

**RCRA Closure at the Connecticut Yankee Atomic Power Company
Haddam Neck Plant - 15655**

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ABSTRACT

From 1968 through 1996 Connecticut Yankee Atomic Power Company (CYAPCO) operated the Haddam Neck Plant (HNP) at 362 Injun Hollow Road, East Hampton, Connecticut. In 1980 CYAPCO applied to be a permitted generator and storage facility for hazardous waste and was issued a Resource Conservation and Recovery Act (RCRA) Part A Treatment, Storage, and Disposal Facility Permit.

During the operational period, the HNP produced more than 110 billion kilowatt-hours of energy. In 1996, CYAPCO decided to close and decommission the HNP. Decommissioning activities began in 1998 and were successfully completed in 2007 in accordance with Nuclear Regulatory Commission (NRC) regulations and the CYAPCO License Termination Plan.

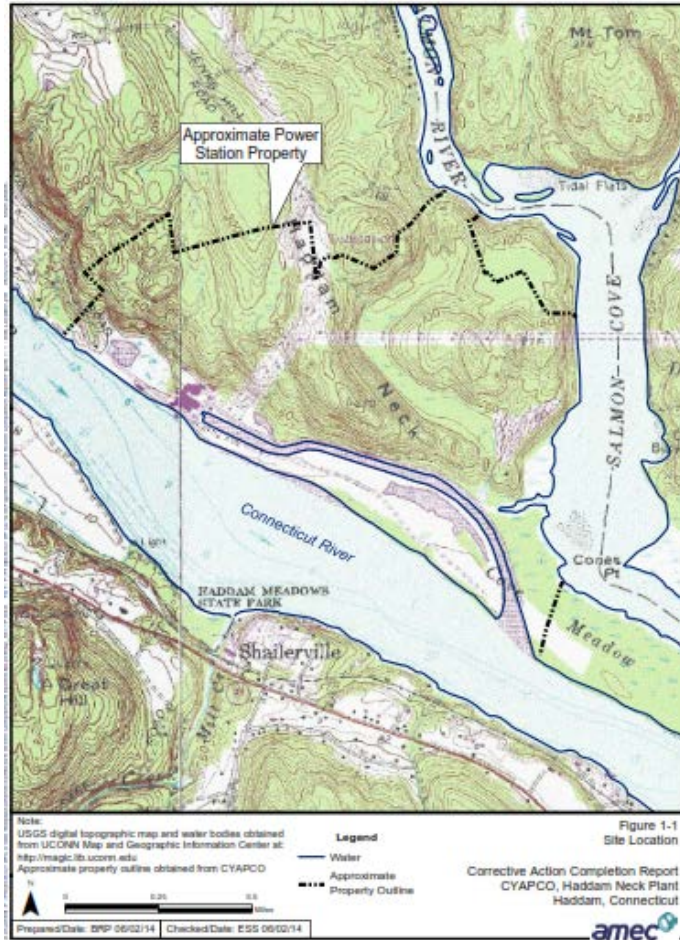
As part of the closure process for the HNP, closure of the RCRA permit under the RCRA Corrective Action Program (CAP) was required. From 2002 through 2007, under the RCRA CAP, CYAPCO completed investigations and remediation work to address environmental impacts resulting from chemical usage at the HNP. The RCRA CAP was conducted under the regulatory authority of the United States Environmental Protection Agency (USEPA) and the Connecticut Department of Energy and Environmental Protection (CTDEEP). In the fall of 2014, the RCRA closure process was completed, and CYAPCO, with concurrence from USEPA, was issued a Letter of Completion from the CTDEEP signifying completion of the RCRA closure process.

The paper discusses the RCRA closure process completed at the HNP, including the investigation, remediation, groundwater monitoring, and closure activities completed to achieve closure of the HNP under the RCRA requirements.

