Radiological Surveys Performed in Support of the Demolition and Bulk Disposal Decommissioning Method

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ABSTRACT

Connecticut Yankee Atomic Power Company is decommissioning the Haddam Neck Plant using the 'Demolition and Bulk Disposal' method, or commonly referred to as 'Rip and Ship'. In general, completing the project using this method entails the removal of all irradiated fuel and highly contaminated systems and components, and the subsequent demolition of the above ground portions of most site structures. Since most structures are removed from site, cost and time savings are realized by virtually eliminating the need for remediation. However, this method of decommissioning creates more waste, both radiological and non-radiological, which must be segregated, packaged and disposed of properly. Prior to demolition, various types of radiological surveys must be performed and work controls put into place to minimize the spread of contamination to other areas of the site, and to prevent the inadvertent release of radioactive materials from the site.

This paper will discuss the various types of radiological surveys performed, and controls implemented, in support of the demolition and bulk material disposal decommissioning method, with the emphasis on pre-demolition surveys. Details will be provided on the release criteria, survey design, survey implementation and data analysis on each of the various surveys, as well as a discussion on the controls implemented to prevent the various wastes from inadvertently being shipped to an inappropriate disposal facility. This paper will also strive to provide lessons learned for future projects that utilize the demolition and bulk disposal decommissioning method.

INTRODUCTION

On December 5, 1996, Connecticut Yankee Atomic Power Company (CYAPCO) notified the United States Nuclear Regulatory Commission (NRC) of the permanent cessation of operations of the Haddam Neck Nuclear Power Plant (HNP). This decision to decommission HNP was made after approximately 28 years of operation. In April of 1999, CYAPCO awarded a fixed-price contract to a Decommissioning Operations Contractor (DOC) to perform all decommissioning activities at HNP. In June of 2003, CYAPCO terminated the DOC contract

and transitioned from an oversight role to one of self-performing the decommissioning using staff augmentation and subcontractors for specialty work [1].

Soon after the transition came the management decision to procure a fixed-price contract for all demolition and decommissioning related services. A team of on-site specialists in various disciplines was assembled to prepare a Request for Proposal (RFP). It was during the crafting of the RFP that the plans for implementing the demolition and bulk disposal decommissioning method came together. Each structure on site, no matter how small, was identified and classified as to its potential for containing residual contamination, both radiological and non-radiological. This was accomplished through the use of 'Demolition Control Indicators'. It was also necessary to establish a program by which these indicators could be verified prior to turning control of a structure over to the demolition contractor.

Two types of radiological surveys were developed to verify that residual contamination limits for demolition and disposal are met. An 'Unconditional Release Survey' (URS) is performed on secondary side structures (usually) to demonstrate that the structures are suitable for unconditional release from the site. A 'Contamination Verification Survey' (CVS) is performed on primary side structures (usually) to verify that pre-demolition contamination levels are below those established for open-air or interior demolition.

Additional radiological surveys are performed after demolition to quantify the as-left radiological conditions of the site. 'Radiological Assessments' may be performed in parallel with pre-demolition surveys on structures where a portion of the sub-surface structure will remain after license termination. After demolition, a radiological assessment may be performed in an excavated area after remedial activities have been completed and prior to backfill. Lastly, 'Final Status Surveys' (FSS) are performed to demonstrate that the dose from residual radioactivity is less than the maximum annual dose criterion for NRC license termination.

BACKGROUND

The option of decontaminating site structures, and performing subsequent final status surveys, was evaluated against demolishing the above ground portions of the structures and transporting the debris to off-site disposal facilities. Lessons learned from similar decommissioning projects showed that the remediation of primary side structures to achieve the release criteria could be burdensome and that 'chasing cracks' was not uncommon. The upfront engineering time needed for FSS design, as well as the back end time for data analysis and survey reporting, would add considerable time and cost to the project. Additionally, even if structures were found to be below the FSS release criteria, the demolition debris could not leave the site as 'clean' waste until license termination since the material may still contain detectable radioactivity. The concrete debris could have been used as backfill for building basements but metal and other debris would have to be disposed of at a landfill upon license termination. Given the small footprint of the HNP site, it was determined to be impractical to store large quantities of debris over a large area for a long period of time.

