CONNECTICUT YANKEE ATOMIC POWER COMPANY

HADDAM NECK PLANT
362 INJUN HOLLOW ROAD • EAST HAMPTON, CT 06424-3099

August 22, 2001
Docket No. 50-213
CY-01-132

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Haddam Neck Plant
Historical Site Assessment Supplement in Support of the License Termination Plan
(TAC NO. MA9791)

This letter forwards Connecticut Yankee Atomic Power Company's (CYAPCO's) Historical Site Assessment Supplement (HSAS) in support of the Haddam Neck Plant's License Termination Plan. This supplements the original Haddam Neck Plant Characterization Report dated February 2000, submitted to the US Nuclear Regulatory Commission (NRC) in November 2000[1].

In the CYAPCO response[2] to the NRC's request for additional information (RAI)[3], a number of the responses relied on the submittal of this HSAS. Specifically, the responses to Questions 6, 7, 8, 17, 19, 20, 21, 25, 29, and 77 relied on the HSAS in whole or in part. This submittal is intended to complete the response to these questions, as well as to supply supporting information for other responses to the RAI.

CYAPCO is available to discuss this HSAS with the NRC Staff at your earliest convenience. Please let us know if you would like to meet with us to discuss the enclosed document. If you should have any questions, please call Gerry van Noordennen, at (860) 267-3938.

Sincerely,

G. P. van Noordennen for

Noah Fetherston
Site Manager

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1. CYAPCO letter CY-00-167, "Submittal of Characterization Report," dated November 8, 2000.
2. CYAPCO letter CY-01-047, "Response to the Request for Additional Information Regarding The Haddam Neck Plant License Termination Plan (TAC NO. MA9791)," dated June 14, 2001.
3. NRC letter "Haddam Neck Plant – Request for Additional Information Regarding The License Termination Plan (TAC NO. MA9791)," dated March 19, 2001.

A001

Enclosure: Haddam Neck Plant Supplemental Historical Site Assessment

cc: H. L. Miller, NRC Region I Administrator
J. E. Donoghue, NRC Senior Project Manager, Haddam Neck Plant
R. R. Bellamy, Chief, Decommissioning and Laboratory Branch, NRC Region I
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BECHTEL HEALTH PHYSICS
TECHNICAL SUPPORT DOCUMENT

DOCUMENT No.
24265-000-G65-GEHH-P00067-000

Connecticut Yankee Decommissioning

Health Physics Department Technical Support Document

HP Number: BCY-HP-0067 Revision #: 0

Subject: Historical Site Assessment Supplement

Date: 8/14/2001

Performed By: [signature] Date: 8/17/01

Reviewed By: [signature] Date: 8/20/01

Approved By: [signature] Date: 8/20/01

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Approved By: ____________ Date: 8/20/01

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Connecticut Yankee Atomic Power Company
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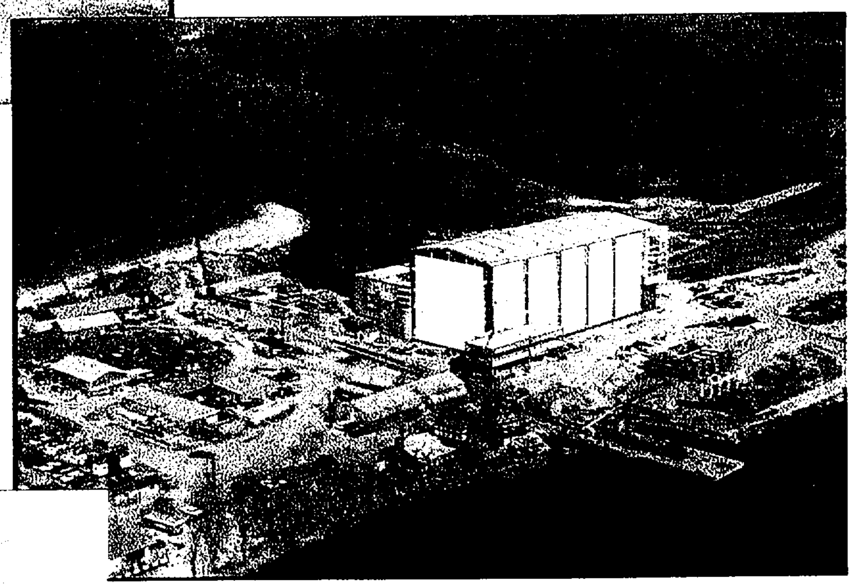
HISTORICAL SITE ASSESSMENT SUPPLEMENT



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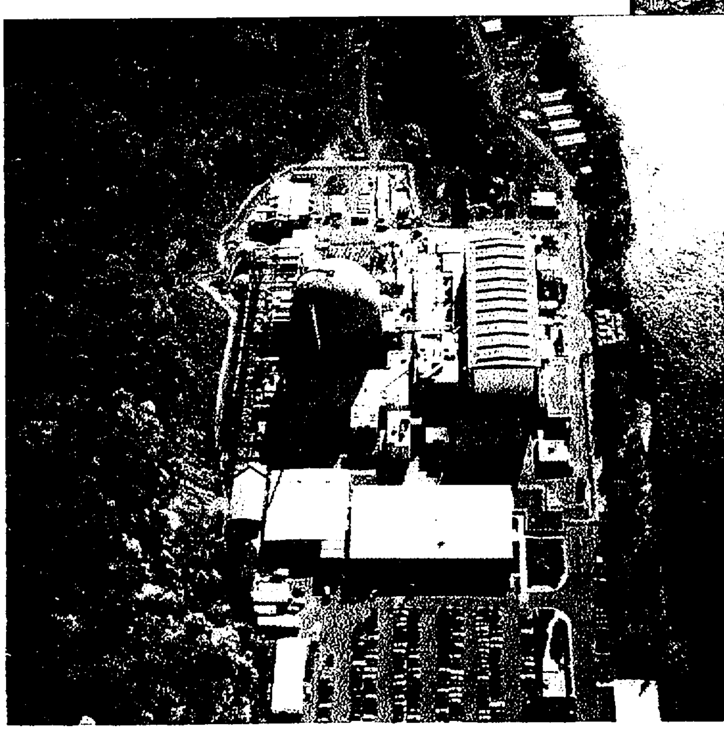

Millennium Services, Inc.