INTRODUCTION

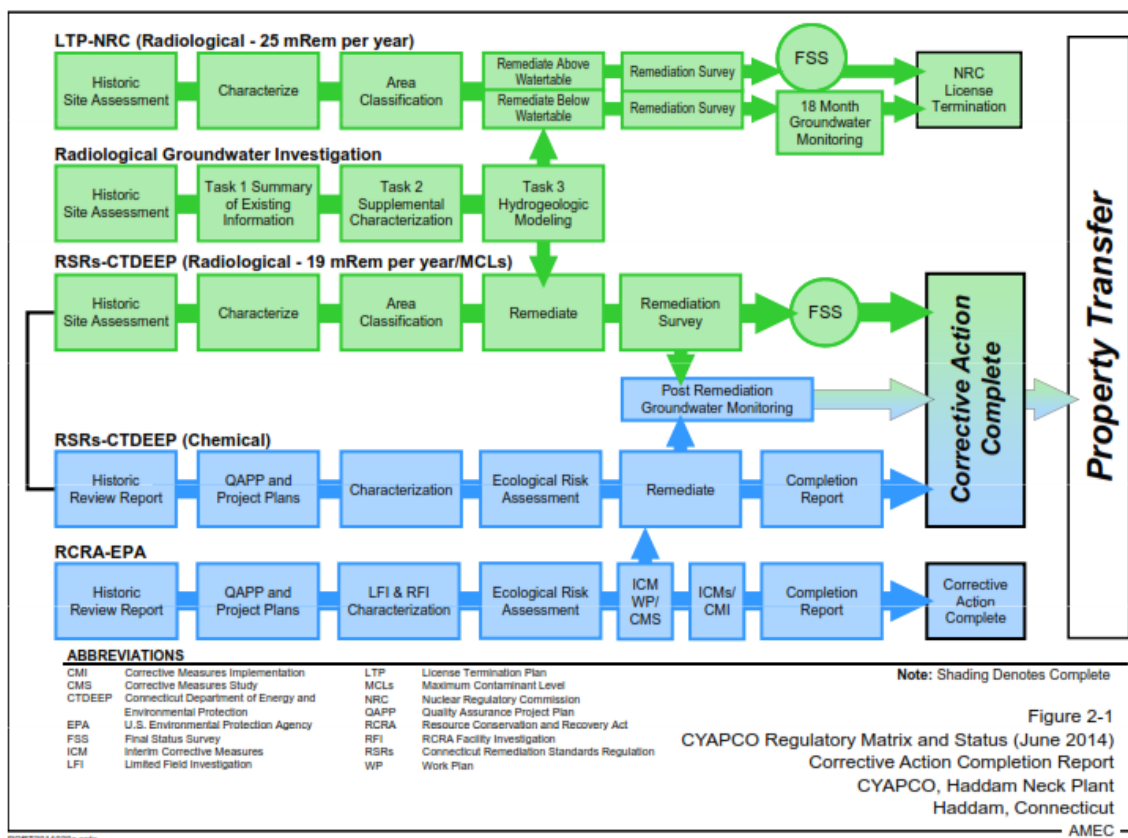
The Connecticut Yankee Atomic Power Company (CYAPCO) is located at 362 Injun Hollow Road in the Town of Haddam, Middlesex County, Connecticut (The Site). The Site is approximately 210 hectares (525 acres) of mostly wooded land bordered on the west by the Connecticut River (Figure 1). Approximately 10 hectares (25 acres) of the property was developed as an industrial area to house the Connecticut Yankee nuclear power plant. Approximately 2 hectares (5 acres) of the site encompasses the Independent Spent Fuel Storage Installation (ISFSI).

The Connecticut Yankee nuclear power plant, a 619 megawatt pressurized water reactor, operated at the Site from 1968-1996. The plant produced more than 110 billion kilowatt-hours during its operation. The plant was permanently shut down in 1996, and decommissioning of the plant began in 1998.



**FIGURE 1
SITE LOCATION MAP**

The regulatory closure processes and pathways followed for closure of the Site are shown on Figure 2. Decommissioning of the plant was successfully completed in 2007 in accordance with NRC regulations and the CYAPCO License Termination Plan [1], which reduced the land under the NRC license to the approximately 2 hectares (5 acres) ISFSI. In 2014, closure of the chemical remediation program was completed in accordance with the USEPA and CTDEEP RCRA closure requirements.



