Characterization of a Contaminated Facility and Associated Soils in Support of D&D and Subsequent Soil Remediation – 15292

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ABSTRACT

Before starting any D&D field work at a United States Department of Energy (DOE) facility such as the Savannah River Site (SRS), it is recommended that a complete review and understanding of the full nature and extent of any contamination located in or previously associated with that facility is known. An integral aspect of this review and research entails a complete characterization of that facility, including, but not limited to, Toxic Substances Control Act (TSCA) limits for Polychlorinated Biphenyl (PCB), radiological, Resource Conservation and Recovery Act of 1976 (RCRA) and other hazardous chemicals, etc. A thorough characterization of a facility and its underlying soils supports:

- establishment of safe working conditions to protect human health and environment
- Deactivation and Decommissioning (D&D) methodology
- cost estimates to support future budget planning for D&D and soil cleanup

A prime example of this is documented in the characterization of the 690-N, Process Heat Exchanger Repair Facility that had a history of PCB and radioactive contamination. Characterization of 690-N included the sampling and analysis of concrete and underlying soils for radiological, PCB and hazardous contaminants. In addition, a sump, the walls of the facility, expansion joint material and the metal base of a drill press were characterized. Results of this comprehensive characterization of the 690-N Building are provided in a detailed report. Analytical results indicate minimal radiological, PCB, or RCRA hazardous contamination is present in the concrete floor slab (industrial exposure levels) and on the steel hut walls. Soils below the concrete floor slab show only trace amounts of radiological contamination and are well below TSCA and RCRA limits. Subsequent decommissioning/demolition activities can be performed safely without harming people or the environment, and cost estimates to perform building demolition can be developed for future budget planning.

INTRODUCTION

The SRS is an 802.9-square-kilometer (310 mi^2) DOE nuclear facility located along the Savannah River near Aiken, South Carolina (Fig. 1), where Management and Operations are performed by Savannah River Nuclear Solutions (SRNS). Located in the extreme southeastern tip of the Central Shops (N-Area) (Figs. 1 and 2) near the center of the SRS is Building 690-N. 690-N, also known as the Ford Building (Photo 1), is a one story metal frame structure with a corrugated aluminum roof and corrugated galvanized sheet metal siding, covering approximately 845.42 $meter^2$ of enclosed space on a concrete slab. 690-N was constructed in the early 1950's as a temporary structure for the purpose of testing Ford Company manufactured reactor control rod drive mechanisms prior to their installation in the SRS production reactors 105-R, 105-P, 105-L, 105-K and 105-C. During the early 1960's, the building was modified and repurposed for machine shop type repair/rework of radiologically contaminated production reactor heat exchangers.