Connecticut Yankee Atomic Power Company

Haddam Neck Plant
Historical Site Assessment Supplement
June 30, 2000

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1.0 Glossary of Terms, Acronyms and Abbreviations

ACM- asbestos containing material
ACR- Abnormal Condition Report
AEC- Atomic Energy Commission
α-alpha (denotes alpha radiation)
ALARA- As Low As Reasonably Achievable
AOC- Area of Concern
ASTM-American Society for Testing and Materials
β- beta (denotes beta radiation)
CAP-Corrective Action Program
ccpm-corrected counts per minute
CFR- Code of Federal Regulations
cfs- cubic feet per second
cm^2-square centimeters
Co-60 – cobalt 60 (radioactive element- Note: The symbols of the elements are presented throughout this document and are not defined in this listing. Cobalt and cesium are provided as examples.)
cpm-counts per minute
CR- Condition Report
Cs-137 – cesium 137 (radioactive element)
CTDEP- Connecticut Department of Environmental Protection
CY-see CYAPCO
CYAPCO-Connecticut Yankee Atomic Power Company
dpm/100cm^2- disintegration per minute per 100 square centimeters
DCGL-derived concentration guideline level or limit
D&D- decontamination and decommissioning
DOC-Decommissioning Operations Contractor
DSN- designation serial number
EI-Environmental Indicators
EOF- Emergency Operations Facility
EPA- United States Environmental Protection Agency
EPRI- Electric Power Research Institute
ft.- feet
γ- gamma (denotes gamma radiation)
HNP- Haddam Neck Plant
HP- health physics
HSA-Historical Site Assessment
IN-Information Notice
LLD- lower limit of detection
MARSSIM- Multi-Agency Radiation Survey and Site Investigation Manual
MDA-minimum detectable activity
MM-Modified Mercalli
mph- miles per hour
mR/hr- millirem per hour
MSL-mean sea level

Glossary of Terms, Acronyms and Abbreviations

MW- monitoring well
MWe- megawatt electric
μCi/g- microcuries per gram
NOAA-National Oceanographic and Atmospheric Administration
NOV-Notice of Violation
NPDES-National Pollution Discharge Elimination System
NRC-see USNRC
NSSS-nuclear steam supply system
OMRP- Offsite Materials Recovery Program
PAB-Primary Auxiliary Building
PASS-Post Accident Sampling System
PCP- Process Control Program
PFSAR – Preliminary Final Safety Analysis
PCB- polychlorinated biphenyls
pCi/g- picocuries per gram
pCi/l- picocuries per liter
PIR- Plant Information Report
PSDAR- Post Shutdown Decommissioning Activities Report
QA- Quality Assurance
QC- Quality Control
RCB-Reactor Containment Building
RCRA-Resource Conservation and Recovery Act
RWST- Refueling Water Storage Tank
SARA-Superfund Amendments and Reauthorization Act
SALP- Systematic Assessment of Licensee Performance
TSD-treatment, storage, disposal
UFSAR- Updated Final Safety Analysis Report
USAEC- United States Atomic Energy Commission
USNRC-United States Nuclear Regulatory Commission
USEPA-United States Environmental Protection Agency
XRF- x-ray fluorescence

2.0 Executive Summary

The Historical Site Assessment (HSA) of Connecticut Yankee Atomic Power Company's Haddam Neck Plant (CYAPCO) has been conducted in accordance with the guidelines of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) and American Society for Testing and Materials Standards (ASTM) Standards 1527-94 and E 1528-93 in preparation for the decommissioning and license termination of the facility. The HSA process began in 1997, shortly after termination of commercial operations, and continued until submittal of the License Termination Plan in 2000. The assessment consisted of a review of site historical records regarding plant incidents, radiological survey documents, operations and maintenance records, plant modification documents, and both routine and special reports submitted by CYAPCO to various regulatory agencies. Interviews with site personnel, both past and present were conducted, reviews of historical site photos and extensive site walk downs were performed to provide a thorough understanding of events that impacted the site relative to the decommissioning process. In parallel with the HSA process, division of the site into initial survey areas was completed. The initial survey areas were created based on the anticipated MARSSIM classification for the areas, and have been, and continue to be, modified as necessary as information pertaining to those areas was assimilated. The HSA process, combined with site characterization data, establishes the basis for the survey area classification in accordance with the guidelines contained in MARSSIM.

Although the Site Characterization Report was previously issued with summaries of historical information and data, queries and comments from the NRC staff demonstrated a need for more detailed information in order to assess the adequacy of CYAPCO assessments and survey classifications. Consequently, this HSA supplement has been developed to facilitate access to additional information for further clarification of the historic site assessment at HNP. (Reference 2-1)

This HSA supplement follows the outline proposed in the MARSSIM guideline and contains information available through June 30, 2000. A summary of physical and environmental characteristics is presented in Section 4.0. The HSA approach and methodology are presented in Section 5.0. Documents reviewed during the process that provide significant information toward the determination of potential or known impact on site areas are provided as references. A history of site operations is presented in Section 6.0.

Findings and conclusions are presented in Sections 7.0 and 8.0. The design of the Haddam Neck Plant, includes several enclosures designed to contain radioactive systems and components. By design, routine operations and equipment maintenance resulted in radiological impact of enclosures such as the reactor containment building, the primary auxiliary building, waste disposal buildings, the spent fuel building and other support facilities, such as the service building maintenance shop. The HSA was performed prior to removal of many of the highly radioactive components such as the reactor vessel, steam generators, waste processing equipment, and similar components and equipment. Consequently, access to many areas was therefore limited. However due to the design intent and operational history, classification of many of these survey areas as Class 1 impacted areas was apparent. During early years of plant operations waste handling occurred outside the enclosures, but within the RCA yard area. This has resulted in a Class 1 impacted designation for these areas. Operational events resulted in radiological impact on many of the areas adjoining the RCA including areas outside the industrial area.

