Challenges with Final Status Surveys at a Large Decommissioning Site – 13417

Heath Downey*, Peter Collopy*, Eugene Shephard*, Nelson Walter* and John Conant**
* AMEC, 511 Congress Street, Portland, ME 04112 heath.downey@amec.com
** ABB Inc., 5 Waterside Crossing, Windsor, CT 06095

ABSTRACT

As part of decommissioning a former nuclear fuel manufacturing site, one of the crucial final steps is to conduct Final Status Surveys (FSS) in order to demonstrate compliance with the release criteria. At this decommissioning site, the area for FSS was about 100 hectares (248 acres) and included varying terrain, wooded areas, ponds, excavations, buildings and a brook. The challenges in performing the FSS included determining location, identifying FSS units, logging gamma walkover survey data, determining sample locations, managing water in excavations, and diverting water in the brook. The approaches taken to overcome these challenges will be presented in the paper. The paper will present and discuss lessons learned that will aid others in the FSS process.

INTRODUCTION

A former nuclear fuel manufacturing site, which was operational from the late 1950's until the early 1990's has been undergoing decommissioning in order to terminate the Nuclear Regulatory Commission (NRC) radioactive materials license and release the site for unrestricted use. The entire site is approximately 248 hectares (613 acres) and previous decommissioning activities have remediated some of the facilities and areas associated with radioactive materials use. The NRC previously released 148 hectares (365 acres). The remaining 100 hectares (248 acres) encompass the primary portion of the site associated with nuclear activities plus a buffer zone around the perimeter. The remaining areas for decommissioning were primarily associated with early nuclear fuel manufacturing operations of Naval nuclear fuel. These areas have been designated part of the Formerly Utilized Sites Remedial Action Program (FUSRAP); however, there are limited commercial nuclear materials comingled in these areas. Approximately 12 hectares (30 acres) were remediated as part of decommissioning operations, but the entire 100 hectares (248 acres) required FSS.

Decommissioning activities focused on remediation of areas associated with waste handling/disposal in outdoor areas (Equipment Storage Yard, Burning Grounds, Woods Area, Drum Burial Pit), liquid effluent discharge pathways (underground waste lines, wastewater treatment plant and brook) as well as decontamination/dismantlement of 2 buildings associated with nuclear fuel manufacturing. Radionuclide contaminants consisted primarily of high enriched uranium (HEU). Other radionuclides encountered in relatively minor amounts during the clean-up included cobalt 60 (byproduct materials), thorium and radium. Derived concentration guideline levels (DCGLs) were established for these radionuclides in soil utilizing the resident farmer scenario and approved by the NRC. Because one section of the nuclear fuel manufacturing building will remain at the time of license termination, building DCGLs were developed for HEU and cobalt 60 utilizing renovation worker scenario.

The site is mostly open around buildings/developed portions, but the majority of the site is heavily wooded, with several ponds and a brook. In addition, the areas around the brook have steep banks (up to 30 meters [100 foot] change in elevation in sections) and some portions of the underground lines were at depths of 8 meters (25 foot) below ground surface.

After remediation was complete in areas, FSS and government independent verification were performed to demonstrate compliance with the DCGLs prior to backfill/restoration.

FSS APPROACH

Part of the Decommissioning Plan for the site was to perform FSS after remediation in areas following the guidance in Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) [1]. MARSSIM [1] provides guidance collaboratively developed by United States Federal agencies (Department of Defense, Department of Energy, Environmental Protection Agency and Nuclear Regulatory Commission) for planning, conducting, performing, evaluating and documenting FSS. A FSS Plan was developed in accordance with MARSSIM [1] but that also addressed some of the unique scenarios associated with decommissioning of this site. This included FSS of excavations prior to backfill, trench excavations, areas with water (brook), and industrial buildings. In all, 71 FSS units were created with 35 Class 1, 21 Class 2 and 15 Class 3 survey units. 1,562 soil samples were collected from these areas and analyzed for demonstrating compliance with the DCGLs.

The general approach to FSS was that areas of remediation were designated as Class 1 survey units, adjacent areas were Class 2 survey units and the buffer areas were Class 3. For excavations/trenches, the bottom of the excavation was Class 1 with a Class 2 survey on the next adjacent layer. Soils for backfill (overburden) were also randomly sampled in order to demonstrate that it would meet DCGLs. Following MARSSIM [1], Class 1 and 2 surveys units had samples distributed on a triangular grid, while Class 3 survey units had a random sample distribution. Soil samples were analyzed by gamma spectroscopy.

