

Nuclear Fuel Site Decommissioning and License Termination – 14378

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ABSTRACT

A former nuclear fuel manufacturing site has achieved license termination under the Nuclear Regulatory Commission. The site was constructed for nuclear fuel manufacturing in the mid-1950's and clean-up of the site including various legacy materials has been achieved. Ultimately the decommissioning and clean-up of this site involved numerous regulatory agencies, including Nuclear Regulatory Commission, Environmental Protection Agency, United States Army Corps of Engineers, and State of Connecticut, to work together in order to address the various concerns and establish mutually agreeable criteria. Remediation and decommissioning of this site took more than 15 years and was performed in phases in order to satisfy the various criteria that will allow this site to be beneficially reused. An overview of the phased decommissioning process, regulatory challenges encountered and solutions are presented.

INTRODUCTION and BACKGROUND

Activities at the Combustion Engineering (CE) Site commenced in 1955 when CE was contracted by the United States Atomic Energy Commission (USAEC) to engage in research, development, and manufacturing of nuclear fuel for the U.S. Navy. Contracts with the USAEC led to the construction of several buildings for the development, design, and fabrication of fuel element subassemblies for U.S. Navy submarines. USAEC contracts also included the construction, testing, and administration of the S1C submarine reactor training facility on the CE Windsor Site. USAEC manufacturing and research and development activities for naval nuclear fuel were terminated by 1961.

From the early 1960s to 2000, the Site was involved in the research, development, engineering, production, and servicing of nuclear and fossil fuel steam supply systems. These activities were performed under both commercial and federal contracts. Projects included nuclear and fossil research for commercial use, as well as large-scale boiler test facilities, and coal gasification. The historical processes at the Site generated both low-level radioactive waste, as well as Resource Conservation and Recovery Act (RCRA) hazardous chemical wastes and Toxic Substance Control Act (TSCA) materials.

Historically, there have been more than 30 buildings on the Site, about half of which were used for radiological related activities. All buildings and structures located on the Site have been demolished with the exception of four buildings remain in use on the Site by a tenant conducting fossil fuel R&D.

A timeline of the CE Windsor site history is presented in Figure 1. The entire property consists of approximately 612 acres and Figure 2 is an aerial photograph of the site when it was fully operational.

