

**BUILDING 7602 DECONTAMINATION AND DECOMMISSIONING  
FOR REUSE BY SPALLATION NEUTRON SOURCE**

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**ABSTRACT**

Building 7602 at the Oak Ridge National Laboratory (ORNL) was constructed in 1963 as a Reactor Service Building for the Experimental Gas-Cooled Reactor; the reactor was never fueled or operated, and the project was terminated in 1965. Significant building modifications were performed during the late 1970s and early 1980s. Beginning in 1984, separation processes and equipment development and testing were initiated for the Consolidated Fuel Reprocessing Program (CFRP). The principal materials used in the processes were depleted and natural uranium, nitric acid, and organic solvents. CFRP operations continued until 1994 when the program was discontinued and the facility declared surplus to the U.S. Department of Energy (DOE). Systems and equipment were shut down; feed and waste materials were removed; and process fluids, chemicals, and uranium were drained and flushed from systems.

Bechtel Jacobs Company, LLC (BJC) contracted with Safety and Ecology Corporation (SEC) to perform decontamination and recovery of the Dissolver Facility of Building 7602. This effort, performed between September and December 2000, involved removal/relocation of equipment and materials and identification and removal of radioactive and hazardous materials contamination to satisfy site criteria for unrestricted use. Following completion of equipment removal, decontamination, and recovery, a final status survey was performed to demonstrate that project criteria had been satisfied. UT-Battelle utilized in-house craft resources to remove and relocate three major pieces of equipment, the Chemical Systems Test (CST) Skid, the CST Support Stand, and the Feed Housing, during July–September 2000 prior to SEC mobilizing to the facility for decontamination and decommissioning (D&D) activities.

UT-Battelle, LLC then took possession of the facility in September 2001 to coordinate the initial reuse of the decontaminated facility by the Spallation Neutron Source (SNS) Project. In addition to the SNS, various DOE programs and other projects with need for this area include:

Robotics and intelligent machines initiatives

- Environmental Management's Robotics Deactivation and Decommissioning projects
- Military robotic and remote handlings projects
- Other projects requiring large amounts of overhead room and crane and remote handling system support.

The SNS Project initially required the area to setup large-scale experiments to support testing of neutron shutter assemblies and other Target Systems components. UT-Battelle required additional facility modifications to support these project objectives; thus, a subcontract was issued to SEC in November 2001 to perform these construction activities. The 7602 Facility modifications were completed in January 2002.

This paper will present an overview of the Building 7602 D&D activities, final radiological survey, facility modifications, and project interfaces.

## INTRODUCTION

Building 7602 is located in the Robotics and Process Systems Complex at the east end of the ORNL site. Outer construction is steel frame and concrete. Most interior walls are covered with transite or thin sheet metal over concrete or drywall; the inner drywall has been removed from portions of the upper walls. The Digester Pit, located in the Dissolver Room floor, is lined with steel sheet; the Dissolver Room floor is concrete; and the Main Level floor is primarily concrete with sections of metal plate. Stairs and landings are metal plate or grating.

The Dissolver Facility has three levels: the mezzanine level, the Dissolver Room and Digester Pit (approximately 115 m<sup>2</sup> total floor surface area), and the Main Level (approximately 130 m<sup>2</sup> floor surface area). Wall surfaces included in this project extend to approximately 2.2 m (7 ft) above the Main Level floor. The mezzanine level, upper walls, ceiling, and the non-restricted access stairway from the Main Level to the mid-level landing were not included in the initial decontamination and radiological survey. Figure 1 shows a view of the Digester pit prior to remediation and Figure 2 shows the building layout.