**FIGURE 2
CLOSURE PROCESSES AND PATHWAYS**

RCRA PERMIT AND RCRA CLOSURE REQUIREMENTS

On November 18, 1980, CYAPCO applied to be a permitted generator and storage facility for hazardous waste and issued a Resource Conservation and Recovery Act (RCRA) Part A Treatment, Storage, and Disposal Facility Permit No. CTD042306720. The RCRA permit brought CYAPCO into the RCRA Corrective Action Program (CAP) as part of closure process. From 2002 through 2007, under the RCRA CAP, CYAPCO completed investigations and remediation work to address environmental impacts resulting from chemical usage at the HNP.

The RCRA CAP was conducted under the regulatory authority of the United States Environmental Protection Agency (USEPA) and the Connecticut Department of Energy and Environmental Protection (CTDEEP). USEPA delegated RCRA Authority to CTDEEP with the understanding that the clean-up goals, the Connecticut Remediation Standard Regulations (RSRs), are protective of human health and the environment and are the appropriate clean up criteria for RCRA sites in Connecticut.

The RCRA closure requirements for the Site required that a complete site characterization be conducted to develop an understanding of the environmental conditions of the Site and the distribution of contaminants in the environment. The site characterization followed the conceptual site modeling process

to evaluate existing information, guide investigations, and evaluate new data to formulate a Conceptual Site Model (CSM). Once the site was characterized, closure under RCRA required that the clean-up goals outlined in the RSRs, soil and groundwater standards, be met.

CONCEPTUAL SITE MODEL

Applying the CSM approach to characterize a site uses an iterative process to compile known site history and couple it with an interpretation of available site-specific and regional data to form a picture of a site to address the following questions:

- What activities have been conducted at the Site?
- How releases have or may have occurred?
- What contaminants have or may have been released?
- What is the fate and transport of contaminants in the environment?
- What are the impacts that contaminants have or may have on human health and the environment?

The CSM approach relies on developing an understanding of the entire site picture. This includes identifying and evaluating:

- Physical site features;
- Geology;
- Hydrogeology;
- Source areas and contaminants; and
- Contaminant fate and transport.

A CSM needs to address the physical site setting, historical operations, potential migration pathways, potential receptors, and extent of impacted media. Because each site is unique, each site has a unique CSM.

RCRA SITE CHARACTERIZATION

Following the CSM approach, characterization activities at the Site were conducted in a phased approach and the CSM was refined throughout the process.

The first characterization phase included a Historical Records Review (HRR) [2]. The HRR included the collection, evaluation, and documentation of existing information regarding the Site and its surroundings. Activities conducted to support completion of the HRR included:

- Reviewing regional geology and hydrogeology.
- Reviewing existing files and documents.
- Interviewing current and past employees.
- Reviewing historic and current operations.
- Reviewing regulatory files (FOIA).
- Reviewing aerial photographs and historic maps.

The HRR documented historic and current operations and identifies areas of known and/or potential releases of site related material to the environment; such as leaking tanks, or underground utilities and identified 21 areas of concern (AOCs), including numerous potential contaminant sources (PCSs)

where chemicals were potentially released and/or historical practices may have impacted environmental conditions.

Following the HRR the second phase of characterization, the Limited Field Investigation (LFI), was conducted. LFI included the collection of environmental data including the installation of soil borings and groundwater monitoring wells, the collection and analysis of soil, groundwater, surface water, and sediment samples, and geophysical surveys to collect data to assess the potential releases of chemical constituents to environmental media at the Site. Data collected during this phase was used to characterize environmental conditions, develop a preliminary CSM, and identify data gaps for planning the RCRA Facility Investigation and risk evaluations. The LFI field activities were completed in 2003 and documented in the LFI Report and RCRA Facility Investigation (RFI) Work Plan submitted in 2004 [3]. Based on the findings of the LFI, additional characterization and Interim Corrective Measures (ICMs) were warranted for several AOCs.

