CEM-1-002 and FW-1-001). The interior SS sprinkler system is supplied by an outside ring main that is classified as GS.

The facility addressed the decision not to classify the outside fire water main as SS in Report NNP-WSB-2007-00033, *Waste Solidification Building Fire Water Supply Path Forward*, Rev. 1, dated February 20, 2008. Six action items were identified in this document:

1. Complete an evaluation of the F-Area fire water supply to document compliance with the NFPA code of record and the system's ability to operate reliably on a continuing basis for the expected service life. Evaluate the effects of age-related degradation on the system and the processes in place to ensure that age-related degradation will not compromise the future ability of the system to accomplish design functions when required.
2. Complete design and installation of the facility fire suppression system.
3. Incorporate the plan and strategy into the FHA.
4. Perform startup testing to verify header flows.
5. Document the results in the facility PDSA.

6. Complete interface agreements with the Infrastructure & Support department.

Items 1 and 6 have not been completed and are not being tracked to closure in the project's schedule or site issue tracking system. A successor document has been issued, Technical Report F-TRT-F-00001, *Operability Determination of Fire Water Supply Systems in F-Area to Support Safety Significant Fire Suppression Systems in Buildings 772-F, 772-1F and the Waste Solidification Building (WSB),* Rev. 0, dated 11/30/2010. The Technical Report references Item 1 but does not address age-related effects or the processes to ensure that degradation will not compromise the future ability to accomplish design functions, and does not address Item 6. Technical Report F-TRT-F-00001 indicates that the water storage tanks, 902-1F and 902-2F, do not have automatic refill capability as required by NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection,* but does not identify the lack of this capability as a deficiency. Lastly, the Technical Report does not consider the most recent hydraulic data for the WSB sprinkler systems. For example, Attachment 2 of Technical Report F-TRT-F-00001 indicates that the most demanding sprinkler system is WSB Zone 102, with a total required flow of 1114 gallons per minute (gpm) at 99.4 pounds per square inch (psi). However, a confirmed hydraulic calculation, F-CLC-F-00044, indicates that the most demanding zone is WSB Zone 104, with a total required flow of 1290.6 gpm at 115.5 psi. The Technical Report concludes that the existing fire water supply is adequate to operate reliably as an SS system, but has not been updated to reflect the reliability of the fire water supply using the latest hydraulic data. In addition, Technical Report F-TRT-F-00001 does not address the functionality of the underground fire water supply system with respect to the multiple users in F-Area, and how different piping arrangements and alignment of isolation valves could impact the availability of the required hydraulic demand at WSB. (See **FINDING 9**)

Technical report F-TRT-F-00001 references the *Interim Guidance on Design and Operational Criteria for Safety Class and Safety Significant Wet Pipe Sprinkler Systems, Defense Nuclear Safety Board Recommendation 2008-1* in Section 3.0. The Technical Report Basis reads, "WSB SS fire sprinkler systems are taking advantage of the EXISTING GS F-Area fire water supply system, therefore 2008-1 is being utilized as a non-mandatory guide." This statement is not entirely true, since the GS WSB ring main and GS standpipe are newly designed and constructed to support the project. Although the 2008-1 Technical Report is a guidance document, the intent of this Technical Report is to emphasize the importance of operational and design requirements that support credited systems. Independent Oversight plans to assess the analysis and implementation of the WSB's DSA and TSR to ensure that the reliability of the newly constructed GS ring main, the GS standpipe, and the GS F-Area fire water supply system is adequately addressed to support the credited interior WSB SS sprinkler systems. The analysis and implementation of the WSB DSA and TSR should be completed as soon as practical to ensure that any changes to these analyses will not impact startup of the WSB or adversely affect project costs. (See **OFI-8**)

6.0 CONCLUSIONS

Independent Oversight determined that many aspects of the construction quality program need improvement. Independent Oversight determined that several Specification Sections and the inspection plans for these sections do not include or reference appropriate quantitative or qualitative acceptance criteria for determining that installation requirements and QC inspections for some work activities have been satisfactorily attained. In addition, Independent Oversight determined that the project needs to address several important fire protection design findings and some findings in updating the FHA and other fire protection program documentation. Specific findings that need to be addressed are provided in Sections 7, and opportunities for improvement for NNSA and SNRS consideration are provided in Section 9. Collectively, the findings and observations indentified on this review indicate a need for increased NNSA and SNRS management attention on construction quality and fire protection at WSB.

7.0 FINDINGS

Independent Oversight identified the following findings. Findings are items identified in appraisal reports that warrant a high level of attention on the part of management and aspects of a program that do not meet the intent of DOE policies and requirements. If left uncorrected, findings could adversely affect the DOE mission, the environment, worker safety or health, the public, or national security. Findings require resolution through a formal corrective action process.