Fig. 1. View of Digester Pit Prior to Remediation

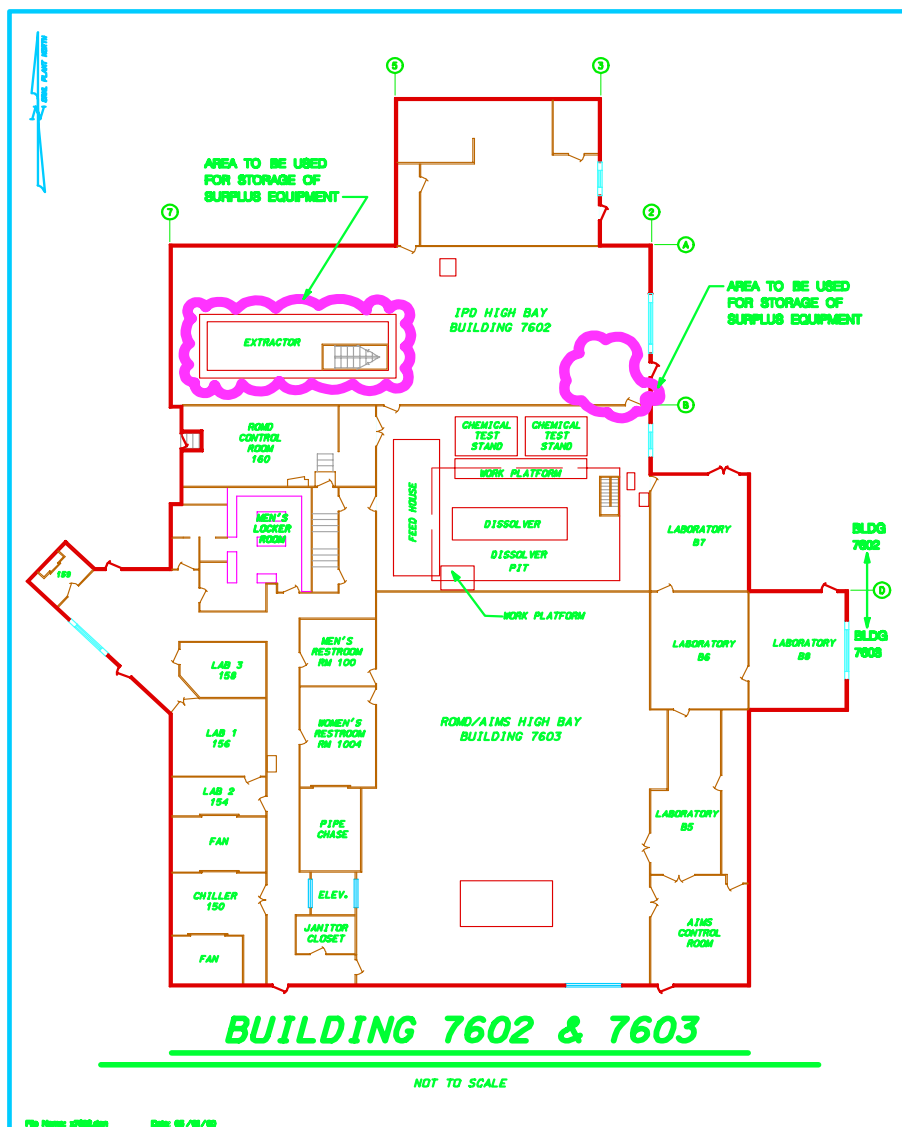


Fig. 2. Building Layout.

## DEMOLITION APPROACH

The primary objective of demolition was to remove the Dissolver Assembly from the 7602 Dissolver Pit, stage the Dissolver Assembly for final relocation, and remove and dispose of unneeded associated ancillary equipment to facilitate decontamination of the facility to allow unrestricted personnel access.

To increase the floor space area and eliminate unnecessary safety hazards, miscellaneous “loose” items were removed from the pit floor area. Once loose materials were removed, the overhead crane was utilized to lower scaffolding, a scissors lift, and miscellaneous materials into the Pit. SEC operated the crane under the direct supervision of the UT-Battelle operator. An area on the Dissolver Pit floor was designated for a loading area for the B-25 boxes for material that could not feasibly be decontaminated due to economic reasons. A second area was designated as a size reduction and decontamination zone.

Removal of insulation from pipes was accomplished in two separate work activities, asbestos and non-asbestos abatement. Sections of pipe were removed by cold cutting practice. A large percentage of insulated pipe contained steam, condensate, chilled water, and return water which were drilled to facilitate drainage into containers to eliminate spillage and slick work surfaces and also to vent pipe.

When all components have been removed from the Dissolver unit, the Dissolver was unfastened from the platform frame. A four way spread was used for lifting the dissolver with process knowledge indicating a weight less than 6200 pounds. Utilizing the overhead crane and the four-point spreader, and working in accordance with the Hoisting and Rigging Plan, the Dissolver skid was relocated to the main level for disposition.

The supply line of the heating, ventilation and air condition (HVAC) duct work on the north wall of the pit was removed and checked for radiological contamination, dry decontaminated, and placed back in service.

After all pipe, tubing, and electrical components were removed, the next step was removal of the metal sheet panels involving the use of aerial-lift equipment. The fasteners that connect the panels to the concrete wall were removed with an impact wrench.

In addition to removal of the items above, the Digester tanks and the NOX scrubber stack were removed in the same manner as described above.

## **FACILITY DECONTAMINATION**

All radiological contamination on facility floors and walls was assumed to be various uranium compounds, in addition to some residue/rust/chemical stains that were present. All miscellaneous debris was removed from the area prior to surface decontamination activities.