Numerous cost-benefit analyses were performed to provide management with the various options for the final disposition of bulk materials resulting from the demolition of primary and secondary side structures. Given the increased cost associated with implementing a FSS and the problems associated with using valuable site real estate for storage purposes, the option of decontaminating

site structures followed by FSS was deemed to be not viable and therefore, the demolition and bulk disposal method for decommissioning was chosen. A key element to this decision was the ability to obtain relatively low disposal costs.

DEMOLITION CONTROL INDICATORS

In order to properly manage the potential health and environmental impacts of demolition so there are no unacceptable impacts to the public, environment, and site workers, all structures and areas at the HNP site have been categorized with the level and condition of radiological (R) or environmental (E) contamination present in each structure or area. It should be noted that the radiological and environmental control indicators are specified and implemented independent of each other [2]. The demolition control indicators used at HNP are shown in Table I and are described as follows:

Radiological Control Indicators

R1 is designated to structures where the radiological contamination is indistinguishable from background. This designation usually applies to structures that reside outside the Radiologically Controlled Area (RCA) of the facility. Prior to release of a structure to the demolition contractor for R1 demolition, an URS will be performed. The URS provides data to demonstrate that the structure is suitable for unconditional release from the site, i.e., free released as "clean" materials. For structures designated as R1 radiological controls are usually not required during demolition.

R2 is designated to structures that reside within the RCA (usually) where the radiological contamination is greater than the R1 levels, but less than the limits specified as being suitable for open air demolition ($R2^{Open\ Air}$) or interior demolition ($R2^{Interior}$) where the structure is scheduled for interior demolition. $R2^{Open\ Air}$ controls are instituted mainly to protect the environment and the public whereas $R2^{Interior}$ controls are instituted to protect the worker and to limit the potential for the spreading of contamination to other interior areas. Prior to structure turnover for R2 demolition, a CVS will be performed to verify that pre-demolition contamination levels are below the limits established for open air or interior demolition. For structures designated as R2, limited radiological controls are required, including but not limited to intermittent health physics coverage, misting, air sampling and periodic sampling. The resultant debris from the demolition of an R2 structure is treated as low level radioactive waste.

R3 is designated to structures, or portions of structures, within the RCA where the radiological conditions exceed the $R2^{Open\ Air}$ or $R2^{Interior}$ limits, as applicable. For structures designated as R3, significant radiological controls are required. This could include but are not limited to controls such as constant health physics coverage, application of surface fixatives, use of tents and HEPA ventilation, more intense air and surface sampling and personnel protective equipment (PPE) such as respirators. The resultant debris from the demolition of an R2 structure is treated as low level radioactive waste.

Table I. Radiological Contamination Limits for Demolition

Demolition Category	Total Surface Contamination	Loose Surface Contamination	
	β/γ	β/γ	α
R1	Non Detectable	Non Detectable	Non Detectable
R2$^{\text{Open Air}}$	2 mR/h @ Contact (.02 mS)	1,000 dpm/100 cm^2 (.17 bq/cm^2)	20 dpm/100 cm^2 (.003 bq/cm^2)
R2$^{\text{Interior}}$	10 mR/h @ Contact (.1 mS)	10,000 dpm/100 cm^2 (1.7 bq/cm^2)	200 dpm/100 cm^2 (.03 bq/cm^2)
R3	100 mR/h @ Contact (1 mS)	100,000 dpm/100 cm^2 (17 bq/cm^2)	5,000 dpm/100 cm^2 (.83 bq/cm^2)

Environmental Control Indicators

E1 is designated for structures where the structure or the remaining commodities contain no hazardous materials, no surfaces with paint containing Polychlorinated Biphenyls (PCB) concentrations greater than 50 parts per million (ppm), and no surfaces are present with paint containing lead or other heavy metals at concentrations that would require special worker personal protection measures, monitoring or engineering controls during demolition. For structures designated as E1, no environmental controls are required during demolition however, standard demolition controls should be applied from an environmental perspective.

E2 is designated for structures where the structure or the remaining commodities contain hazardous materials at concentrations greater than any Permissible Exposure Level (PEL) limit, such as, but not limited to, paint containing PCBs, lead or other heavy metals. For structures designated as E2, limited environmental controls are required, including but not limited to intermittent industrial safety and environmental coverage and air and material sampling during demolition.