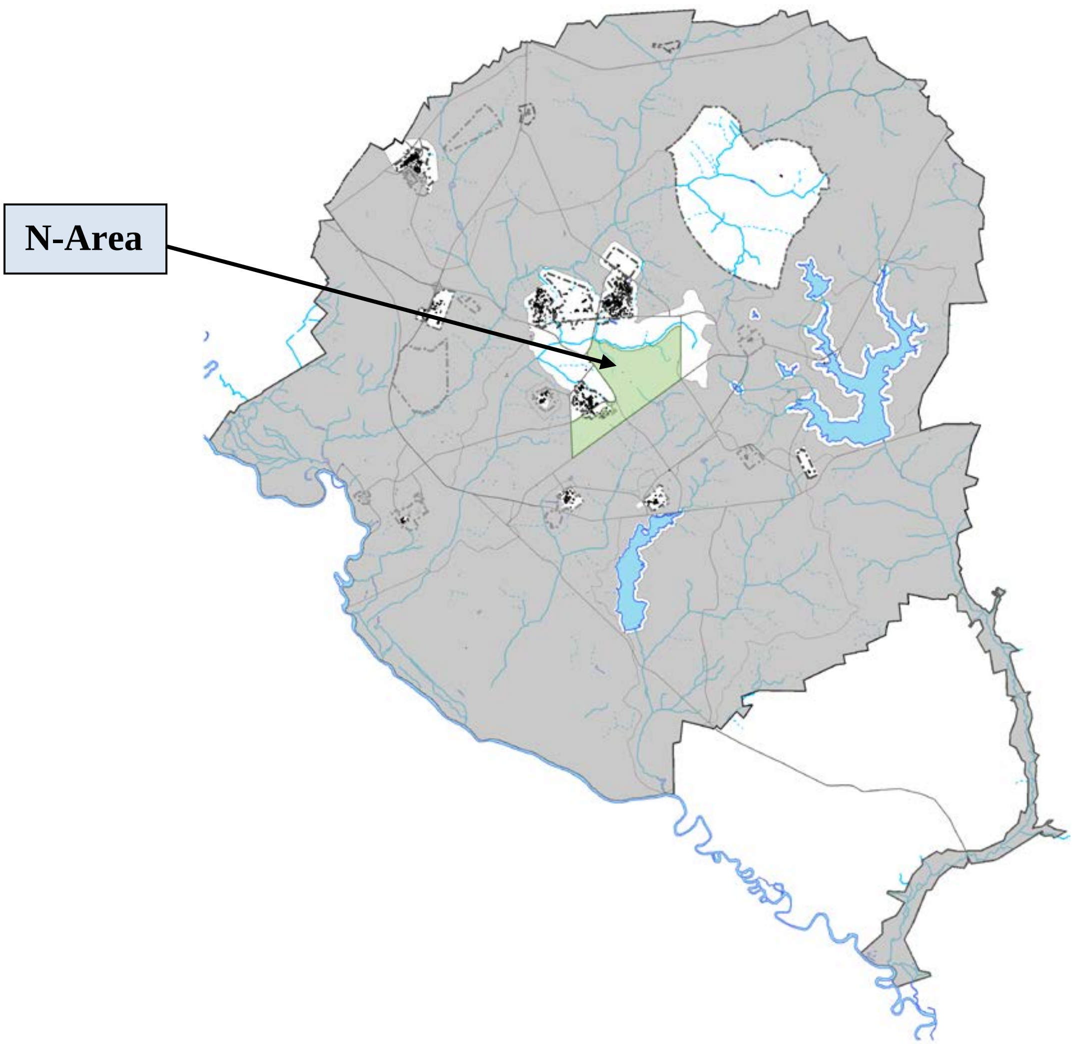

Fig. 1.Savannah River Site w/ N-Area Shown in Green

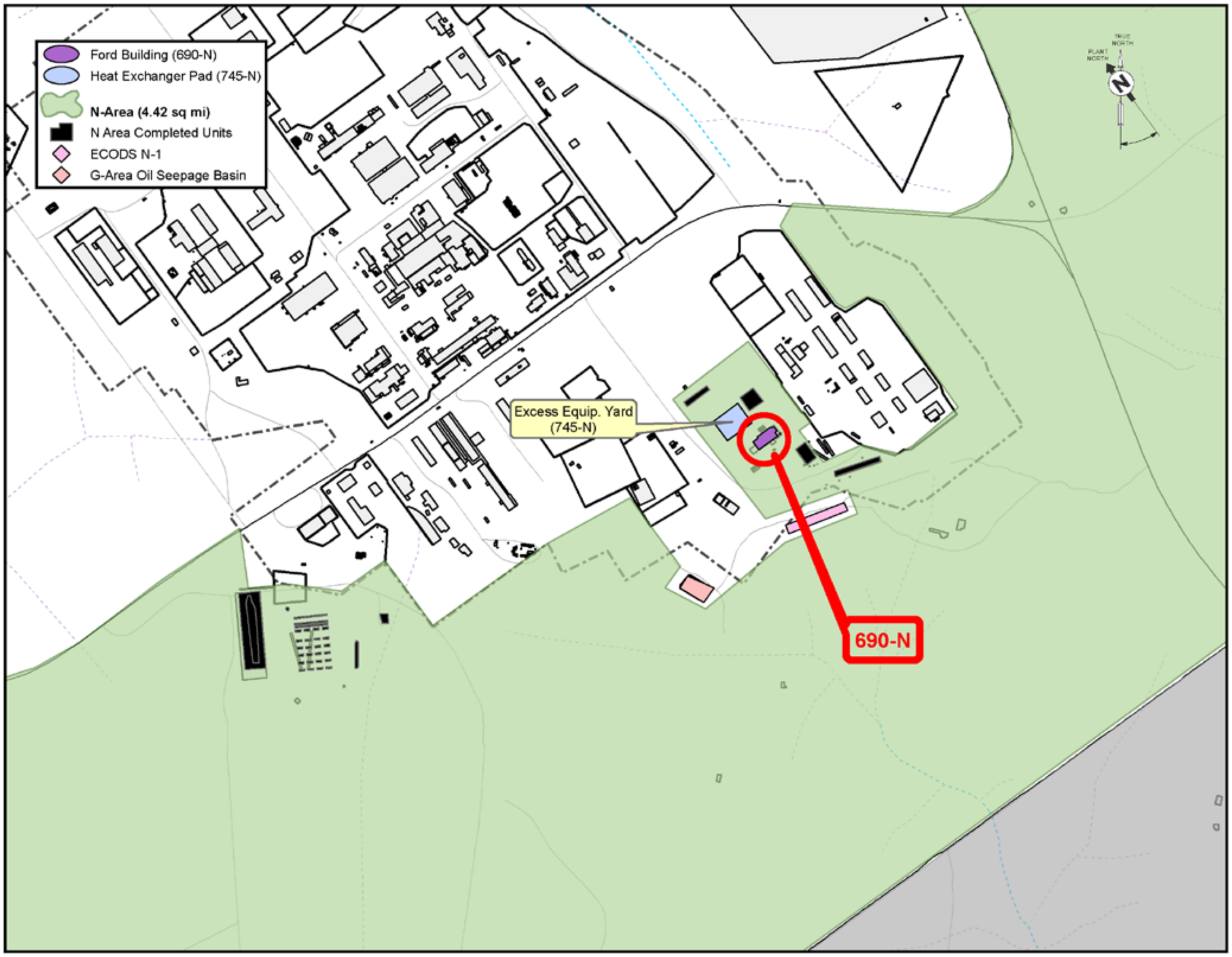

Fig. 2. Location of 690-N in N-Area

Photo 1: 690-N (Ford Building) - Looking Northeast

A steel containment hut was installed inside the facility to provide radiological containment for the heat exchanger rework. At the same time the steel hut was installed inside the facility, a process sewer drain line and process sewer floor drains were installed. The drain line was installed between the original Ford Building concrete floor slab and the newly expanded Process Heat Exchanger Repair facility where 20.32 cm of concrete was added, along with train rails, to handle the approximately 94 ton heat exchangers. The radiological contamination in the 690-N facility was due to the repair of the heat exchangers. This work continued until the 1970s. The facility had no installed chemical or radiological process systems and is classified as an “Other Industrial” facility in the SRNS “Standards/Requirements Identification List”.

The PCB contamination that exists within the facility is a result of PCB contaminated oils that were used during the machining work performed on the heat exchangers. In 1997 these PCB-contaminated oils were found to have contaminated the equipment and floor areas in the facility. An initial clean-up was performed in 1998 and the residual contamination was encapsulated with epoxy primer and basecoat floor coatings. Inspections conducted since 1998 revealed areas where possible PCB-contaminated oil had migrated up through the floor coating necessitating regular maintenance and reapplication of the coating materials.

In order to adequately plan for the safe demolition of the 690-N building, extensive characterization of the structure was performed from February 2014 to June 2014 to determine the nature and extent of contaminants.