Surveys performed at the time of the events as well as subsequent surveys have provided a basis for the specific survey unit classifications. Only one survey area, 9532, the eastern most area of the site, has been classified as non-impacted. Specific area survey classifications are identified in Section 8.0.

The HSA process is the commencement of the effort to fully characterize, remediate and survey the Haddam Neck Plant site in preparation for license termination. Further characterization, on-going throughout the remediation phase, will provide radiological data to enhance the detailed knowledge of site conditions. The license termination process presented in MARSSIM provides a mechanism for re-evaluation of decisions reached during the initial phase of the process, and modification if that data shows that initial decisions were less conservative. The effort expended on the information assessment required to complete this HSA has bounded the areas impacted by Haddam Neck Plant operations as well as the development of the initial classification of areas within that scope.

3.0 Purpose of the Historical Site Assessment

The Historical Site Assessment was conducted on the Connecticut Yankee Atomic Power Company Haddam Neck Plant (HNP) to:

- Identify potential, likely, or known sources of radioactive material and radioactive contamination based on existing or derived information,
- Identify potential, likely or known sources of hazardous substance or petroleum contamination in the environmental media based on existing or derived information,
- Identify sites that need remedial action as opposed to those with no potential for exceeding radiological or hazardous substance limits for site closure,
- Provide an assessment of the likelihood for contamination migration,
- Provide information useful to scoping and characterization surveys, and
- Provide initial classification of the site as impacted or non-impacted.

The information presented in the assessment was derived from historical documents, records, interviews and inspections dating from 1967 to June 30, 2000.

4.0 Property Identification

The property is the Connecticut Yankee Atomic Power Company, Haddam Neck Plant, associated structures and lands.

4.1 Physical Characteristics

4.1.1 Name

The site name and address is:
Connecticut Yankee Atomic Power Company
Haddam Neck Plant
362 Injun Hollow Road
East Hampton, Connecticut 06424-3099

USNRC License # DPR-61
Docket No. 50-213
USEPA ID # CTD042306720
(Reference 4-1)

4.1.2 Location

The 525-acre site is located in the Town of Haddam, Middlesex County, Connecticut, on the east bank of the Connecticut River at a point 21 miles south-southeast of Hartford, Connecticut, and 25 miles northeast of New Haven, Connecticut. See Figure 4-1.

The geographical coordinates of the centerline of the reactor are as follows:

Latitude	Longitude
N41° 28'55"	W72° 29'57"

(Reference 4-1)

4.1.3 Topography

The Haddam Neck Plant is located in the general area designated as Cove Meadow on the United States Geological Survey, Deep River Quadrangle, Connecticut Sheet.

The main station is located on a level, 600-foot-wide terrace. Two ponds, each up to about 300 feet wide, are located on the terrace about 900 feet northwest and southeast of the reactor. The Emergency Operations Facility (EOF) is located about 200 feet northwest of the western pond and 1,600 feet northwest of the power station.

To the southeast, a 5,500-foot-long cooling water discharge canal leads to the river from the southern edge of the plant. It is separated from the Connecticut River by a 200 to 1,000-foot-wide peninsula floodplain with typical elevations of about 5 to 15 feet mean sea level (MSL). Three septic leaching fields occupy the westernmost 750 feet of the peninsula. The westernmost field measures approximately 50 by 100 feet and was abandoned in 1972. Southeast of this field are four 27 by 63-foot covered active leaching structures constructed over an earlier system that was retired in 1980. The third and easternmost field measures approximately 108 by 306 feet and was in use from 1980 until the active system went on-line.

At the back or east side of the plant, a steep wooded hillside rises to elevations over 300 ft. MSL within one-half-mile to the north. The lowermost 30 to 40 feet of the hillside adjacent to the plant consists of nearly vertical rock cut. The Connecticut River acts as a barrier on the west side as well as at the southern end of the peninsula, approximately one mile from the plant. Access to the site is gained over an improved access road from the north.

A potable water supply well field is located on the peninsula 2,000 feet southwest of the station.

At the eastern edge of the site, between the Salmon River and a small stream called Dibble Creek, is a terrace that was quarried for sand. The quarry was presumably created during the construction of the station and now includes the landfill and the shooting ranges. Before quarrying, the terrace had an upper elevation of over 100 ft. MSL. Quarrying activities lowered the grade to between 40 and 50 feet MSL and left a narrow, steep-sided ridge with elevations up to 80 feet MSL between the landfill/range and the Salmon River. To the south are bedrock outcroppings with elevations over 50 feet MSL west of the landfill. Dibble Creek, largely impounded at about elevation 36 feet MSL by beaver dams and the access road embankment, flows southward just west of the landfill/range and through a gap in the bedrock outcroppings to the south. North of the landfill/range is undisturbed terrain and more quarried areas rising about 50 ft. MSL. The landfill/range area is approximately 4,500 feet east of the station.

The station area topography originally consisted of a north-south trending promontory approximately 400 feet wide that connected the steep hillside north of the station to a floodplain terrace along the river's edge. The steep hillside extended southward to the northeastern-most third of the containment building.

The southern part of the promontory consisted of a 300-foot-long by 100 foot-wide knoll above 16 ft. MSL with 11 bedrock outcroppings reaching up to 25 ft. MSL. The largest outcrop was up to 110 feet long and most outcrops were present at and just southeast of the turbine building. Wetlands 250 to 300 feet wide and at an elevation of about 4 feet MSL extended for 1,000 feet or more to the northwest and southeast of the promontory. Both the wetlands and the promontory were separated from the river by a terrace approximately 150 to 200 feet wide with an elevation of 12 to 14 feet MSL.

During construction of the station, the steep hillside to the north and the higher portions of the promontory were cut and the adjacent wetlands filled. The discharge canal was excavated through wetland, terrace, and floodplain to the southeast. The general plant area was filled and graded from an initial elevation of approximately 12-ft MSL to a final elevation of 21 ft. MSL. The 100-year flood plain elevation is 15 ft., with this grade at 1.5 ft. above the highest recorded river level near the site. The general topography is shown on Figure 4-2. (Reference 4-2)

4.1.4 Stratigraphy

Six different layers of unconsolidated sediments overlying metamorphic bedrock comprise the stratigraphy of the immediate station area.