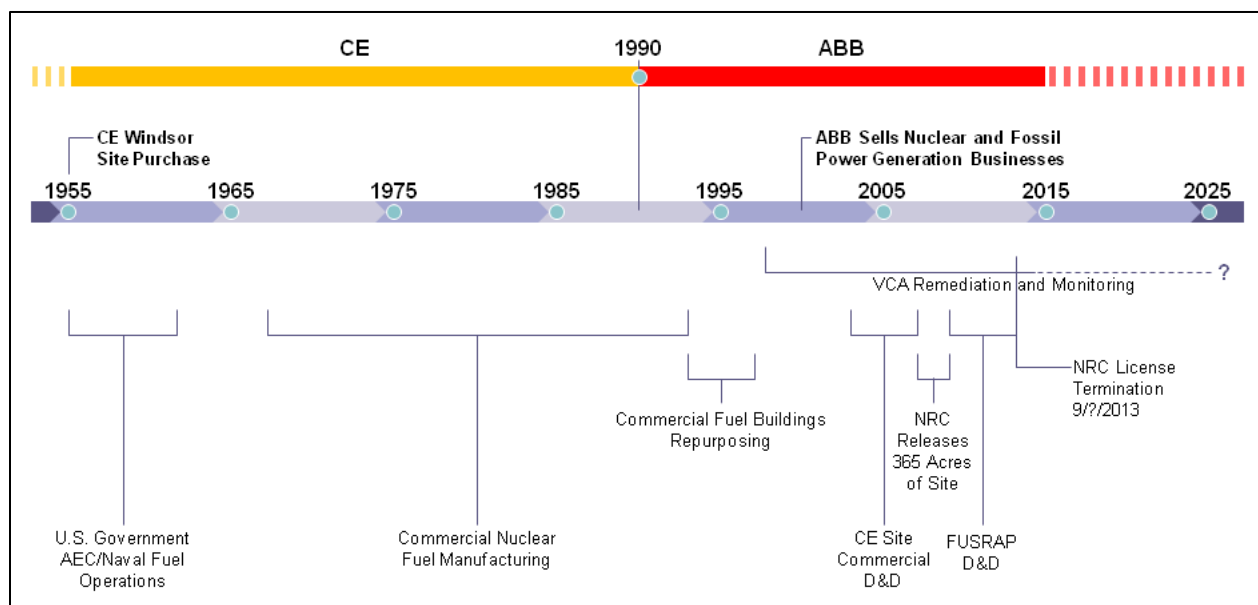


Figure 1 – CE Windsor Site Timeline



Figure 2 – CE Windsor Site Circa 1980's

REGULATORY FRAMEWORK AND COMPLIANCE HISTORY

The decommissioning objective for the site was to decommission the Site such that it met the criteria for unrestricted use in accordance with the requirements of the License Termination Rule at 10 CFR Part 20, Subpart E and to terminate the U.S. Nuclear Regulatory Commission (NRC) license for the site, and meet the state of Connecticut radiological remediation standards. This process has taken many years of investigation, evaluation, planning, regulatory approvals, remediation and final status surveys (FSS) in order to achieve this final goal of beneficial reuse of the property.

The overall chemical cleanup goal for the Site was to meet the state of Connecticut Department of Energy and Environmental Protection (CTDEEP) Remediation Standard Regulations (RSRs) residential remediation standards. Chemical-related remediation was conducted under the Connecticut Property Transfer Act and the Site's RCRA Stewardship Permit, with regulatory oversight by the Site Licensed Environmental Professional (LEP), DEEP, and United States Environmental Protection Agency (USEPA).

The site was remediated under several regulating authorities:

NRC - The NRC was the lead agency for radiological and many times was the interface with other regulatory agencies. The major approvals associated with decommissioning required agreement from the other associated regulators.

USEPA - In 1997, the Site entered into an agreement with the USEPA to perform a RCRA Voluntary Corrective Action (VCA) at the CE Windsor Site. In addition to the requirements of the RCRA VCA Program, the Site is also regulated by the DEEP under the Property Transfer Act (Connecticut General Statutes [CGS] Sections 22a-134 through 22a-134e) and must comply with the DEEP RSRs (CGS Section 22a-133k). While the EPA was primarily involved for chemical concerns, there also is a memorandum of understanding between the EPA and NRC. Several memorandums and evaluations were needed to address the agreed upon process/standards between these agencies.

DEEP - The State of Connecticut was involved in the entire process, both chemically and radiologically. The proposed process or approach was discussed with them and their input was utilized. This was particularly true for risk assessment/remediation criteria, and regulatory submittals to other agencies. Under Connecticut law, DEEP may authorized an independent Licensed Environmental Professional (LEP) to verify the environmental remediation of the Site in place of direct DEP oversight. In January 2002, DEEP notified the Site that a LEP could oversee the Site cleanup with the exception of radiological issues. The DEEP Radiation Division would continue to provide oversight and approval of all radiological issues.

In September 2009, the DEEP issued a RCRA Stewardship Permit (DEP/HWM/CS-164-007) for the CE Windsor Site. The Stewardship Permit regulated and authorized the Site to complete RCRA closure and post-closure activities and perform environmental investigation and remediation at the Site.

FUSRAP - In 1994, the USDOE assumed responsibility under the Formerly Utilized Sites Remedial Action Program (FUSRAP) for the cleanup of residual radiological contamination in areas of the Site resulting from government contracted activities. DOE started some preliminary investigative activities at the site, but in 1997, the U.S. Congress assigned FUSRAP remedial responsibilities to the United States Army Corps of Engineers (USACE). Characterization, remediation, and closure of these areas were to be conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). As a result of an agreement reached between the USACE and USNRC in August 2007, CE was allowed to conduct remediation of residual nuclear waste material under USNRC license at the remaining co-mingled commercial and FUSRAP radiological areas at the Site. The NRC accepted this approach which allowed CE to supplement the existing DP, decommission the remainder of the Site pursuant to NRC regulations and complete license termination.