DISCUSSION

The characterization of the building began with development of a detailed characterization plan that identified contaminants of concern for the building. The list of contaminants was developed based on process history and included standard RCRA suites of possible contaminants. Details of the characterization plan are included below. Data quality objectives were established to:

- determine the nature and extent of contamination
    - Radionuclides – from repair work of heat exchangers
    - Metals – from repair work of heat exchangers
    - PCBs – PCB contaminated oils used during machining work on heat exchangers
- determine likely D&D and soil remediation methodology
- determine waste management requirements
- determine level of personal and environmental protection required during cleanup activities
- gather data to facilitate work planning and development of cost estimates for future budget planning

CHARACTERIZATION PLAN

The Characterization Plan included full assessment of the 690-N facility, including the process concrete floor slab, soil below the process concrete floor slab, process floor equipment sump, concrete joint filler, process area walls, and the drill press metal base. A full radiological survey of the facility was performed prior to entry.

Process Floor Concrete - 20 concrete locations were chosen for sampling based on previous characterization data and locations where the epoxy coating was buckling. An additional location (for a total of 21) was chosen due to identification of additional deterioration of the floor coating. Each location was sampled for the following analytes:

- Alpha, Beta Rad Screening Surveys
- Tritium
- PCBs
- RCRA Metals
- Volatile Organic Compound (VOC)
- Semi Volatile Organic Compound (SVOC) } Waste Acceptance Criteria
- Total Halogens

Note: Approximate total thickness of slab(s) was 30.48 cm. Total number of samples was 42.