Data collected during the initial characterization of the facility was utilized to identify areas where contamination must be removed. Areas were scanned before and after decontamination attempts to determine if efforts were successful and whether more aggressive techniques would be required.

Decontamination efforts were initiated on the Main Level at an elevation of 7 ft above the floor surface. Walls and floors were decontaminated using a "top-to-bottom approach" so that the pit floor was the last area to be decontaminated. Detergent and dry wipes were utilized on intact painted surfaces. If contamination remained, wire pads/brushes were used to remove contamination. For chemical stains from acid spills that could not be removed by these methods, caustic substances (e.g., Borax, etc.) and dry wipes were used. For unpainted surfaces with fixed contamination, electrical grinders and chippers were employed to break the contamination loose. In the bottom of the pit, a high-pressure steam cleaner was utilized for more aggressive decontamination. Debris, dirt, liquid decon water, and removed contamination were collected by high-efficiency particulate air vacuum.

## **RADIOLOGICAL STATUS SURVEY APPROACH**

Guidance provided in Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) was the basis for this survey. The MARSSIM process was developed collaboratively by the Nuclear Regulatory Commission, Environmental Protection Agency, Department of Energy, and Department of Defense for use in designing, implementing, and evaluating radiological surveys. The primary focus of MARSSIM is to demonstrate compliance of a site or facility with criteria established for future use without radiological restrictions. This type of survey is known as a "Final Status Survey," and MARSSIM provides highly prescriptive guidance for designing and conducting such a survey. On the basis of previous ORNL and SEC monitoring activities, residual uranium contamination in excess of project-specific criteria was anticipated in portions of this facility.

Many aspects of MARSSIM are intended for application with dose-based guideline levels of residual contamination, implemented by averaging over an entire "survey unit." This dose-based guideline approach also incorporates provisions for establishing additional limitations for small isolated areas of elevated concentrations of the contaminant. The established project criteria for radioactive contamination in the Dissolver Facility are not dose-based, thus limiting applications of MARSSIM to this survey. However, this survey design provided a level of thoroughness and technical soundness that equals or exceeds that of MARSSIM.

Normally, BJC and UT-Battelle would have performed two separate radiological surveys—BJC confirming that the criteria above was met and UT-Battelle doing verification for acceptance. For this project, it was agreed that an UT-Battelle Radiation Control Technician (RCT) would work with the BJC RCT so that only one survey was performed. This integrated effort saved both time and money.

## **RADIOLOGICAL SURVEY IMPLEMENTATION**

Following removal of equipment and structures and general surface cleaning, alpha and beta surface scans were performed. A Ludlum Model 239-1F floor monitor with a large area gas proportional detector and a Ludlum Model 2221 scaler/ratemeter was used for scanning large floor areas; separate scans were performed for alpha and beta radiation. Scans of walls and other surfaces, not accessible with the floor monitor, were conducted using Ludlum Model 2221 instruments with alpha scintillation and pancake GM detectors. Scan speeds for all instruments were approximately one probe width/second. Audible response of the instruments was monitored and locations of elevated audible response were noted for further investigation. Coverage was 100% of accessible surfaces.

Gamma scans of floor surfaces were performed using a Ludlum Model 44-10 NaI scintillator with a Ludlum Model 2221 scaler/ratemeter. Scan speed was approximately 0.5 m/s. Audible response of the instrument was monitored and locations of elevated audible response were recorded. Coverage was 100% of accessible floor surfaces.

Alpha and beta measurements of total surface activity were performed using Ludlum Model 43-5 alpha scintillation and 44-9 pancake GM detectors with a Ludlum Model 2221 scaler/ratemeter. The measurements were performed at locations identified by surface scans and at additional representative locations by integrating the counts for a minimum of 1 minute. Separate measurements were performed for alpha and beta radiation. Because of adverse surface

conditions, alpha measurements were not reliable indicators of true activity and, therefore, total surface beta activity was used as an indicator of radiological status.

Surface scans identified areas of elevated gamma, alpha, and beta radiation on the floors of the Main Level and Dissolver Room. One isolated location on the Dissolver Room floor had a gamma level of 27 K cpm; several additional small areas had levels ranging from background up to twice background. One isolated location in the southeast corner of the Dissolver Room had a maximum beta activity level up to  $2.5 \times 10^6$  dpm/100 cm<sup>2</sup>, and several additional areas had maximum levels ranging from  $1 \times 10^5$  to  $1 \times 10^6$  dpm/100 cm<sup>2</sup>. In accordance with direction from BJC, contamination on these surfaces was fixed in place by covering with patching compound and/or paint; Figure 3 illustrates the fixed contamination levels on the floor of this facility. Scans and measurements on other facility surfaces demonstrated that total surface contamination ranged from less than typical ambient background levels up to twice background levels.