Permits – Additional State and local permits were needed for many remediation activities and the most challenging were those associated the remediation of the brook where a 401 Water Quality permit was obtained from the DEEP and a wetlands 404 permit was obtained from the US Army Corps of Engineers. Many of the permits required both the chemical and radiological data for assessment of the activities and potential impacts.

Endangered/Protected Species - The United States Fish and Wildlife Service (USFWS) indicated that the dwarf wedge mussel (*Alasmodonta heterodon*) has been identified in the Farmington River upstream of the Site. In addition, DEEP indicated that the Eastern box turtle and hog nose snake occur in the vicinity of project area. DEEP identified them as “species of concern” to be protected during the project work, and it required literally miles of fencing to be installed to keep them out of work areas and hundreds of hours of biologists’ time to search for and relocate these animals when found.

Nuclear Criticality Safety - While the decommissioning activities followed conventional radiation protection practices and procedures, the residual enriched uranium required additional safety measures. These additional measures required specialized reviews and evaluations to ensure safety in all activities. Furthermore, these changed the approach to some of the remediation and waste handling activities.

Independent Verification - After radiological remediation, verification was conducted by FSS. Regulatory agencies performed independent verification either by themselves or through a contractor (Oak Ridge Associated Universities). The established process was to have DEEP perform verification as soon as possible after FSS since they were local. NRC reviewed the FSS process and performed their own independent verification several times during FSS. In addition, Oak Ridge Associated Universities performed a comprehensive independent verification of large portions of the site as available. Quite often the NRC and DEEP would jointly perform independent verification.



Figure 3 - NRC and CT DEEP Oversight and Verification

SUMMARY OF REMEDIATION ACTIVITIES

Remediation of the CE Windsor Site generally falls into three major categories:

- Radiological Remediation (Commercial D&D and FUSRAP D&D)
- Chemical Remediation
- West Campus Demolition

Commercial D&D

Residual radiological contamination resulting from historical nuclear operations associated with commercial contracts was identified in 4 building complexes. D&D of these buildings, along with removal of underground utilities and any radiologically-contaminated soil, were completed between 2001 and 2005 in accordance with the Site's Decommissioning Plan. Deep basements and foundations at depths greater than four feet were surveyed for radiological contamination, cleaned where necessary, and left in place. Completion of the commercial D&D activities is

documented in Final Status Survey Reports submitted to the USNRC and DEEP in 2005 and 2006.

FUSRAP D&D

Residual radiological contamination resulting from historical nuclear operations associated with government contracts was identified in 8 areas. D&D of Buildings 3 and 6, removal of the Industrial Waste Lines and other underground utilities, removal of contaminated soil from various areas, and removal of sediment from Site Brook were completed in accordance with the Site's Decommissioning Plan and Remedial Designs for various aspects of the FUSRAP D&D Program. Deep basements and foundations at depths greater than four feet were surveyed for radiological contamination, cleaned where necessary, and left in place. Areas of chemically-contaminated soil that were co-located with radiologically-contaminated materials were removed in conjunction with the radiological remediation efforts.

FUSRAP D&D activities were completed between 2009 and 2011, and were documented in various Final Status Survey Reports submitted to the USNRC and DEEP between July 2011 and May 2012. Remediation of the chemically-contaminated soil co-located with the radiologically-contaminated materials was addressed concurrently with the FUSRAP D&D and remediation efforts.