E3 is designated for structures where the structure or the remaining commodities have surfaces that contain, but are not limited to, paint with PCBs at concentrations greater than 50 ppm and/or lead or other heavy metals at concentrations that will require worker personal protection measures and/or engineering controls during demolition. For structures designated as E3, significant environmental controls are required, including but not limited to use of tents and HEPA filtration, intense air and material sampling during demolition and use of PPE. Demolition performed under this category may require a phased approach [2].

PRE-DEMOLITION RADIOLOGICAL SURVEYS

Organization and Responsibilities

Radiological surveys performed prior to demolition are implemented by two groups at HNP, the Radiation Protection Group and the Site Closure Group. The Radiation Protection Group, managed by the Radiation Protection Manager (RPM), primarily performs surveys in support of system and component removals, as well as any work activities associated with the removal of spent fuel from the pool, transfer of spent fuel to the Independent Spent Fuel Storage Installation (ISFSI), and subsequent remediation of the spent fuel pool. The group also has the responsibility

for performing routine radiological monitoring of all areas on site, including site boundaries. The Site Closure Group performs the majority of radiological surveys necessary to support building demolition and NRC license termination.

Although two separate entities, the groups work together to protect the environment, public and workers prior to, during and after building demolition. The FSS Project Lead, working in the Site Closure Group, has the overall responsibility for ensuring survey design and survey results adhere to procedural and regulatory requirements. Radiation Protection Supervisors review the survey design for all pre-demolition survey packages prior to their implementation. The RPM has the overall authority to approve the results of a pre-demolition survey and no materials may leave the HNP site without prior approval from the RPM.
Key to the success of this organizational structure is the cross-training of field supervisors and technicians from the Radiation Protection and Site Closure groups. Technicians and supervisors who are typically assigned to the Site Closure Group maintain their qualifications as Radiation Protection technicians or Radiation Protection supervisors by attending routine training classes and group meetings. The ability to intersperse personnel from both groups allows the managers to augment their staff in accordance with schedule needs. This is especially important during the backend of the decommissioning project when staff levels are typically reduced.

Pre-Remediation Surveys

Pre-remediation surveys are performed in areas where the surfaces, systems or components in the areas are suspected to contain contamination levels which may exceed a Radiological Control Indicator limit, e.g. R1, R2, R3. Although primarily performed on primary side structures, these surveys may be performed on secondary side structures to verify the absence of any detectable contamination in suspect areas. These surveys are performed early in the turnover and control process to determine if remediation activities are necessary. This allows management ample time to schedule and budget for surface remediation or system/component removal activities. Pre-remediation surveys are typically performed by technicians under the direction of the Site Closure Group, although the Radiation Protection Group may sometimes perform these surveys.

Pre-remediation surveys consist of biased gamma scans using an HP-270 GM detector coupled to an ASP instrument, as well as monitoring for loose surface contamination. If the technician performing the survey identifies any area which exceeds the radiological control indicator limit, the area is physically marked for subsequent remediation. If no areas are found to exceed the limit, the area is usually locked down with a fixative and access is controlled until the CVS, or URS, can be performed.

Remedial Action Surveys

Remedial action surveys are surveys performed in support of remediation activities. The Site Closure field supervisor and technicians work closely with the CYAPCO field engineer responsible for the building or area. The survey uses the same instrumentation and protocols as a pre-remediation survey. Working with the craft performing the remediation, the technicians re-survey areas after remediation, continuing to mark areas requiring further remediation. Radiation

Protection technicians typically provide the health physics job-coverage function for the remediation activities.

Once all areas have been adequately remediated, and no areas are found to exceed the radiological control indicator limit, the area is usually locked down with a fixative and access is controlled until the CVS, or URS, can be performed.

Contamination Verification Surveys (CVS)

Contamination verification surveys are the radiological assessment of structures within the RCA (usually) that are scheduled for demolition and subsequent removal from site as low level radioactive waste material. A CVS is performed under the direction of the Site Closure Group to verify that pre-demolition radiological contamination levels are below the limits established for demolition. Demolition limits are specified separately for open air and interior demolition. Guidance for the preparation, performance, documentation and approval of these surveys is contained in a CYAPCO procedure [3]. State and federal regulatory agencies periodically review CVS data and conduct on site inspections of areas which have undergone a CVS.