From the surface down, these six layers consist of:

- Surficial sand fill (0-18 ft. thick)
- Wetland silt and organic matter (0 –7 ft thick)
- Gravelly sand (15-26 ft. thick)
- Red fine-grained sand (0-55 ft. thick)
- Brown sand (0-30 ft. thick)
- Glacial till or cobbly gravel (0-10 ft. thick)

Sand Fill Layer
The construction activities at the station resulted in the addition of an area-wide layer of surficial sand fill that directly overlies the original topographic grade, the cut bedrock surface, or the original bedrock surface. The fill is mostly tan or brown and has a sandy composition similar to the landfill area (former sand pit) deposits from where much of the fill may have been derived. At some locations it is gray or red-brown with substantial silt, gravel, and cobbles and resembles the gravelly sand layer.

Portions of the fill may be spoils from areas excavated below the original site grade. The fill layer is less than 10 feet thick, but it is thickest within the former excavation around the reactor containment building (12 to 18 feet) and over the former wetland area to the southeast of the station (14 feet). (Reference 4-2)

Silt and Organics Layer
A layer of gray, organic rich silt and fine sand underlies most of the former wetland area to the southeast of the reactor containment. The layer ranges from 0 – 7 feet thick. (Reference 4-2)

Gravelly Sand Layer
The gravelly sand layer was the original surficial material before station construction. It remains under the fill below most areas that were not excavated, but is absent northeast of and around the Reactor Containment Building (RCB) and under the turbine building and Primary Auxiliary Building (PAB) where bedrock is very shallow. The layer is generally red-brown and has a coarse-grained sand and gravel composition with silt, cobbles, or boulders in some areas. It is typically about 15 feet thick. In the former wetland area to the southeast of the RCB, where original grade elevations were about 4 ft. MSL, the layer is less than 10 feet thick. (Reference 4-2)

Red Fine Sand Layer
Below the gravelly sand and flanking the eastern and western sides of the bedrock promontory is a layer of red, fine-grained sand with surface elevations between –3 and –15 feet MSL. It is typically laminated and contains lesser amounts of silt, clay, and coarser-grained sand and traces of gravel. The layer thickens to the east and west of the promontory and reaches a recorded maximum of 55 feet over the center of the bedrock surface trough. (Reference 4-2)

Brown Sand Layer
In a limited area east of the station and underlying the red fine sand is a light brown to gray sand layer with minor gravel and silt with surface elevations from –29 to –65 feet MSL. A few feet of laminated, olive-brown, fine-grained sand was found only on the bedrock on the west side and within the deeper part of the buried bedrock surface trough east of the station but it may extend farther to the southeast. (Reference 4-2)

Till/Cobbly Gravel
Beneath all of the other surficial layers and situated directly on the bedrock surface is a layer of glacial till. Till was absent from the pre-construction promontory rock outcrops and the upper slopes of the buried bedrock surface. It was excavated from the lower slopes on the steep hillside north of the station and generally increases in thickness with depth of bedrock as a mantling wedge of material up to 10 feet thick on either flank of the promontory. Although its color and composition vary considerably in the record, till is always described in boring logs as compact in nature. It can consist of olive-gray, gravelly fined-grained sand and silt, yellow, brown, or red sand, gravel, and boulders at many locations, or just boulders. (Reference 4-2)

Bedrock
Other investigators have extensively mapped the bedrock lithology and structure in the hills north of the station. The rock types found on the hill and under the station area consists of a suite of recrystallized volcanic rocks mapped regionally as the Monson Gneiss and Middletown Formation. These rock types are found in a belt extending from the Long Island Sound shoreline, east of New Haven to Old Lyme, northward through Haddam Neck and Middletown, into Monson, Massachusetts, and farther north.
See Figure 4-3 (Reference 4-1)

4.2 Environmental Setting

4.2.1 Geology

Excavations for the plant structures were not geologically mapped during construction. Original site geological information was developed from literature about the region and from results of borings taken at the site. Several major faults or fault systems have been recognized in the site region. No evidence has been found indicating a capable fault. Many of these faults were identified and mapped during the United States Nuclear Regulatory Commission (NRC) sponsored New England Seismotectonic Research Program. This study began in 1978 and was completed in 1983 under the direction of the Weston Observatory of Boston College.
(Reference 4-1)

The site lies on the eastern shore flood plain of the Connecticut River within the Piedmont Atlantic Coastal Province. Geologically, this province is characterized by a Precambrian basement overlain by early Paleozoic metamorphic rocks, consisting of schists, gneisses and amphibolites, which are locally intruded by plutons of Paleozoic age. These formations strike in a north-south direction with local variations of 15° to 30° to the west and dip to the east at 65° to 75°. These rock types are exposed in outcrops on the high ground at the site. A series of bands of mica schists was found to run across the southern sector of the site. Since these bands are softer than the gneiss, the shearing distortions due to folding and movement of rocks in the geologic past have developed open joint planes and small faults, which have resulted in deep weathering of the schists. See Figure 4-4 and 4-5.

To the east, a fault in the bedrock surface, filled with up to 100 feet of sediments, lies below the southeastern former wetland. This feature, the Bonemill Brook Fault, is exposed on the steep hillside northeast of the station as a 100-foot- wide, 700-foot-long, north south oriented linear topographic swale. The swale enters the subsurface 300 feet east of the RCB and widens and deepens southward. The axis of the trough lies beneath the active septic leach field. In the subsurface, the western edge of its slope dips at about 40 degrees to below –96 feet MSL. See Figure 4-4. (Reference 4-2, 4-7)

Unweathered rock was discovered at depths ranging from 10 to 100 ft below the ground surface. In the northern sector of the site, a broad bank of granitic gneiss substantially covers an area outlined by outcrops. The gneiss is coarsely crystalline. It is considerably stronger and more resistant to weathering than the mica schists.