Phase three of the characterization included completion of the RFI. The RFI program was designed to fill data gaps from the LFI and focused on providing a comprehensive characterization of the Site to refine the CSM. Similar to the LFI, the RFI included the collection of environmental data using site investigation and sampling techniques to refine and define the assessment of the releases of chemical constituents to environmental media at the Site. The RFI activities were completed in the fall of 2006 and the USEPA approved the RFI Report in December 2006. The RFI Report was revised based on comments from the CTDEEP and the Final RFI Report [4] was submitted to the USEPA and CTDEEP in January 2007. The CTDEEP approved the Final RFI Report in March 2007.

Highlights of the RCRA characterization program included:

- Over 110 groundwater monitoring wells were installed to support the investigation of groundwater.
- Impacts to the environment from chemicals were generally located within the industrialized portion of the Site.
- During radiological decontamination and demolition (D&D) activities, and more specifically during the soil and groundwater remediation conducted within the Radiologically Controlled Area (RCA), areas requiring remediation were excavated and replaced with clean fill.
- During radiological D&D, portions of the Site were dewatered to access and remediate radiologically impacted soil and fractured bedrock below the natural water table.
- Under the RCRA, groundwater did not require active remediation.

RCRA CORRECTIVE MEASURES

The primary constituents of concern (COCs) identified during the characterization process were polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), extractable total petroleum hydrocarbons (ETPH), and metals (i.e., arsenic, chromium, copper, lead, and zinc), which were detected in some shallow soils and sediments at the Site. Corrective measures and remedial actions at the Site were completed to address the COCs and achieve unrestricted future use.

The corrective measures and remedial actions that were necessary to obtain site closure under RCRA were completed between February 2004 and May 2007. The corrective measures and remedial actions included:

- Interim Corrective Measures (ICMs) to address chemical soil contamination completed at 16 AOCs;
- Closure of four (4) RCRA Container Storage Areas; and

- Closure of Underground Storage Tanks at two (2) AOCs.

Depending on the chemical COCs identified at any given remediation area, along with whether the chemical COCs were commingled with radiological constituents, the excavated soil and sediment was shipped to the appropriate off-site for disposal. Restoration of the excavation areas generally consisted of re-grading the area and/or backfilling with clean fill from an off-site borrow source.

POST REMEDIATION GROUNDWATER MONITORING

Section 22a-133k-3(g) of the CTDEEP RSRs provide specific requirements for groundwater compliance demonstration to be conducted following remediation of a release area or contaminated groundwater plume. The groundwater monitoring program at the Site was conducted under the Groundwater Monitoring Plan for Compliance with the CTDEEP RSRs [5]. The Groundwater Monitoring Plan defined the requirements to demonstrate that chemical and radiological constituents complied with the CTDEEP RSRs and other CTDEEP approved numeric criteria, and was conducted to:

- (1) Assess the remedial activities completed;
- (2) Document groundwater compliance with remediation criteria (e.g., RSRs); and
- (3) Document the effectiveness of the remediation (i.e., post-remediation groundwater monitoring).

The groundwater monitoring program began in 2007 and was completed in 2013 and included a total of 62 sampling locations collected from 59 wells. Sampling results were compared to the CTDEEP RSRs to evaluate compliance. All wells in the monitoring program demonstrated compliance with the requirements of the Groundwater Monitoring Plan. In August 2013, CYAPCO submitted the Groundwater Report for Compliance with CTDEEP RSRs Monitoring Plan Closure [6] to document compliance with the Groundwater Monitoring Plan and closure of the monitoring program. In the spring of 2014, all remaining monitoring wells at the Site were decommissioned.