The CVS is a part of a formalized contractual process by which CYAPCO releases a building to the demolition contractor. The survey area is initially released to the Site Closure Group by the Decommissioning Group by signature on a form. The form states what area is to be demolished along with the waste disposition. The Site Closure Group accepts the area for CVS when it is satisfied that all decommissioning activities having the potential to contaminate the area at levels that meet or exceed a specific radiological control indicator have been completed. All tools and equipment not necessary for performing the survey must be removed from the area and any engineering controls used for limiting the spread of contamination should be in place.

Once accepted for CVS, the boundaries of the survey area are posted and access controls are instituted. Permission must be granted by Site Closure management for access to a posted area in non-emergency situations. While it is highly desirable to control access to specific areas as soon as possible following completion of pre-demolition activities, it is absolutely essential that access be positively controlled at the time of and following the CVS up to the start of actual demolition.

A survey package is prepared for each individual survey area. Large buildings may be divided into smaller units to optimize the scheduling and performance of the CVS. The survey package is a collection of information in a standardized format for controlling and documenting field measurements collected for the CVS. As a minimum, the survey package will contain detailed survey instructions, survey maps, the field data collection results, smear sample result reports, safety requirements and documentation of a pre-job safety briefing.

A historical review is performed by reviewing previous radiological surveys, historical site assessments, 10CFR50.75(g) files and if necessary, by conducting interviews with site personnel knowledgeable of past uses and radiological conditions.

Instrumentation used for the CVS are selected to provide both reliable operation and adequate sensitivity to demonstrate attainment of the established limits. Instrumentation is setup, operated

and maintained in accordance with appropriate procedures and all technicians are trained in their use. Typical instrumentation used at HNP for a CVS is an HP-270 GM detector coupled to an ASP instrument for the performance of gamma scans. Gamma spectroscopy measurements may be obtained using an Exploranium GR-130 NaI detector to analyze areas of elevated activity to investigate whether the elevated area is plant-related or naturally occurring. If necessary, beta/gamma and/or alpha scans will be performed using a scintillation detector.

Typically, the CVS will consist of a gamma scan of a percentage of the area along with a pre-determined number of loose surface contamination measurements which are analyzed for beta/gamma and alpha contamination. Beta/gamma scans and static measurements may also be prescribed. The survey design and intensity of the CVS will vary dependant on the historical use of the area. General guidance for survey design is contained in Table II.

Table II. Recommended Area Coverage for Contamination Verification Surveys

Surface	**Minimum Scan Coverage**		**Smear Surveys (α and β/γ)**
	$R2^{Open\ Air}$	$R2^{Interior}$	$R2^{Open\ Air}$ and $R2^{Interior}$
Floor	10%	10%	Usually a minimum of 30 smears are prescribed. Additional smears are obtained at any areas of elevated activity. Smears shall be analyzed for β/γ and α contamination.
Walls <2 meters	10%	10%	
Walls >2 meters	5%	5%	
Ceilings	5%	5%	
Exterior walls <2 meters	10%	N/A	
Exterior walls >2 meters	5%	N/A	
Roof	10%	N/A	

Upon completion of the CVS, a review of the field measurement data is performed by Site Closure supervision and management to ensure all measurements prescribed in the survey design have been obtained and all data is below the limits specified in the survey plan. The survey package is then forwarded to the RPM for approval. The RPM verifies the Radiological Control Indicator limits have been met and may at this time designate certain restrictions on the building demolition such as:

- Health Physics job coverage required,
- Radiation Work Permit required,
- Further surveys required during intermediate steps of demolition,
- No radioactive materials to be stored in the area, and
- Special waste disposal or segregation methods required

Completion of the CVS releases a 'hold point' in the Work Plan and Inspection Record (WP&IR) which is the major procedure that controls physical work at the HNP site. When all pre-demolition hold points in the WP&IR are satisfied, and when all requirements of procedure ENG-1.7-179, "Control of Systems, Structures, or Components (SSCs) Turnover to the

Demolition Contractor" [4], have been satisfied, control of the area or building is turned over to the demolition contractor.