Gamma Walkover surveys were performed at 100% coverage in Class 1 survey units, Class 2 survey units had a target range of 20-50% (expanded if elevated readings identified), while Class 3 survey units were approximately 10% coverage. Gamma walkover surveys were performed with 2x2 sodium iodide detectors or with 5x2 sodium iodide detectors in water (wet) areas.

Building surveys were performed with alpha/beta scintillator probes or gas proportional floor monitor and wipes were collected as well. Wipes were analyzed with a gas proportional alpha/beta system.

FSS CHALLENGES

Given the complexity of the site and various areas for decommissioning, numerous challenges were presented for both design and implementation of FSS. These challenges included terrain (location and access), excavations, water, and buildings. Each of these needed to be addressed during design as well as implementation of FSS so that the FSS Reports will support license termination by the NRC. Specific details for each of these challenges are provided.

Location

One of the primary concerns for FSS is to provide accurate locations for samples and measurements. The objective is to provide the location such that the position is known within 1 meter. This level of accuracy would allow for return to the location for investigation or confirmation. MARSSIM [1] provides guidance regarding options for a reference coordinate system that would allow this type of accuracy. This includes the use of physical markers (stakes, pins, etc.) and spacing of a grid relative to sample density.

Given the size and variety of terrain at this site, a combination of approaches was taken to provide accurate locations. First, a site-wide grid was established with 30 meter (100 ft) square grid nodes as the primary unit. Included with this grid were 6 meter (20 ft) square sub-grid nodes such that each 30 meter (100 ft) square grid contained 25 – 6 meter (20 ft) square sub-grid nodes. The identification of this grid was based upon the reference coordinate system, which was North American Datum of 1983, Connecticut State Plane. An example of the grid is provided in Figure 1. In specific areas targeted for decommissioning activities, a land surveyor was utilized to establish reference points with pins and the grid with wooden stakes. This included the woods area, burning grounds, clam shell pile and site brook. The sub-grid could be added as needed and use of reference points allowed for rebuilding the grid after remediation activities were complete.

In open areas where GPS satellite coverage was not restricted by tree canopy, sub-meter accuracy GPS systems were utilized to provide locations. This could be done to record locations of remediation, underground piping, etc., but also to locate corners of FSS units or sample locations. In areas where the grid was established, the GPS and grid could be used to confirm locations (if satellite coverage was available).