Consequently, the area presents a comparatively uniform rock stratum upon which the plant is located. The bedrock extends from above the original ground level at the outcrops to about 10 to 20 ft. below ground level over most of this area. At the most northerly end and at the river's edge, the rock is 30 to 50 ft. below ground surface. The overburden was excavated, thus permitting thorough examination and removal of weathered or excess rock material. Also present in the bedrock are naturally occurring minerals that include boron and uranium. (Reference 4-2)

In general, the soils overlying the bedrock consist of interbedded sands and gravels, some of which contain moderate amounts of silt. These materials vary appreciably in density, as indicated by the variation in number of blows on the standard penetration test. There are several small back swamps behind the natural river levees.

Soils of these swamps consist of about 3 to 5 ft of highly compressible organic silty sands. See Figure 4-6. (References 4-1,4-2)

4.2.2 Hydrogeology

Overall groundwater movement beneath the power station is primarily within the fractured bedrock, flowing southwest and downward near the hillside and upward near the canal and the Connecticut River. The water table ranges from 2 to 20 feet below the ground surface. Locally, the RCB and the mat drain sump are important hydrogeological features. The groundwater flow pattern around the impermeable RCB is distorted with at least a component of flow toward the drainage system under the RCB. The mat drain sump, located on the southern side of the RCB, removes groundwater and depresses the water table around it. The cooling water discharge tunnels divert the shallow groundwater towards the head of the cooling water discharge canal, and possibly also towards the mat drain sump. Southwest of the tunnels, the shallow groundwater appears to flow southwesterly and upwards directly toward the river. (Reference 4-2)

4.2.3 Hydrology

The Connecticut River is the major surface hydrological feature in the region and makes up the southwest boundary of the site. The river serves as the main pathway for stream flow originating within the Connecticut River watershed and terminate in Long Island Sound. The Connecticut River is a tidal river (for about 40 miles) and thus the flow is a combination of stream flow, freshwater runoff and tidal exchange. Although the river experiences tidal reversals, ocean waters do not extend to the site. The salt wedge extends to about 2 miles southeast of the site. The tidal range in the river is approximately 2.5 ft. and the minimum average daily flow past the site is 15,000 cfs. The Connecticut River experiences seasonal flooding from heavy rainfall and tidal flooding from severe coastal storms. Natural river temperatures range from a high of 86 °F to freezing. See Figure 4-7. (Reference 4-1)

The groundwater table general gradient slopes downward toward the river. Groundwater on the hillsides occurs under a mixture of perched conditions and in minor quantities in cracks in the rocks. The unsaturated zone on the hillsides is relatively thin.

For the Containment Building, a layer of porous concrete was placed under the foundation mat to collect groundwater and carry it to an external sump.

This drainage system is designed to maintain the groundwater level below the mat, thus minimizing uplift pressures. The containment was designed such that failure of the pumps would not overstress the structure during a simultaneous flood and earthquake.

Rains or spills on the ground surface may arrive at the river by overland flow or as groundwater movement at velocities from a few to several hundred feet per day. No changes since construction have occurred to alter the drainage system in such a way as to create local flooding. (Reference 4-2)

Power Station Groundwater Quality

Approximately six areas were investigated by deep drilling for permanent pumps to supply plant makeup and sanitary service. All wells with the exception of one were "dry," that is, no aquifer was found that would support pumping. One location, about 2400 ft south of the plant site, permitted the installation of two permanent pumps. It is believed that the aquifer is supplied primarily from the hillside.
(Reference 4-1)

No public drinking water supplies are taken from the Connecticut River in the site area. Industrial water use is limited to cooling purposes. The site wells are considered to be a public drinking water supply and have been classified by the State of Connecticut as a Non-Transient, Non-Community water system. Due to lead and copper contamination in the site plumbing, all site drinking water is bottled and supplied by vendors.
(Reference 4-1)

Groundwater is presently monitored on site through a network of thirty-eight (38) monitoring wells:

- 23 main plant area monitoring wells,
- 8 landfill monitoring wells,
- 6 peninsula area wells,
- 1 monitoring well located behind the Emergency Operating Facility.

(Reference 4-2)

Sampling Events
Several driving forces initiated the sampling and characterization of HNP groundwater. These are:

- Regulatory requirements for the annual reporting of radiation dose assessments on the public,
- Installation of new wells for monitoring or drinking water supply,
- As requested by the State of Connecticut Department of Environmental Protection (CTDEP), and
- In support of decommissioning activities.

In 1999, the Malcolm Pirnie Ground Water Monitoring investigation was initiated by CYAPCO as requested by CTDEP. The primary purpose of the investigation was a radiological characterization of groundwater quality within the immediate vicinity of identified areas of interest both on and off the Connecticut Yankee (CY) property. The Final Report was submitted in July 1999 and revised in September 1999. (Reference 4-2)

The investigation consisted of:

- The installation of 21 groundwater monitoring wells,
- Two sampling rounds, conducted during March and April 1999, and
- Samples analyzed for dissolved boron, tritium (H-3), gross alpha and beta emitting radionuclides as well as a gamma spectroscopy.

The report identified groundwater plumes containing tritium, boron and cesium-137 within the confines of the immediate power station area.

Tritium is a radionuclide created in the reactor coolant water as a normal by-product. Because it behaves like water, its hydrologic behavior and subsurface migration are the same as ground water. It is not subject to the physical/chemical factors affecting the movement of dissolved chemicals, such as volatilization, retardation, or chemical degradation.

The detection of tritium in the groundwater indicates a release of refueling cavity water and other process water. Because of the chemical properties of tritium, it is expected to move and dilute faster than chemicals dissolved in the groundwater.