After Commercial and FUSRAP D&D work was completed, groundwater monitoring was conducted downgradient of each area where soil remediation was necessary to document compliance with remediation criteria (e.g., radiological MCLs and DEEP RSR criteria for radiological contaminants in groundwater) and to evaluate the effectiveness of the remedy (i.e., post-remediation monitoring). There were no locations at the Site where groundwater exceeds the radiological MCLs (drinking water standards), and no radiological groundwater remediation was needed at the Site.

Chemical Remediation

RCRA-related remediation activities to address chemical contamination fall into two categories: Interim Corrective Measures (ICMs) and Remedial Actions. Prior to the issuance of the RCRA Stewardship Permit in September 2009, ICMs (primarily soil remediation) were conducted under the RCRA Corrective Action Program with USEPA oversight. After the RCRA Stewardship was issued, cleanup activities are overseen by DEEP (and were termed "Remedial Actions" instead of ICMs).

To move the cleanup process forward, numerous ICMs were completed between 1998 and 2008 to address chemical-related soil contamination associated with AOCs 2, 3, 5, 6, 8, 10, 15, 16, 17, 18, 21, 22, 24, and 27. As areas of contamination were discovered that were readily addressed through soil remediation, the Site proceeded with cleanup with those areas. The result of the ICMs was to complete soil remediation in all areas of the site by 2008 with the exception of areas that were impacted by FUSRAP materials, or areas where soils were not accessible due to the location adjacent to or beneath buildings.

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Remedial Actions were completed between 2009 and 2011 to address chemical-related soil contamination associated with the FUSRAP Area related AOCs: 1, 4, 7, 9, 10, 11, 12, 13, 21, and 27.

While almost all of the soil contamination at the Site has been addressed, there are two isolated areas of remaining soil contamination (AOC 9 and AOC 10). The soil contamination at AOC 9 is a localized area of polychlorinated biphenyl (PCB) impacts beneath an active electrical transformer adjacent to the Building 3 High Bay. This soil could not be remediated until the transformer is removed from service. Soil contamination at AOC 10 is beneath the water table and is being remediated in conjunction with the groundwater at AOC 10.

Remedial Action Plans (RAPs) were prepared to address remediation of residual chlorinated solvents in groundwater associated with AOC 6, 10 and 18, and groundwater remediation is currently underway at the site.

West Campus Demolition

The West Campus Demolition Project was completed between March 2010 and May 2012, and consisted of demolition and removal of numerous buildings and structures. Most building foundations were completely removed. However, sections of Building 7, Building 12, and the Cooling Towers foundations greater than four feet below ground surface were left in place. Service utilities within the footprints of the demolished buildings were removed. Utilities outside the building footprints were abandoned in-place. Storm drainage sewer lines, structures, and swales were left in place for continued storm water management at the Site.

Asbestos-containing materials (ACM) and polychlorinated biphenyl (PCB)-containing materials were identified at various locations within the buildings during pre-demolition inspection surveys. These and other waste materials encountered during the demolition project were removed and transported off-site to appropriate licensed disposal facilities.

REGULATORY APPROVALS AND RELEASES, AND ENVIRONMENTAL STATUS

While many of the regulatory requirements can be addressed by a single agency, this was not typical for addressing a large complex site with comingled chemical and radiological contaminants. It became standard practice to discuss and review all planned activities and approach with the primary regulatory agencies and resolve differences prior to submitting formal documents. This approach reduced the number of follow-up questions but also kept them involved as a stakeholder in the decommissioning process. While this is not a requirement, it provides value and efficiency during the long-term course of decommissioning.

As remediation of the Site neared completion, CE decided that portions of the property should be made ready for productive reuse by obtaining regulatory approvals for the portions of the property where remediation was complete. Because of the several regulatory agencies involved, and the various laws and rules regulating the project cleanup activities, navigating the many regulatory requirements was one of the biggest challenges of the project.