Unconditional Release Surveys (URS)

Unconditional release surveys are radiological assessments of structures outside the RCA (usually) that are scheduled for demolition and subsequent removal from site as "clean" or non-radioactive waste material. An URS is performed under the direction of the Site Closure Group to demonstrate that the bulk materials from structures are suitable for unconditional release from site. The URS program was developed using guidance from NRC Information Notice 85-92, "Surveys of Wastes Before Disposal From Nuclear Reactor Facilities" [5], and NRC IE Circular 81-07, "Control of Radioactively Contaminated Material" [6]. Guidance for the preparation, performance, documentation and approval of these surveys is contained in a CYAPCO procedure [7]. State and federal regulatory agencies periodically review URS data and conduct on site inspections of areas that have undergone a URS.

The URS is also a part of a formalized contractual process by which CYAPCO releases control of a building to the demolition contractor. The survey area is initially released to the Site Closure Group by the Decommissioning Group by signature on a form. The form states what area is to be demolished along with the waste disposition. The Site Closure Group accepts the area for URS when it is satisfied that all decommissioning activities having the potential to contaminate the area at levels that exceed the R1 limits have been completed. The limit to unconditionally release material from the HNP site is 'no detectable activity above background'. All tools and equipment not necessary for performing the survey must be removed from the area. Decommissioning activities in adjacent areas having the potential to spread contamination in the area undergoing an URS must be completed or engineering controls must be in place.

Once accepted for URS, the boundaries of the survey area are posted and access controls are instituted. Permission must be granted by Site Closure management for access to a posted area in non-emergency situations. While it is highly desirable to control access to specific areas as soon as possible following completion of pre-demolition activities, it is absolutely essential that access be positively controlled at the time of and following the URS up to the start of actual demolition. The use, movement or storage of radioactive materials is prohibited in an area which has undergone an URS without authorization from Site Closure management.

A survey package is prepared for each individual survey area. Large buildings may be divided into smaller units to optimize the scheduling and performance of the URS. Similar to a CVS package, the URS survey package will contain detailed survey instructions, survey maps, the field data collection results, smear sample result reports, safety requirements and documentation of a pre-job safety briefing.

A historical review is performed by reviewing previous radiological surveys, historical site assessments, 10CFR50.75(g) files and if necessary, by conducting interviews with site personnel knowledgeable of past uses and radiological conditions. The survey area or unit is then classified according to the potential for containing contamination as follows:

- Low Potential for Residual Contamination. These areas have a low potential for containing radioactive contamination, based on knowledge of site history and previous survey information. Previous remediation precludes an area from being classified as having a low potential for residual Contamination.

- Medium Potential for Residual Contamination. The area is located in a portion of the site near or adjacent to areas impacted by licensed operations or the area was used to store radioactive material. Previous remediation precludes an area from being classified as having a medium potential for residual Contamination.

- High Potential for Residual Contamination. The area is located in or adjacent to an area impacted by licensed operations, where historical information identified past contamination events or where the area has undergone remediation.

Instrumentation used for the URS are selected to provide both reliable operation and adequate sensitivity to demonstrate attainment of the established limits. The instrumentation used for an URS must meet the requirements of NRC IE Circular 81-07 which states that contamination monitoring using portable survey instruments or laboratory measurements should be performed with instrumentation and techniques (survey scanning speed, counting times, background radiation levels) necessary to detect:

- 5,000 dpm/100 cm^2 (.83 bq/cm^2) total beta/gamma contamination
- 1,000 dpm/100 cm^2 (.17 bq/cm^2) removable beta/gamma contamination
- 100 dpm/100 cm^2 (.017 bq/cm^2) fixed alpha activity (if suspected)
- 20 dpm/100 cm^2 (.003 bq/cm^2) removable alpha activity (if suspected)

Instrumentation is setup, operated and maintained in accordance with appropriate procedures and all technicians are trained in their use. Typical instrumentation used at HNP for an URS are a MicroR meter for gamma scans, and a HP-260 detector coupled to an E140, or a DP6BD or DD scintillation detector coupled to an Electra digital survey instrument for beta scans. Gamma spectroscopy measurements may be obtained using an Exploranium GR-130 NaI detector to analyze areas of elevated activity to investigate whether the elevated area is plant-related or naturally occurring.