Initially, tritium was detected at seven well locations within the power station area only, forming a plume that extends from the Refueling Water Storage Tank (RWST) southwestward to the wells adjacent to the river. In March, of 1999, tritium concentrations above EPA drinking water criterion of 20,000 picocuries/liter (pCi/l) were found in five wells, with a maximum concentration of 138,700 pCi/l. See Figure 4-8. (Reference 4-2)

In April 1999, concentrations were reduced at nearly all sample locations, with those above 20,000 pCi/l limited to just three wells and the highest concentration down to 67,400 pCi/l. Weekly sampling by CYAPCO personnel of the mat drain sump discharge found tritium concentrations varying between 5,210 and 1,900 pCi/l, with a declining concentration trend. (Reference 4-2)

A boron plume was found that coincides with the location of the tritium plume with the highest concentration of 9,590 ug/l. Because it is a dissolved contaminate, its migration in the environment is subject to retention, and as a stable element it will not chemically or radioactively degrade. Therefore, the boron plume will take longer to migrate and dilute compared to the tritium plume. The boron concentrations generally remained the same during the sampling period. (Reference 4-2)

The cesium-137 is not considered mobile and occurs as a residual, surface contamination when found. (Reference 4-2)

On November 17,1999 CYAPCO issued letter CY-99-077 documenting the results of the Groundwater Monitoring Report. The Groundwater Monitoring Report summarized the activities, results, conclusions and recommendations for four areas of interest on the CY property:

- Power station area
- Peninsula water supply well area
- Emergency Operations Facility area
- Landfill area

The letter stated, "The total tritium in groundwater as of March 1999 is estimated to be about one Curie. The estimate of groundwater tritium is based on measured concentrations in the monitoring wells."

Also stated, "The results of the investigation show that the presence of tritium is limited to the power block. There is no tritium outside the power block, and there is no impact on the onsite or offsite drinking water wells." (Reference 4-3)

In June of 2000, the existing monitoring well network within the Industrial Area was again used as the framework for the ground water sampling event to provide an indication of the potential baseline presence/absence of non-radiological constituents. The monitoring report for this event provided a summary of data as well as comparison to the CTDEP Remediation Standard Regulations GA Ground Water Protection Criteria. (Reference 4-4)

Generally across the Industrial Area, there was a significant downward trend in tritium concentrations over time. Analytical results from the previous sampling round indicated that three monitoring well locations were above EPA drinking water standard of 20,000 picocuries per liter.

The June 2000 data show that only monitoring well MW103D exhibited a concentration above this standard at 20,900 picocuries per liter. Monitoring well MW-103D, which is the deeper well in the cluster located near the former RWST, exhibits concentrations that have remained fairly constant in the 20,000 picocuries per liter range over the four sampling rounds.

The RWST, now drained, is considered the major source of tritium and Cs-137 in the ground water. Over time, there also appears to be an overall downward trend in boron concentrations.

Based upon the analysis of the data from the sampling event the following should be considered:

- Cesium 137 has been detected within monitoring well MW-103S. (72.2 pCi/l)

- Tritium analytical results within monitoring well MW-114S and the Containment Mat Sump increased, indicating a potential alternate source of contamination to the groundwater.

- Localized hydrological cross contamination may have resulted due to the configuration of the monitoring well construction.

- The groundwater beneath the industrial facility is contaminated, as defined by Section 22a-423 of the Connecticut General Statues. (Reference 4-4)

The Bonemill Brook Fault which passes under the site grounds may allow the transportation of site ground water below the Connecticut River under certain circumstances, the existence of which has not been established. Investigations into the potential for this fault to act at a transport mechanism for site ground water should be conducted. (Note: CYAPCO management is implementing a ground water assessment program to address this and other issues related to groundwater flow.)

Surface Drainage
Since the pre-construction site elevation was approximately 12 ft. above sea level, and some means of high water protection had to be provided, knowledge of flood flows and elevations at the site was important. The two greatest flows over the past 325 years occurred 30 months apart, on March 21, 1936, and September 23-24, 1938. Computed flood stages and discharges at Bodkin Rock were 28.2 and 25.75 ft. MSL, and 267,000 and 239,000 cfs, respectively. The August 1955 hurricane produced a 20.44 ft. MSL flood stage and 177,000 cfs discharge.

Extreme tidal flooding resulting from severe coastal storms can also cause high river stages. The worst recorded high tides at the mouth of the river were associated with the hurricanes of September 1938, and August 1950, in which respective elevations of 9.5 and 9.1 ft. MSL were experienced.

Before construction, the site consisted largely of a grassed airstrip, about 3,200 feet long and several hundred feet wide. On the east side, there were marshy areas that appeared to drain to Salmon Cove. Several small streams, with hillside drainage areas of about two-tenths of a square mile, drained to the marshy areas.

The general elevation was filled and graded to 21 ft. MSL for the plant area. Rock appeared as an outcrop, which rose about 5 ft. above the airstrip, and as a bedrock at the foot of the steep wooded hills, which rise to a maximum elevation of 270 ft. MSL forming the flood plain eastern boundary.

The average flood plain width, from normal stream bank to the 25 ft. contour, was approximately 600 ft. The thin soil mantle, the bedrock near the surface and the steep slopes tended to cause the surface drainage from the hills to respond quickly to variations in rainfall intensity.

The drainage is now intercepted by a ditch and discharge canal that empties into the Connecticut River. Since the hillsides were kept in their original natural wooded state, with well-preserved mantle and little cover, little or no erosion is likely.

Careful consideration was given to flood protection required for the plant. The airstrip was partially flooded at least five times since 1947 to about 13 ft. MSL. A flood stage of 19.5 ft. MSL, the maximum recorded, would have inundated the original plant site. Therefore, elevation 21 ft. MSL was selected as the yard grade that would essentially eliminate the likelihood of plant damage in any foreseeable fresh water runoff flood situation.

The calculated site flood stage corresponding to a modified 1936 flood is 15.1 ft. MSL. A study to determine the theoretically maximum possible high-water level at the site for a combination of worst case hydrological and meteorological conditions were developed from documented U.S. Geological Survey and Corps of Engineers data. This study is based on the premise that tidal flooding will in effect displace the fresh water run-off; it makes many conservative assumptions and takes no credit for expanding the flood plain. The results indicate that for simultaneous occurrence of the worst ever experienced conditions, namely the 1936 flood and the 1938 costal hurricane, a site elevation of 20.4 ft. MSL would be reached. Using the 1936 flood and the Standard Project Hurricane Tidal Flood combination, the calculated site flood stage would be 23.7 ft. MSL. (Reference 4-1,4-2)

In 1984, extensive rains in the Connecticut River Valley caused severe flooding of the Connecticut River. The peak of 15'5.5" above MSL occurred on June 21, 1984, the highest since the 1938 flood. (Reference 4-4)

4.2.4 Meteorology

Regional Climatology
The climatology of the Haddam Neck Plant region may be reasonably described by the National Weather Service Station for Bridgeport, Connecticut.