Commercial D&D

Residual radiological contamination resulting from historical nuclear operations associated with commercial contracts was successfully remediated and was documented in Final Status Survey Reports submitted to the USNRC and DEEP in 2005 and 2006. After completion of the Commercial D&D work, the Site applied for, and the USNRC approved release of 365 acres of the Site from the USNRC license for unrestricted use on January 20, 2009, which documented that the area was cleared of any radiological impacts and had been accepted by the USNRC and DEEP. As a result of this release, the USNRC licensed area was decreased to the interior portion of the Site totaling approximately 246 acres.

FUSRAP D&D

Residual radiological contamination resulting from historical nuclear operations associated with government contracts was successfully remediated and is documented in Final Status Survey Reports submitted to the USNRC and DEEP between July 2011 and May 2012. The Site applied for, and the USNRC approved termination of the USNRC license for unrestricted use on September 9, 2013. The Site no longer has any radiological encumbrances anywhere on the property.

One remaining task is related to the FUSRAP remediation that will be ongoing for several years. In order to remediate the Site brook, a US Army Corps of Engineers wetlands permit (404 Permit) was required to work in and around the brook. Under the 404 Permit, monitoring of the wetlands restoration was required for 10 years, is on-going.

Chemical Remediation

ICMs and remedial actions have been successfully completed at all areas of the Site where soils exceeded cleanup criteria with two exceptions: a localized area of saturated zone soil contamination at AOC 10, which is being addressed as part of the groundwater remediation approach specified in the Remedial Action Plan for AOC 10 Groundwater Remediation; and a small area of PCB-contaminated soil beneath an electrical transformer adjacent to which could not be safely accessed until the transformer is removed from service. Groundwater remediation is on-going for three localized areas of the Site.

The Site Licensed Environmental Professional (LEP) “Verified” (certified that remediation activities were completed and that the site met the CT DEEP cleanup standards in the RSRs) the outer portion of the site in September 2009, and the DEEP issued a RCRA Stewardship Permit for the 292-acre interior portion of the Windsor Site on September 29, 2009. In conjunction with the Stewardship Permit, the DEEP issued a Certificate of Completion for the approximately 319-acre outer portion of the Site, which released this portion of the Site for unrestricted use in accordance with the state of Connecticut residential remediation standards as stated in the RSRs (see Figure 1-1). The LEP Verification combined with the DEEP Certificate of Completion provided the documentation that the outer portion of the Site was now free of chemical contamination, and

along with the NRC release of portions of the Site in January 2009, allowed planning for redevelopment to proceed.

In keeping with the goal of allowing portions of the property to be readied for redevelopment, a Second Portion of an Establishment Verification was submitted to the DEEP in April 2012, documenting completion of remediation of remaining areas of the Site with the exception of the 73 acres where post remediation groundwater monitoring and/or groundwater remediation was occurring. A modification to the Stewardship Permit is in process which will make result in about 90% of the property being available for redevelopment.

West Campus Demolition

Dismantlement and removal of buildings, structures, and utilities associated with the West Campus Demolition Project, along with removal of any chemically-contaminated soil encountered at concentrations above applicable DEEP RSR Criteria were completed in accordance with the West Campus Demolition Remedial Design.

CONCLUSIONS

Numerous challenges were encountered during the 12 plus years as the site was remediated and decommissioned. These included multiple regulators, changing regulations, nuclear safety, species of concern, groundwater, permits, risk assessment and establishing remediation criteria, FSS and verification in order to achieve license termination for unrestricted use of the site. Most of these regulatory agreements and MOUs took time in order to provide the information for a detailed review and assessment by the regulators. Although this approach did slow down the process at the beginning, it allowed the decommissioning process to move forward in phases with greater confidence that release would not be jeopardized at the last minute. While not always possible to determine the potential regulatory issues at the beginning, it is well worth the extra time spent working through and resolving with the regulators. There were numerous times throughout the decommissioning process that these evaluations and MOUs were utilized to establish benchmarks or allow other evaluations to be performed more quickly. Overall the process and approach working with the various regulators was a huge success for all stakeholders and allowed a large complex site to complete decommissioning and license termination in a timely manner. This approach lead to a successful decommissioning that is a testament to everyone involved.

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