Typically, the URS will consist of an initial gamma scan checking for possible previously undetected gamma emitters or high background. The gamma scan is biased towards areas likely to exhibit elevated radiation readings such as high traffic areas, low points, cracks, expansion joints, etc. A beta scan is then performed over a percentage of the area also biased towards areas likely to exhibit elevated readings. The technician will monitor the visual and audible count for an increase in activity. A pre-determined number of loose surface contamination measurements are also obtained which are analyzed for beta/gamma and alpha contamination. The survey design and intensity of the URS will vary dependant on the potential for containing residual radioactive contamination. General guidance for survey design is contained in Table III.

Table III. Recommended Area Coverage for Unconditional Release Surveys

Surface	**Minimum Scan Coverage**			**Smear Surveys (α and β/γ)**		
	Low	Medium	High	Low	Medium	High
Floor	10%	25%	100%	1 smear per each 50 m^2 of area surveyed (minimum of 30) and at areas of elevated activity.	1 smear per each 25 m^2 of area surveyed (minimum of 30) and at areas of elevated activity.	1 smear per each 4 m^2 of area surveyed (minimum of 30) and at areas of elevated activity.
Walls <2 meters	10%	25%	100%			
Walls >2 meters	<5%	10%	50%			
Ceilings	<5%	10%	50%			
Exterior walls <2 meters	5%	10%	50%			
Exterior walls >2 meters	<5%	5%	10%			
Roof	10%	25%	100%			

Upon completion of the URS, a review of the field measurement data is performed by Site Closure supervision and management to ensure all measurements prescribed in the survey design have been obtained and all data is below the criteria for unconditional release. The survey package is then forwarded to the RPM for approval. The RPM verifies the criteria for unconditional release has been met and may at this time designate certain restrictions on the building demolition as previously stated in the CVS section.

Completion of the URS releases a 'hold point' in the WP&IR. When all pre-demolition hold points in the WP&IR are satisfied, and when all requirements of procedure ENG-1.7-179 have been satisfied, control of the area or building is turned over to the demolition contractor.

To provide an extra measure of insurance that radioactive materials will not inadvertently be released from the HNP site, the following post-demolition controls are utilized:

- All trucks and/or containers must receive an aggregate microR survey prior to leaving site.
- All truck and/or containers must pass through a truck monitor prior to leaving site, even if the materials originated from an area outside the Industrial Area.
- Items or materials exhibiting licensed material is controlled as radioactive material or disposed of as low level radioactive waste.

POST DEMOLITION SURVEYS

Radiological Assessments

A radiological assessment may be performed in an excavated area after demolition activities have been completed and prior to backfill. The assessment is designed using protocols similar to

those used for FSS, i.e., use of the Data Quality Objective process defined in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) [8]. The radiological assessment covers all surfaces of the excavation including any soil, bedrock, water, and any remaining concrete foundations. The assessment may utilize several standard survey techniques such as scan surveys, fixed-point measurements, loose surface contamination measurements, and bulk material sampling. Core bores are usually collected in the bedrock and on any remaining concrete to appropriate depths. The use of an In-Situ Object Counting System (ISOCS) may also be used to create a spectroscopy profile over areas of the excavation.

The goal of the assessment is to verify that the as-left radiological conditions of the excavated area are below the FSS release criteria. A report is generated for each assessed area and an independent verification survey may be performed by regulators. Once the radiological conditions of the assessed area are determined to be below the FSS release criteria, the excavated area is released to the demolition contractor for backfill.

Final Status Surveys

Final status surveys are performed to satisfactorily demonstrate that the dose from residual radioactivity is less than the maximum annual dose criterion for license termination for unrestricted use specified in Title 10CFR20.1402 and support release of the site, or portions of the site, from the 10CFR50 license. The additional requirement of 10CFR20.1402 that residual radioactivity be reduced to levels that are As Low As Reasonably Achievable (ALARA) must also be satisfied. The release criteria used at the HNP is as follows:

- 25 mrem (.25 mS)/year TEDE (NRC - License Termination Plan)
- 19 mrem (.19 mS)/year TEDE (State of Connecticut)
- 10 mrem (.1 mS)/year TEDE (CYAPCO administrative limit)

The FSS is designed and implemented by the Site Closure Group in accordance with the HNP License Termination Plan, the FSS Quality Assurance Plan, as well as numerous procedures and technical support documents. Guidance for the FSS is also provided in the MARSSIM and NUREG-1757, Consolidated NMSS Decommissioning Guidance [9]. There are five major steps in the FSS process.