The Bridgeport National Weather Service Station is located at Sikorsky Memorial (Bridgeport Municipal) Airport, approximately 40 miles southwest of the site. The Haddam Neck plant is approximately 20 miles inland from Long Island Sound, while the airport weather station is located on a peninsula that protrudes into Long Island Sound.

The site and Bridgeport are influenced by similar synoptic scale and mesoscale meteorological conditions. Temperature data prior to January 1, 1948, along with precipitation and snowfall data prior to March 1, 1948 are available from cooperative Bridgeport locations. Following these dates, all data reviewed for the HSA were collected at Bridgeport Municipal Airport location.

The site, although some 19 miles inland, is characterized by the climatological features of both the coast and the interior. Maritime influence is felt by frequent sea breezes especially during the afternoon and evening hours of the spring and summer months.

In winter, the proximity to the Sound tempers the incidence and magnitude of snowfall and is responsible for moderating temperature when winds blow from a southerly quadrant.

In contrast, the valley location and protection of the surrounding hills are responsible for shielding the site from strong winds in many directions and allow strong radiational cooling of the lowest layer of the atmosphere in dry air. (Reference 4-1)

General Climate

The general climate of the region is described with respect to types of air masses, synoptic features, and general airflow patterns.

Air Masses and Synoptic Features

The general eastward movement of air encircling the globe at middle latitudes transports large air masses into the region. Four types of air masses usually influence the meteorology in the region of the Haddam Neck site: cold, dry continental polar air originating in Canada; warm, moist tropical air originating over the Gulf of Mexico and the Atlantic Ocean; cool, damp maritime air originating over the North Atlantic; and modified maritime air originating over the Pacific Ocean.

Constant interaction of these air masses produces a large number of migratory cyclones and accompanying weather fronts affecting the region through the year.

These weather systems are strongest during the winter and decrease in intensity during the summer. Infrequently, a storm of tropical origin affects the Haddam Neck site. (Reference 4-1)

Temperature, Humidity, and Precipitation
The mean annual temperature is approximately 51°F at Bridgeport, Connecticut. Due to the proximity of Long Island Sound and the Atlantic Ocean, both the heat of summer and the cold of winter are moderated. During the summer months, normal monthly temperatures near the shoreline average 3°F to 5°F cooler than nearby inland stations.

Temperatures of 90°F or greater occur an average of seven days per year at Bridgeport, while temperatures of 100°F or greater have occurred only in July and August with an extreme maximum of 103°F occurring in July 1957.

Winters are moderately cold, but seldom severe. Minimum daily temperatures during the winter months are usually below freezing, but subzero (°F) readings are observed, on the average, less than one day every two years.

Below zero temperatures have been observed in each winter month, with an extreme minimum of -20°F occurring in February 1934. The normal annual precipitation at Bridgeport is well distributed throughout the year. Migratory low-pressure systems, and their accompanying frontal zones, produce most of the precipitation throughout the year. From late spring through early fall; bands of thunderstorms and convective showers produce considerable rainfall. These storms, often of short duration, frequently yield the heaviest short-term precipitation amounts. During the remainder of the year, the heaviest amounts of rain and snow are produced by storms moving up the Atlantic coast of the eastern United States. Precipitation of 0.01 inch or more occurs approximately 127 days annually.

On the average, relative humidity values are lowest during the winter and spring months in the early afternoon. Relative humidity values are at a maximum during the summer and fall months in the early morning hours. On occasions, the humidity is uncomfortably high for periods up to several days during the warmer months. (Reference 4-1)

Prevailing Winds
The global band of prevailing westerly winds throughout most of the year controls the weather pattern in the region. These winds act as the steering current for synoptic scale weather systems that produce day-to-day weather changes.

During the winter months, the predominating northwesterly winds transport cold, dry air from the northern United States and Canada into the region. From April through September, warm and often humid southwesterly winds occur most frequently. (Reference 4-1)

Wind speed and direction joint frequency distributions for data measured at two elevations (33 feet and 196 feet above ground level) at the Haddam Neck site are provided in Table 4-1, 4-2 for the period of 1991-1995 as an example. The relatively high frequencies of west to northwest and southeast to south winds and the higher speeds from those directions, particularly at the 33 foot level, are the result of channeling of wind by the valley in those directions. The lower frequency of wind and lower wind speeds from other directions reflect the sheltering effects of the hills that define the valley and the light nighttime drainage flows into the valley. (Reference 4-1)

Strong Winds
Strong winds, usually caused by intense low-pressure systems, tropical cyclones, or passages of strong winter frontal zones, occasionally affect the region. For the 1961 through 1990 period, the fastest-mile wind speed recorded at Bridgeport was 74 mph occurring with a south wind during Hurricane Gloria in September 1985. (Reference 4-1)

Thunderstorms, Lightning
Thunderstorms most commonly occur during the late spring and summer months, although they have been observed during all months of the year. They occur on an average of 22 days per year. Severe thunderstorms with strong winds, heavy rain, intense lightning, and hail have infrequently affected the region. (Reference 4-1)

Hurricanes
Storms of tropical origin occasionally affect the region during the summer and fall months. According to a 1971 statistical study by Simpson and Lawrence, the 50-mile segment of coastline closest to Haddam Neck was crossed by five hurricanes during the period from 1886 through 1970. Most recently, the site was affected by Hurricanes Gloria in 1985 and Bob in 1991. (Reference 4-1)

Tornadoes
From a study of tornado occurrences during the period of 1955 through 1967 (augmented by 1968-1981 storm data reports), the mean tornado frequency in the one-degree (latitude-longitude) square where the Haddam Neck site is located is determined to be approximately 0.704 per year. (Reference 4-1)

Extremes of Precipitation
The normal annual precipitation at Bridgeport is 43.63 inches. Since 1894, annual totals have ranged from a minimum of 23.03 inches in 1964, to a maximum of 73.93 inches in 1972. Monthly precipitation totals have ranged from 0.07 inch in June 1949 to 18.77 inches in July 1897. Since 1949, the maximum measured 24-hour rainfall has been 6.89 inches occurring in June 1972. (Reference 4-1)