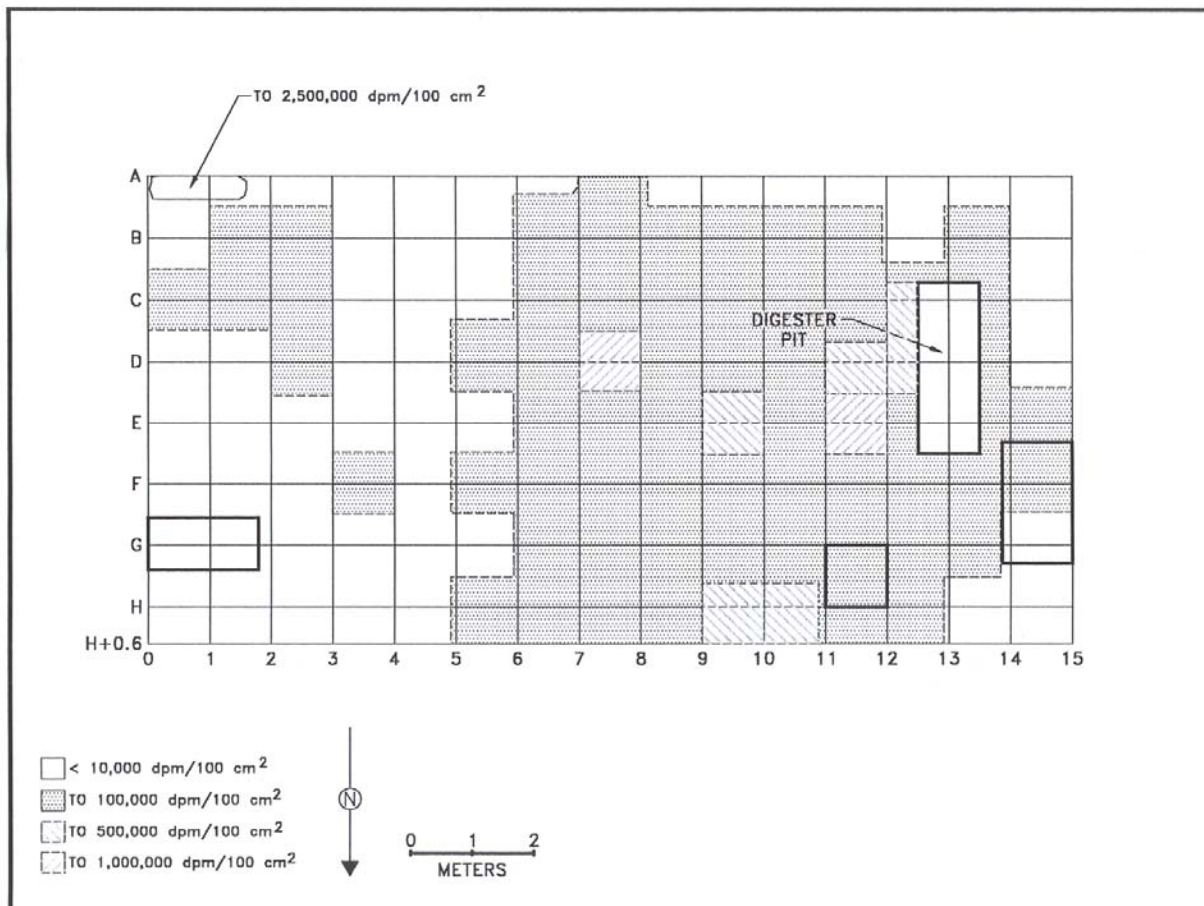


Fig. 3. Facility's Fixed Beta Contamination Levels on Floor.

Following fixing of floor contamination, surfaces were surveyed in accordance with a MARSSIM approach for removable activity.

Surface contamination measurement locations were systematic. A random starting point was selected in each survey unit and a triangular sampling (measurement) pattern established. Spacing between data points was determined in accordance with Equation 5.5 of MARSSIM. Stairs and miscellaneous surfaces were not surveyed using this pattern; instead, representative data point locations on those surfaces were selected by the Project Supervisor based on potential

for contamination and representative distribution. Dose equivalent rate measurements were performed at 1 m above the floor surface at locations selected by the Project Supervisor and surveys to provide thorough area coverage and to be representative of the range of facility conditions as indicated by results of other radiological measurements.