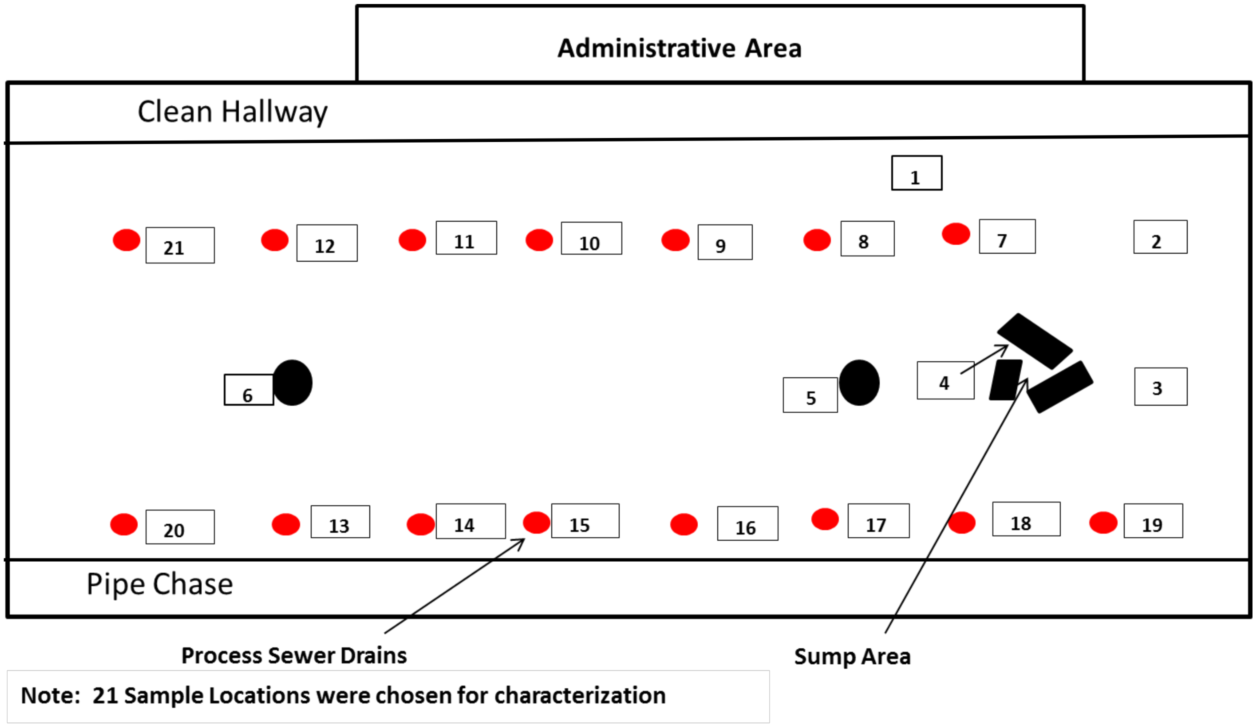

Fig. 3. Core Sample and Rad Survey Locations

The process floor concrete slab sampling was performed using a hammer drill method. Twenty one (21) locations were sampled (Fig. 3.). Prior to drilling, each sample location was radiologically surveyed to determine exposure potential for sample workers and to provide "screening level" characterization data. In order to obtain the required aliquot for the analysis requested, several drills were made per sample location for the 0 cm to 15.24 cm depth and then repeated for the 15.24 cm to 30.48 cm depth (Fig. 4.). At each drill location, a different drill bit was used for each depth, and the concrete sample (dust) was removed and bagged before proceeding to the next depth to avoid cross contamination (Photo 2). Each sample location included material from the 20.32 cm top concrete slab, which had been added when the facility was enlarged to be used as a repair/rework facility for the Heat Exchangers, and from the 10.16 cm lower (original) concrete slab when the facility was used for Ford Motor Company manufactured motor control packages.

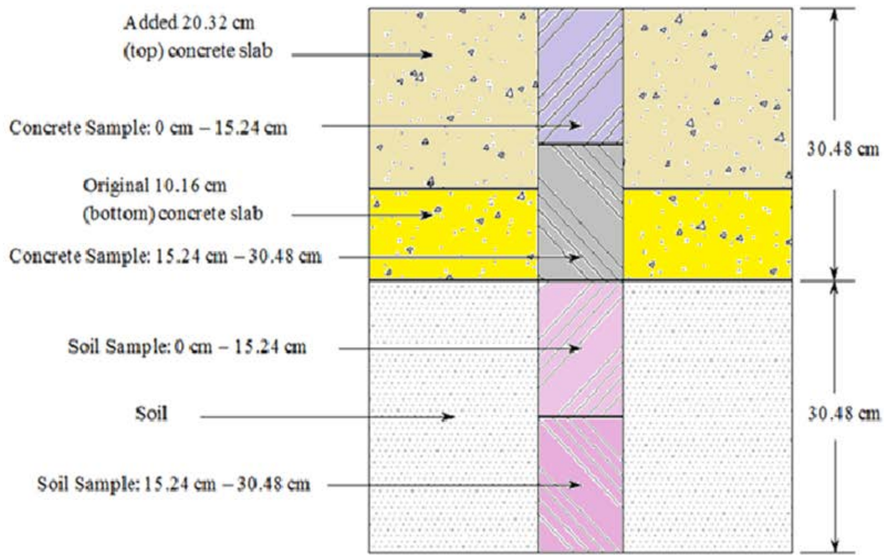

Fig. 4. - Concrete Floor Slab and Soils Cross Section

Photo 2 – Concrete Floor Sampling

Soil Beneath the Concrete Slab – After concrete samples were taken from each drill location, each drill location was filled with left over concrete material/dust from that hole to prevent cross contamination to an immediately adjacent hole where a 10.16 cm core was drilled to get to the soil beneath the concrete slab(s). The top 25.4 cm of the concrete was cored using a conventional wet method of coring, and then the final 5.08 cm (+/-) a dry core to prevent any water getting to the soil below the slab. Twenty one (21) locations immediately adjacent to the concrete drill locations were surveyed using a hand auger method of soil extraction. At each location a soil sample was taken by hand auguring from 0 cm to 15.24 cm, then changing the auger to prevent cross contamination, and repeating the process from 15.24 cm to 30.48 cm (Fig. 4.).

Process Floor Equipment Sump – 1 Sample (solid) – LSC with Tritium
1 Sample (solid) – PCBs

A concrete sample was collected from the bottom of the sump using a hammer drill method. Previous sludge samples taken in this area indicated PCB levels in the sludge above TSCA limits

Concrete Joint Filler - 1 Sample (Solid) – LSC w/Tritium
1 Sample (Solid) – Polychlorinated Biphenyls (PCBs)

The concrete joint material sample was collected using a scraper to obtain the required amount of material required for analysis. Prior to sample collection, the location was radiologically surveyed. Concrete Joint Filler (Expansion Joint Material) was sampled due to materials of construction (i.e. polysulfide [Thiokol Rubber]).