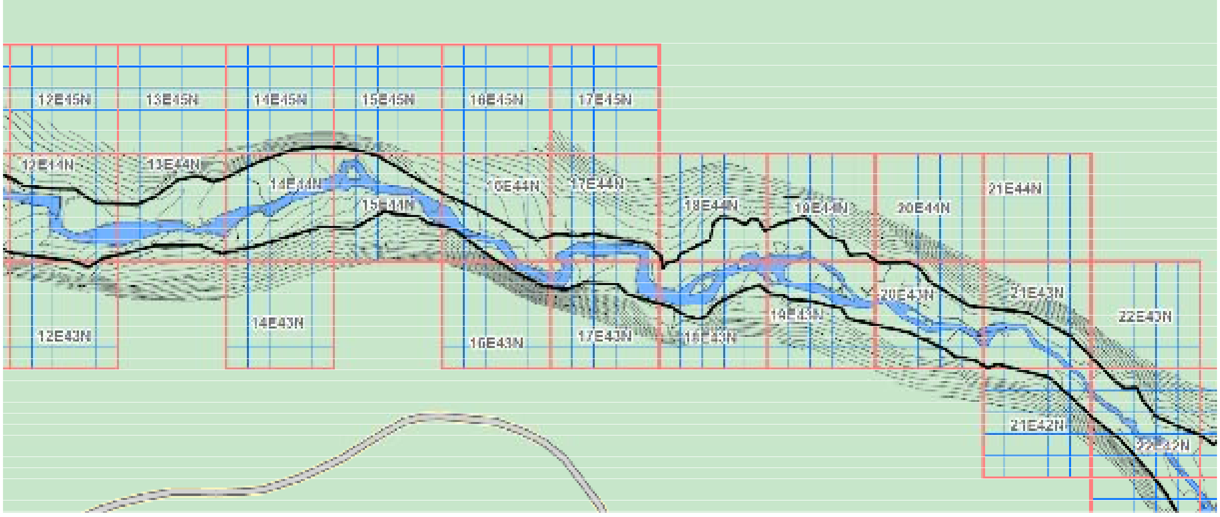

Figure 1 Site Grid Example

Another important aspect of establishing a grid reference system at a site is basic site preparation. Clearing should be performed prior to establishing the reference points or grid, because this will remove potential interferences and allow for a quicker and safer installation of the grid. Removal of necessary trees, shrubs, rocks or other items that would interfere with FSS in an area should be removed as soon as possible in the process so that they are not used as a reference point or prevent the placement of a stake or pin in the proper spot for establishment of the grid. In some cases this could be complete removal of trees and other items within the area or could entail selective removal in order to minimize ecological impacts on animal habitats or species of concern.

Gamma Walkover Surveys

FSS of soil areas also include gamma walkover surveys. In order to determine the location/instrument reading combination, a system with gamma instruments and GPS was utilized. This system recorded the GPS position and gamma reading every second, which produces significant quantities of data, but also records readings that a technician may not be able to observe in real-time. In locations where the GPS satellite coverage was poor, such as large tree canopy, surveys were performed within the grid and notes recorded the path and times for performance of the gamma walkover surveys. This way the data set could be reviewed and mapped appropriately. An example of this is provided in Figure 2.