CTDEEP STEWARDSHIP PERMIT

In 2007 CTDEEP in consultation with USEPA terminated the sites interim status under RCRA and issued a Stewardship Permit for the Site. The Stewardship Permit program is administered by the CTDEEP Remediation Division of the Bureau of Water Protection and Land Reuse and regulates the site-wide environmental investigation and cleanup ("closure and corrective action") and performance of long-term stewardship activities. There are six types of Stewardship Permits:

1. Closure and Corrective Action
2. Corrective Action
3. Long-term Obligations
4. RCRA Hazardous Waste Land Disposal Facility
5. Solid Waste Land Disposal Facility
6. Corrective Action Management Unit ("CAMU")

CYACPO was issued a Long-term Obligation type permit, Permit No. DEP/HWM/CS-061-02. The Stewardship Permit documented that all environmental investigation and remediation activities had been completed, and that the only remaining requirement to obtain site closure was the completion of the groundwater monitoring program.

With the completion of the groundwater monitoring program in 2013, the requirements of the Stewardship Permit were fulfilled and CYPACO began the process of terminating the permit. On July 9, 2014 CYAPCO submitted a Petition for Termination of the Stewardship Permit to the CTDEEP [7].

CTDEEP issued a Notice of Tentative Determination to terminate the Stewardship Permit on July 17, 2014 [8], and a public notice was published and broadcast on July 18, 2014. The public comment period ran from July 18, 2014 through September 2, 2014. A Public Information Session and Public Hearing were held on August 25, 2014. On September 19, 2014, CTDEEP issued the Letter of Completion and Final Determination to Terminate the Stewardship Permit [9]. This was the final step in the RCRA Site Closure process.

CONCLUSIONS

CYAPCO operated the Connecticut Yankee nuclear power plant, a 619 megawatt pressurized water reactor, from 1968-1996 at 362 Injun Hollow Road in the Town of Haddam, Middlesex County, Connecticut. The plant produced more than 110 billion kilowatt-hours during its operation, and was permanently shut down in 1996. Decommissioning of the plant began in 1998 and was successfully completed in 2007 in accordance with NRC regulations and the CYAPCO License Termination Plan.

The RCRA CAP was conducted under the regulatory authority of the USEPA and the CTDEEP to close the Site under RCRA. From 2002 through 2007, CYAPCO completed investigations and remediation work to address environmental impacts resulting from chemical usage at the HNP.

In 2007 CTDEEP in consultation with USEPA terminated the Site's interim status under RCRA and issued a Stewardship Permit for the Site. The Stewardship Permit documented that all environmental investigation and remediation activities had been completed, and that the only remaining requirement to obtain site closure was the completion of the groundwater monitoring program.

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REFERENCES

- [1] "Haddam Neck Plant License Termination Plan (Through Revision 1A)", Connecticut Yankee Atomic Power Company October, 2002.
- [2] "Historical Review Report"; RCRA Corrective Action Program; Connecticut Yankee Atomic Power Company; Haddam Neck Plant; Haddam, Connecticut; March, 2003.
- [3] "Draft LFI Report and RFI Work Plan"; RCRA Corrective Action Program; Connecticut Yankee Atomic Power Company; Haddam Neck Plant; Haddam, Connecticut; March, 2004.
- [4] "RFI Report"; RCRA Corrective Action Program; Connecticut Yankee Atomic Power Company; Haddam Neck Plant; Haddam, Connecticut; January, 2007.
- [5] "Groundwater Monitoring Plan for Compliance with CTDEEP RSRs", RCRA Corrective Action Program; Connecticut Yankee Atomic Power Company; Haddam Neck Plant; Haddam
- [6] "Groundwater Report for Compliance with CTDEEP RSRs Monitoring Plan Closure", RCRA Corrective Action Program; Connecticut Yankee Atomic Power Company; Haddam Neck Plant; Haddam, Connecticut; August, 2013.
- [7] "Petition for Termination of Stewardship Permit", Connecticut Yankee Atomic Power Company, July, 2014.

[8] “Notice of Tentative Determination”, Connecticut Department of Energy and Environmental Protection, Former Connecticut Yankee Atomic Power Plant, 362 Injun Hollow Road, East Hampton, Connecticut; July, 2014.

[9] “Letter of Completion and Final Determination to Terminate Stewardship Permit”, Connecticut Department of Energy and Environmental Protection Connecticut Yankee Atomic Power Plant, 362 Injun Hollow Road, East Hampton, Connecticut; July, 2014.