**Process Area Walls - **10 Rad Smears
10 hexane swipes (PCBs)
The walls within the process area were sampled in ten (10) locations based on previous characterization information using the hexane swipe method. Prior to sampling, each location was radiologically surveyed.

Drill Press Metal Base - 1 Rad Smear
1 Hexane Swipe (PCB)
Due to its proximity to the sump and wall where previous characterization data was the basis for survey of those locations, it was determined that the drill press base should also be surveyed.

RESULTS

The concrete floor slab radiological screen results show that of the 42 samples taken, twenty-one were non-detect with the remaining showing trace amounts of activity (highest being alpha @ 8.08E+00 pCi/g, nonvolatile beta @ 6.17E+01 pCi/g and tritium @ 1.93E+02 pCi/g). The concrete PCB sample results show that four samples were non-detect and the remaining samples contained trace amounts of PCB, (highest concentration being 20 ppm), none of which exceeded TSCA limits of 50 ppm. VOC, SVOC and Total Halogen analyses show either non-detect or trace amounts of contaminants. The RCRA metals analysis show no samples exceeded RCRA limits.

The expansion joint material rad screen results indicate trace amounts of activity (highest being alpha @ 1.63E+01 pCi/g, nonvolatile beta @ 7.74E+02 pCi/g and tritium @ 4.88E+01 pCi/g); however the PCB sample result shows concentrations at 250.8 ppm, exceeding TSCA limits of 50 ppm, which is due to materials of construction rather than a PCB contaminated oil spill.

The soil rad screen results show that of the 42 samples taken, all were non-detect except for seven samples which indicated trace amounts of activity (highest being alpha @ 3.42E+01 pCi/g, nonvolatile beta @ 5.67E+01 pCi/g and tritium @ 6.10E+01 pCi/g). Soil PCB sample results show that no samples exceeded TSCA Limits of 50 ppm. VOC, SVOC and Total Halogen analyses show either non-detect or trace amounts of contaminants. The RCRA metals analysis show no samples exceeded RCRA limits.

Hexane swipe tests were performed on ten locations of the walls of the 690-N facility steel containment hut. Of the ten locations only one exceeded the TSCA limit for the swipe test (i.e. 10ug/100cm$^{2)}$). The one swipe test indicated a concentration of 12.14 ug/100cm^2. As a result, six additional swipes were taken in the location of the exceedance to determine the boundary of contamination, and none of the six exceeded the TSCA limit, which limited this area of contamination to an area of ten (10) inches x ten (10) inches.

A hexane swipe test was also performed on a drill press metal equipment base located at the northeast corner of the steal containment hut. The results of the swipe test of the base were 3.94 ug/swipe, which is below the TSCA limit.

As indicated by the results provided within the characterization report, minimal radiological, PCB, or RCRA hazardous contamination is present in the concrete floor slab, the steel hut containment walls of the 690-N facility and the associated equipment and facilities. Other than trace amounts of alpha @ 3.42E+01 pCi/g, nonvolatile beta @ 5.67E+01 pCi/g and tritium @ 6.10E+01 pCi/g no other contaminates were found in the soil below the concrete floor.

CONCLUSION

Characterization of the 690-N Building is a prime example of the benefits of a comprehensive characterization of a DOE facility in that it:

- found minimal contamination (PCBs, radiological, RCRA) in the concrete, walls, sump and metal equipment base (no PCBs above 20.5 ppm, much less than threshold of 50 ppm)
- found minimal (trace amounts of) radiological contamination in the expansion joint material, but PCBs above the TSCA limit due to material of construction, not due to spills
- found minimal contamination in the soils below the concrete (no PCBs in soil)
- proved that building demolition can be performed safely without harming people or the environment
- facilitates work planning and the development of cost estimates for future budget planning