Background (reference) levels of gross-alpha and gross-beta total and removable surface activity and dose equivalent rate were determined on surfaces of similar construction in the 7602/7603 Building complex, but which have not had a history of radioactive material use. The same instruments and techniques that were used for the final status survey of the Dissolver Facility were used for background measurements. To assure a representative distribution of background values, multiple background data points were obtained for the different instruments and surface types.

### **BUILDING 7602 DISSOLVER PIT RADIOLOGICAL SURVEY CRITERIA**

The purpose of the Survey was to determine the post remediation radiological conditions of interior structure surfaces in the facility and compare the findings with project-specific criteria provided by BJC. At the completion of the decontamination activities at the facility, BJC established the following radiological criteria be achieved:

- 20 dpm/100 cm<sup>2</sup>, removable alpha
- 200 dpm/100 cm<sup>2</sup>, removable beta

These removable contamination criteria are recognized as being conservatively restrictive for this facility, but were selected to be consistent with criteria for other ORNL facilities and operations, which are based on potential contaminants being transuranics (alpha) and strontium-90 (beta). The contaminant of concern is processed uranium, *i.e.*, uranium, which has been, separated from the other naturally occurring members of the uranium and actinium decay series. In addition, BJC established an acceptable dose equivalent criteria for building occupants of 100 millirem/yr (50 microrem/hr, based on annual occupancy of 2000 hrs).

Although total surface contamination criteria were not specified by BJC for this Project, the initial project goal was to also satisfy total ORNL site-wide contamination guidelines. Limited characterization, performed prior to removal of major equipment, did not identify significant levels of fixed contamination. However as the removal progressed and previously inaccessible surfaces were revealed, it was discovered that some surfaces were more highly impacted than originally anticipated. Because decontamination of these impacted areas would have resulted in damage to the surfaces and would have required additional efforts to repair, BJC determined that fixed contamination would be covered with patching material and/or paint and the locations of residual fixed contamination documented.

### **FINAL RADIOLOGICAL CONDITIONS**

Results of removable contamination measurements indicated approximately 95% of the alpha activity measurements and approximately 90% of the beta activity measurements were below the detection sensitivity of the procedures. With exception of one measurement location on the stairs, all removable contamination measurements satisfied the guideline levels; no further actions were necessary to demonstrate compliance with project criteria for those survey units.

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Results of dose equivalent rate measurements, performed throughout floor areas in the Dissolver Room and Main Level indicate that all measurement locations were within the project criteria of 50 microrem/h (100 mrem/year).

All individual final data values for removable activity and dose-equivalent rates were below the project criteria levels. Consequently, in accordance with the MARSSIM approach, statistical testing of the final survey data is not required to demonstrate compliance.

The final survey of the 7602 Dissolver Facility indicates that residual radioactive material contamination in excess of ORNL contamination guideline levels is present on floor surfaces. This material was fixed in place by covering with patching material and/or several layers of paint. Levels of removable alpha and beta contamination were demonstrated to satisfy the project objectives of 20 alpha dpm/100 cm<sup>2</sup> and 200 beta dpm/100 cm<sup>2</sup> at the 95% confidence level. The dose equivalent levels throughout the facility also satisfied the project objective of 100 mrem/yr.

Modifications to the high-bay and pit areas were required to accommodate the impending SNS test operations and future research as previously noted. These modifications included demolition of abandoned piping and equipment, and demolition of walls between the operations pit and the high bay and between the pit and the mezzanine area. A few areas required radiological decontamination when previously inaccessible surfaces were exposed by the removal of equipment and walls. Most of the abandoned piping and equipment was internally contaminated and required radiological controls during demolition.

A new structural steel walkway was installed along the east rim of the operations pit to provide personnel access between the north and south areas of the high-bay. New handrails were installed around the operations pit and on the mezzanine level as required because of removal of the walls in those areas. The digester pit located in the floor of the operations pit was covered with steel plate flush with the operations pit floor. Pipe chase openings in the main and mezzanine floors were covered with steel plate. Existing partially completed walls in the operations pit were finished with installation of sheet metal panels. All of the walls, floors, and structural steel stairs and walkways in the area were repainted. Final conditions are illustrated in Figure 4.





Fig. 4. Building 7602 Final Conditions.

## CONCLUSIONS

BJC, UT-Battelle, and their subcontractor, Safety and Ecology Corporation, were able to work together to take an old facility, remove unnecessary equipment, remove residual surface contamination, and remodel for reuse by a large growing program—SNS. Communication of project objectives and continuous communication of all companies involved was essential to the success of the D&D/facility modification activities.