FINDING 1: Specification Sections 05120, *Structural Steel*, and 15100, *Piping and Tubing*, Section 15800, *Ductwork and Accessories*, and inspection plans titled *Inspection Plan Structural Steel G-SPP-F-00006, Section 05120*, *Inspection Plan Piping and Tubing G-SPP-F-00006, Section 15100*, *Inspection Plan Valves G-SPP-F-00006, Section 15110*, and *Inspection Plan Ductwork and Accessories G-SPP-F-00006, Section 15800* do not include specific inspection and acceptance criteria or specify the attributes requiring inspection to verify that work activities were accomplished in accordance with specification requirements as required by Section 5.0 of the BCCI QAM.

FINDING 2: Two of the six PVV supports examined by Independent Oversight did not comply with the drawing requirements, and the QC inspections did not identify these errors, as required by Paragraph 3.2C.3 of Specification G-SPP-F-00006, Section 05120, *Structural Steel*, and *Inspection Plan Structural Steel G-SPP-F-00006, Section 05120*.

FINDING 3: BCCI weld inspection and test records do not furnish documentary evidence that welds for some SS HVAC supports met specified quality requirements in the areas of traceability of welder/weld traceability as required by Paragraph 3.2.6 of BCCI Procedure QWI 9707-10.01-2, *Visual Examination*.

FINDING 4: BCCI failed to implement the qualification and certification requirements of for QC inspectors. Two of the four BCCI Level II QC inspectors were certified before being tested or demonstrating capability as required by Section 2.5.2 of the BCCI QAM the QAM. The BCCI mechanical QC inspector was not qualified and certified in accordance with American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A, *Personnel Qualification and Certification in Nondestructive Testing*, as required by the BCCI QAM.

FINDING 5: P&ID drawing M-M6-F-4162 shows a paddle-type flow switch, number FSH7, is installed in a dry pipe between a normally closed gate valve (FP-V-4377) and a butterfly valve (FP-V-4378). This configuration exposes the paddle-type flow switch to a potential surge pressure of water that could damage the switch. This configuration does not meet NFPA 13 which states, "Paddle-type water flow indicators shall only be installed in wet pipe systems."

FINDING 6: Handrails in the stairways in the Low Activity Process room leading up to the mezzanine level are not in compliance with NFPA 101, *Life Safety Code*.

FINDING 7: The *Project Fire Hazards Analysis for Waste Solidification Building* was issued in 2008 and has not been updated to reflect the consequences of risks associated with fire as required by *Management and Preparation of Fire Hazard Analysis* (ref. WSRC-SCD-10, Rev. 7), Section 9.2, Project Fire Hazard Analysis.

FINDING 8: The FHA describes the installation and operation of an open head deluge sprinkler system installed in the ductwork upstream of the HEPA filter enclosure located in the Exhaust Fan/HEPA Filter Room. The FHA has not analyzed the collection of potentially contaminated water resulting from the activation of the system as required by NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials.*

FINDING 9: Six action items were identified in Report NNP-WSB-2007-00033 to address the decision not to classify the Area F fire water supply as SS. Technical Report F-TRT-F-00001, was issued to evaluate the six action items. The Technical Report did not evaluate the effects of age-related degradation on the system and the processes in place to ensure that age-related degradation will not compromise the future ability of the system to accomplish design functions when required, and did not address interface agreements with the Infrastructure & Support department. In addition, the Technical Report has not been updated to reflect the reliability of the fire water supply using the latest hydraulic data. Technical Report F-TRT-F-00001 does not address the functionality of the underground fire water supply system with respect to the multiple users in F-Area, and how different piping arrangements and alignment of isolation valves could impact the availability of the required hydraulic demand at WSB.

8.0 ITEMS FOR FOLLOW-UP:

Independent Oversight will perform follow-up inspections to determine the adequacy of QC inspection plans and procedures and the certification process for BCCI QC inspection personnel, review records documenting welding and QC inspection activities, and follow-up on the fire protection issues identified in this report.

9.0 OPPORTUNITIES FOR IMPROVEMENT

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

OFI-1: Inspections of the SS fire protection system piping and pipe supports installed in the HAW area will be performed by BCCI QC inspectors. BCCI have not performed any these inspections as of September 27, 2012, even though installation of the fire protection system has been in progress for almost a year. Some areas may become inaccessible, and deficiencies, if any, identified during inspections may be difficult to repair. Also, if there are errors in any installation work, failure to identify the errors early could allow the same errors to recur, resulting in increased rework. Consider expediting QC inspections required to ensure the HAW SS fire protection system piping and pipe supports are installed in accordance with design requirements.

OFI-2: Drawings and sketches included in work packages should be accurate and thus should be revised when design changes are made.

OFI-3: There are currently only four BCCI QC inspectors (two civil, one electrical, and one mechanical), plus one additional inspector in training, on the project staff. The need for an increase in the number of QC inspectors should be evaluated.