Survey Preparation: This step occurs after all remediation and decommissioning activities are completed for a specific area. A formal turnover and control process is utilized and area isolation and controls are established.

Survey Design: This step establishes the methods and criteria for conducting the survey. The MARSSIM Data Quality Objective process is used for survey design. The site is broken down into survey units which are then classified by the contamination potential (MARSSIM Class 1, 2 or 3). A survey package is prepared for each survey unit and it defines the percentage of scan coverage, the number of samples/measurements required, and the investigation levels.

Survey Data Collection: Data collection is performed in accordance with procedures and specific survey instructions. All FSS instrumentation is calibrated to NIST standards and performance checks are made prior to and after field use.

Survey Data Assessment: A nonparametric statistical analysis is performed on the survey data to verify the survey unit meets the unrestricted use criterion. Either the Sign Test or the Wilcoxon Rank Sum Test is used. Individual results are compared to the investigation levels. An investigation may require further remediation, reclassification and/or resurvey.

Documentation of Survey Results: A release record is prepared for each survey unit to provide a complete and unambiguous record of the radiological status of each survey unit, relative to the release criteria. A final report is then prepared to provide a summary of the survey results and overall conclusions which demonstrate the HNP site, or portions of the site, meets the radiological criteria for unrestricted use. Final reports are submitted to regulators in a phased approach. This allows regulators to review the FSS program and survey data in a timely fashion and if any problems are detected, they can be resolved early in the project rather than later.

WASTE CONTROLS

The amount of waste needing to be dispositioned at CY is approximately 342,000,000 pounds, made up of approximately 225,000,000 pounds of radioactive waste and 117,000,000 pounds of clean waste. This amount of waste includes an additional 30,000,000 pounds of contaminated soils that required remediation. This amount does not include large component removal, e.g., reactor vessel, steam generators, pressurizer, main turbine and generator. The project is approximately 63% complete. There are four major waste streams associated with the waste, clean, radioactive, Resource Conservation and Recovery Act (RCRA), and mixed. These waste streams can be further characterized into various degrees of each main waste stream category.

To get an idea of how much waste 342,000,000 pounds is, it will take approximately 9,217 tractor trailer truck loads of 37,000 pounds each to move the waste. If fifty (50) truck loads can be shipped each week it will take 184 weeks or over three and one half (3.5) years to ship the waste. It takes approximately 400 intermodal containers to maintain an operation of this size. At any given time approximately ten (10) percent or forty (40) of the intermodals will be out of service for some type of repair. There are at least two (2) forklifts equipped with scales to initially weigh the intermodals as they are filled with waste debris, two (2) tractors to move trailers to unload empty and load full intermodals and large portable cranes to move and load casks.

Several waste control issues arise on site from the beginning and carry forward to the end of the decommissioning project. A few of the issues are:

- Minimize waste shipments as much as possible. Can materials be reused on site, e.g., asphalt to make or upgrade roadways that will be part of the final site configuration.
- Where can the waste operation be established on site to handle the number of intermodals, empties, inspections, surveys of full containers, repairs, preparation and staging for shipping?

- Where can the demolition waste that is being generated be placed to minimize the number of times the waste is handled, preferably once from the demolition area into a container?
- Where is the background radiation low enough to perform surveys of the intermodal containers for receipt and prior to shipment?
- Where can casks be stored in preparation for packaging, surveying and shipping?
- Is the demolition plan sufficiently detailed to include the waste portions following the removal of high levels of fixed radiation and loose surface contaminated items?
- Are permits in place at the facility to allow the shipping of placarded materials between dusk and dawn?
- Is the security to the area where the tractor trailer truck movements need to take place to off load empty containers and load full containers efficient to prevent traffic jams for other site work being performed?

An enormous effort is required to characterize, stage, package, ship full containers, receive empty containers, repair damaged containers, ensure contracts are in place at the disposal sites, common truck carriers for clean waste, radioactive waste truck carriers, rail and/or water freight carriers.

Conducting surveys on waste containers efficiently to determine the ultimate disposition is a major challenge at HNP. Very low level waste, which can be sorted and segregated, can be disposed of less expensively than other more highly contaminated wastes that have to be shipped directly to a disposal site for disposal. Waste profiles should be established prior to or during building demolition as it is easier to segregate and stock pile the higher level waste during demolition.