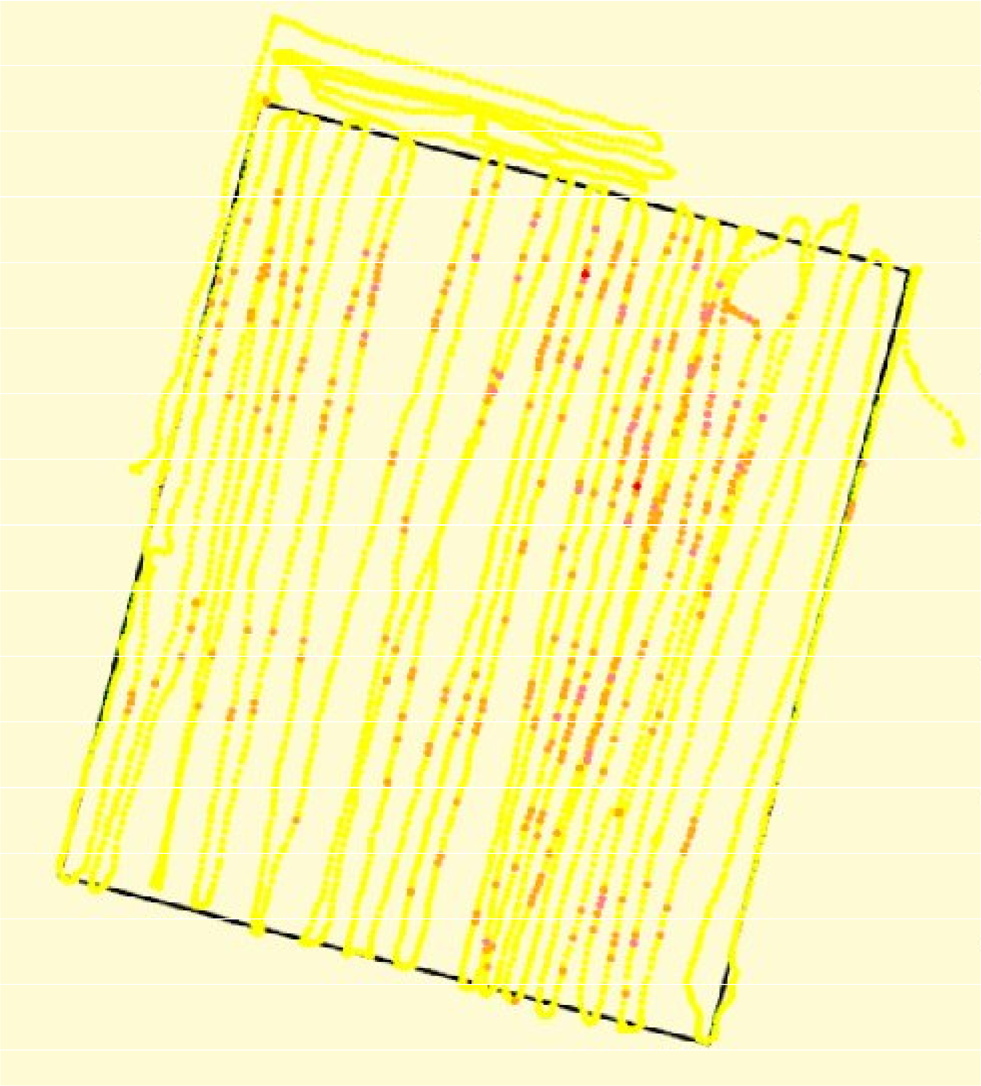

Figure 2 Gamma Walkover Survey Example

Excavations

In excavations, reference points were established, typically from manholes or other features of the underground piping, the locations of which had been previously defined with a ground survey. The site grid was utilized in the event that GPS satellite coverage was not available to support FSS inside the excavation. Excavations were designed and dug to allow for safe entry. In the event that there was a safety concern or change in configuration, modifications were made to the FSS such that personnel safety was always the first priority. This would include surveys/sampling from the top or utilizing the excavator to collect samples if needed.

Water

Another major challenge in FSS at this site was water. There are several ponds, connecting streams and a brook on the site. The water issue was increased due to record rainfall amounts for this locale during FSS activities. The ponds were adjacent to decommissioning areas and the brook was part of the liquid effluent discharge pathway. Modifications were made to some of the gamma walkover instruments so that they could be used in shallow water and long-handled or remote sampling tools were utilized for collecting samples. GPS systems were utilized when satellite coverage was available or the site grid system was used, especially in the brook. Sections of the brook were dammed with the water flow diverted to support remediation and these areas were quite muddy even for FSS. Additional precautions were taken including use of waders, small boat and extra support for recording and handling of samples and equipment during FSS in these areas.

Buildings

Two buildings were part of the decommissioning operations during this phase. Both were associated with Naval nuclear fuel manufacturing activities – Building 3 for the fabrication of fuel and Building 6 for processing of liquid radioactive waste. Building 6 was decontaminated and dismantled while most of Building 3 was dismantled and a portion of it remains in use for non-nuclear research and development activities.

Building 3 was a 4,478 square meter (48,200 square foot) one-story structure constructed of concrete block, concrete floors and steel framing with transite siding, and a steel roof deck. The original building design consisted of a 1,133 square meter (12,200 square foot) fuel fabrication "hot shop" at the north end of the building. The remainder of Building 3 consisted of the South or Cold Fabrication Shop which was adjacent to the hot shop and approximately 3,066 square meter (33,000 square foot), which was divided into equipment and laboratory areas. Building 3 also housed an assembly area known as the Core Assembly Building, approximately 334 square meter (3,600 square foot).

Building 6 was constructed as a liquid radiological waste collection and dilution facility for Building 3. Liquid radiological waste received was diluted and then discharged through the industrial waste lines, terminating at the Site brook. Building 6 was a two level cast-in-place concrete structure with a steel roof deck. The Building 6 footprint was approximately 255 square meter (2,750 square foot). The building housed ten 7,571 liter (2,000 gallon) steel storage tanks on the basement level, four 18,927 liter (5,000 gallon) steel dilution tanks on the ground level, and there was a shallow sump located in the southwest corner of the lower (basement) level.

Building specific grid systems were established, primarily utilizing structural reference points (columns and beams, etc.). No GPS or other location systems were utilized. Boundaries for survey units were marked with paint, tape or chalk and grids were established where needed due to scan coverage or know areas of remediation. Access to elevated areas was primarily accomplished by the use of aerial lifts due to the heights involved. Survey locations were identified by marking the area adjacent to the measurement with the sample ID in marker or paint. Scan surveys were recorded by position within the survey unit or grid node when applicable.

CONCLUSIONS

There are numerous challenges to FSS in addition to standard MARSSIM [1] design and statistics. Planning and implementation on a large site with diverse terrain requires additional planning and preparation to ensure quality results that support license termination. It is important to consider FSS at the beginning of the project so that a reference coordinate system is established that will support the entire decommissioning process. The benefits are that this provides continuity throughout the project and reduces the potential for locations to be missed or improperly FSS. In addition, challenges with terrain, water or other obstacles may compel the need to establish a physical grid or to have other equipment and supplies and procedures available in order to complete FSS in a timely manner. Decommissioning can be a complex process, so advance planning for FSS will reduce potential issues, provide high quality defendable results and allow for license termination.

REFERENCES

1. U.S. Nuclear Regulatory Commission, NUREG-1575 Revision 1, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), August 2000, Washington, DC.