OFI-4: Stainless steel PVV piping is in direct contact with carbon and galvanized steel materials at every support point, and there is a high potential for corrosion of the PVV stainless steel piping if moisture is present. A detailed evaluation of the potential for galvanic corrosion of the stainless steel PVV piping should be performed.

OFI-5: A comprehensive review of inspection plans should be performed to determine if the inspection plans include appropriate inspection and acceptance criteria and specify attributes that require inspection to verify work activities were accomplished in accordance with specification and design drawing requirements. Specific inspection details and acceptance criteria (go – no go criteria) are lacking in the Inspection Plans reviewed by Independent Oversight.

OFI-6: G-SYD-F-00023 states that "the SS boundary has been established as the first valve inside WSB." Currently, the wet pipe sprinkler system design does not show a listed indicating type control valve inside the building at the first flanged connection. Consider locating the control valve at the functional classification boundary between the GS underground and SS interior sprinkler system to benefit the facility with complying with the DSA/TSR and implementing Specific Administrative Controls (SAC).

OFI-7: Personnel using stairways without continuous rails during construction should be made aware of the added risk of ascending and descending stairways without continuous handrails until the stairway handrails have been modified. Modification of the handrails to comply with safety requirements should be completed as soon as practical.

OFI-8: The WSB ring main and the standpipe are newly designed and constructed to support the project and are not part of the existing F-Area fire water supply system. The reliability and operability of these systems to support the WSB SS sprinkler systems will be evaluated as the DSA and TSR become available. The analysis and implementation of the WSB DSA and TSR should be completed as soon as practical to ensure that any changes to these analyses will not impact startup of the WSB or adversely affect project costs.

APPENDIX A
SUPPLEMENTAL INFORMATION

Review Dates: September 24-27, 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 R. Staker, Deputy Director for Oversight
William E. Miller, Deputy Director, Office of Safety and Emergency Management Evaluations

Quality Review Board

William Eckroade
Thomas Staker
Steven Simonson
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
Jeffrey Robinson

APPENDIX B
DOCUMENTS REVIEWED

- SRNS Specification G-SPP-F-00006, Rev. 3, Project Number Y473, Waste Solidification Building, July 14, 2011
- Section 01300 of Specification G-SPP-F-00006, Submittals
- Section 01400 of Specification G-SPP-F-00006, Quality Requirements
- Section 03310 of Specification G-SPP-F-00006, Drillco Maxi Bolts
- Section 05120 of Specification G-SPP-F-00006, Structural Steel
- Section 05500 of Specification G-SPP-F-00006, Metal Fabrication
- Section 15050 of Specification G-SPP-F-00006, Basic Mechanical Requirements
- Section 15100 of Specification G-SPP-F-00006, Piping and Tubing, Rev. 3
- Section 15110 of Specification G-SPP-F-00006, Valves, Rev. 3
- Section 15800 of Specification G-SPP-F-00006, Ductwork and Accessories, Rev. 3
- Baker Concrete Construction Quality Assurance Manual, Rev. 4, dated January 19, 2011
- Baker Concrete Construction Quality Assurance Project Document for the Waste Solidification Building, Rev. 5, dated February 7, 2011
- Baker Procedure QAP 9701-9.01, Controlling Special Processes, Rev. 2, November 19, 2010
- Baker Procedure QAP 9701-10.01, Performing Inspections, Rev. 4, May 9, 2011
- Baker Procedure QAP 9701-13.01, Handling, Storage, and Shipping of Items, Rev. 4, November 19, 2010
- Baker Procedure QAP 9701-15.01, Controlling Nonconforming Items, Rev. 5, October 13, 2011
- Baker Procedure QAP 9701-S2.5, Installation of Structural Concrete, Structural Steel, Soils, and Foundations, Rev. 2, November 19, 2010
- Baker Procedure QAP 9701-S2.8, Installation of Mechanical Equipment and Systems, Rev. 2, November 19, 2010
- Baker Instruction OWI 9.01-2, Weld Filler Metal Control, Rev. 1, December 1, 2009
- Baker Instruction OWI 9.01-3, Weld Repair, Rev. 1, December 8, 2009
- Baker Instruction OWI 13.01-3, Storage and Handling of Materials - Intermech, Rev. 1, December 11, 2009
- Baker Procedure QWI 9701-2.03-1, Discipline-Specific Qualification Categories, Rev. 1, November 20, 2009
- Baker Procedure QAP 9701-2.01, Co-Worker Qualification and Training, Rev. 3, November 19, 2010
- Baker Procedure QAP 9701-2.02, Co-Worker Indoctrination and Training, Rev. 4, November 19, 2010
- Baker Instruction QWI 10.01-2, Visual Examination, Rev. 2, March 2, 2010
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