A waste profile is developed in accordance with the requirements of the waste disposal sites. As containers are filled with the waste a In-Situ Object Counting System is used to create a spectroscopy profile of the waste within the container. A microR meter is then used to obtain a dose rate of the waste container. The spectroscopy profile and the microR dose rates are used to set dose rate limits on the waste containers that can be shipped for segregation and low level disposal. If the dose rate is above the established limit the waste is shipped directly to the disposal site for burial.

Many procedures have been developed to control and manage the waste being generated during the demolition and remediation processes. Each of the structures in the demolition contractor contract had an initial radiological and environmental classification for both demolition requirements and waste stream characterization. Prior to control of a structure or soil remediation area being turned over to the demolition contractor for demolition, any needed surveys, pre-work and exceptions are documented in a turnover certification package as required by ENG-1.7-179. With the waste stream determined, the WP&IR that is used for the demolition contains sufficient information for the construction field engineer (FE) to direct the packaging and labeling of the waste for processing, and shipping to the proper location for disposal or a "HOLD" point may be established in the WP&IR so additional waste stream characterization can be performed on materials that are not accessible until all or a portion of the demolition is completed.

It is extremely important to maintain control over the various types of waste. At HNP a condition report was generated to document that structure 255, an 18,000 gallon recirculation tank concrete slab and rebar debris that was identified in both the demolition contract and the associated turnover certification as potentially radioactive was removed from the site and transported to a clean waste landfill without receiving an URS. Where along the process of all the procedures and documents was the failure to insure that the proper surveys were performed to allow the waste to be packaged, labeled, processed and shipped to the appropriate waste disposal facility?

During the subsequent investigation by a Causal Investigation Team it was determined that the FE assigned to the project took vacation and turned over the project to another field engineer and sufficient information was not transferred regarding the needed URS survey. Additionally, the initial project job briefing and daily pre-job briefings did not cover details that would have revealed the need for a URS survey and the WP&IR did not provide enough information on the waste stream to direct a URS survey since the concrete slab being demolished was outside the RCA.

Immediate response was to notify the regulators, perform an assessment of the concrete and rebar debris using known survey information, a quality assurance surveillance was performed to assess the program and the use of "HOLD" points and signoffs in the field, and to check all ongoing WP&IR projects to ensure sufficient information was provided to the FE to prevent a recurrence.

The Causal Investigation Team recommended several courses of action that have been implemented to prevent recurrence of the event. The recommended actions included procedure revisions, requiring more detailed information regarding waste streams, more clearly defined management expectations for the signing of steps in a WP&IR including the meaning and use of "NOTIFICATION" and "HOLD" points. The pre-job briefing procedure checklist was revised to include discussions on the type of waste stream and upcoming critical job steps. General plant access training was revised to include more details on waste streams, what they are, and what they mean during the demolition and waste management control cycle. Supervisors were briefed and trained on management expectations in the administration of the WP&IR signing of steps and "NOTIFICATION" and "HOLD" points. Management is expected to perform spot checks of field work and the compliance with the signoff requirements of the WP&IR procedure. The Waste Management Organization was tasked to develop a method, independent of the work controls process, to verify the proper waste stream was used. A Shipment Inspection Plan was developed, which is a checklist used by waste management personnel for each intermodal. The checklist requires the inspecting waste management person to determine the types of material and appropriate waste stream, independent of the work controls process which was used to package the waste. There have been a few other occurrences which are to be expected in a waste control project of this magnitude.

CONCLUSION

During a demolition and bulk disposal decommissioning project, a formal program is needed to properly manage the potential health and environmental impacts of demolition so that there is no unacceptable impact to the public, environment, and site workers. Waste controls require procedural compliance coupled with independent verification to ensure proper waste processing

from packaging through disposal. The use of a graded approach, using the contamination verification surveys, unrestricted release surveys, remedial action surveys, radiological assessments, and independent waste controls has streamlined the "demolition and bulk disposal" decommissioning option. These programs have been developed and revised as needed to provide the economical, efficient, and safe decommissioning of the Connecticut Yankee Atomic Power Company Haddam Neck Plant while maintaining the highest levels of protection to the public and workers while restoring the property for beneficial re-use for the future.

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