Extremes of Snowfall
Measurable snowfall has occurred in the months of October through April, although heavy snowfall occurrences are usually confined to the months of December through March. The mean annual snowfall at Bridgeport is 25.3 inches, with totals since 1931 ranging from 8.2 inches in the 1972-1973 seasons, to 71.3 inches in the 1933-1934 seasons. The maximum monthly snowfall, occurring in February 1934, was 47.0 inches. Since 1949, both the maximum measured snowfall in 24 hours (16.7 inches), and the greatest snowfall in one storm (17.7 inches) occurred during the same storm in February 1969. The maximum measured snowfall in 24 hours (16.7 inches) was matched again in January 1978. (Reference 4-1)

Hailstorms
Large hail, which sometimes accompanies severe thunderstorms, occurs infrequently in the Haddam Neck area. Based on a 1955 through 1967 study, hailstones with diameters greater than or equal to 0.75 inch occur at an average of 1.4 times per year in the 1-degree (latitude-longitude) square where the Haddam Neck site is located. Most hail reported in the area is less than 0.50 inch in diameter. (Reference 4-1)

Freezing Rain, Glaze, and Ice Pellets
Freezing rain and drizzle are occasionally observed during the months of December through March, and only rarely observed in November and April. An average of 18.5 hours of freezing rain and 8.5 hours of freezing drizzle occur annually at Bridgeport. (Reference 4-1)

Fog Conditions
The average annual fog frequency (with visibility less than seven miles) is 13 percent (1,139 hours) at Bridgeport, with the maximum monthly frequency of fog (15.4 percent or 115 hours) occurring in May. The average annual ground fog frequency is 2 percent (175 hours), with October having the maximum monthly frequency of 3.4 percent (25 hours).

Only one hour of heavy ice fog, a winter phenomenon, has been recorded during the period of 1949 through 1975.

Heavy fogs (visibility of 0.25 mile or less) occur an average of 1.5 percent of the time (131 hours), on about 29 days annually, predominantly during the months of December through June. The maximum number of consecutive hours of heavy fog observed during the period 1949 through 1964 was 26. (Reference 4-1)

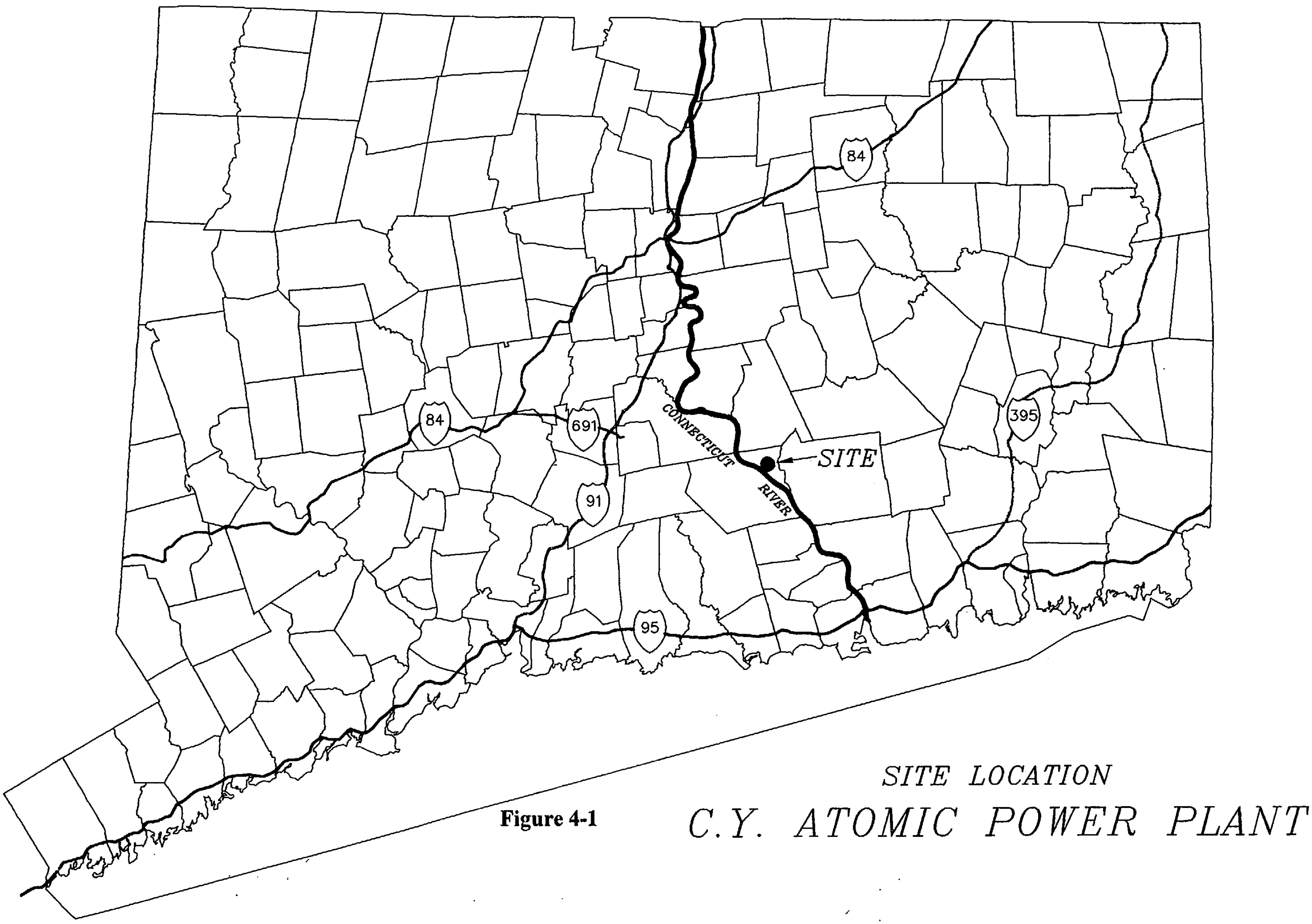
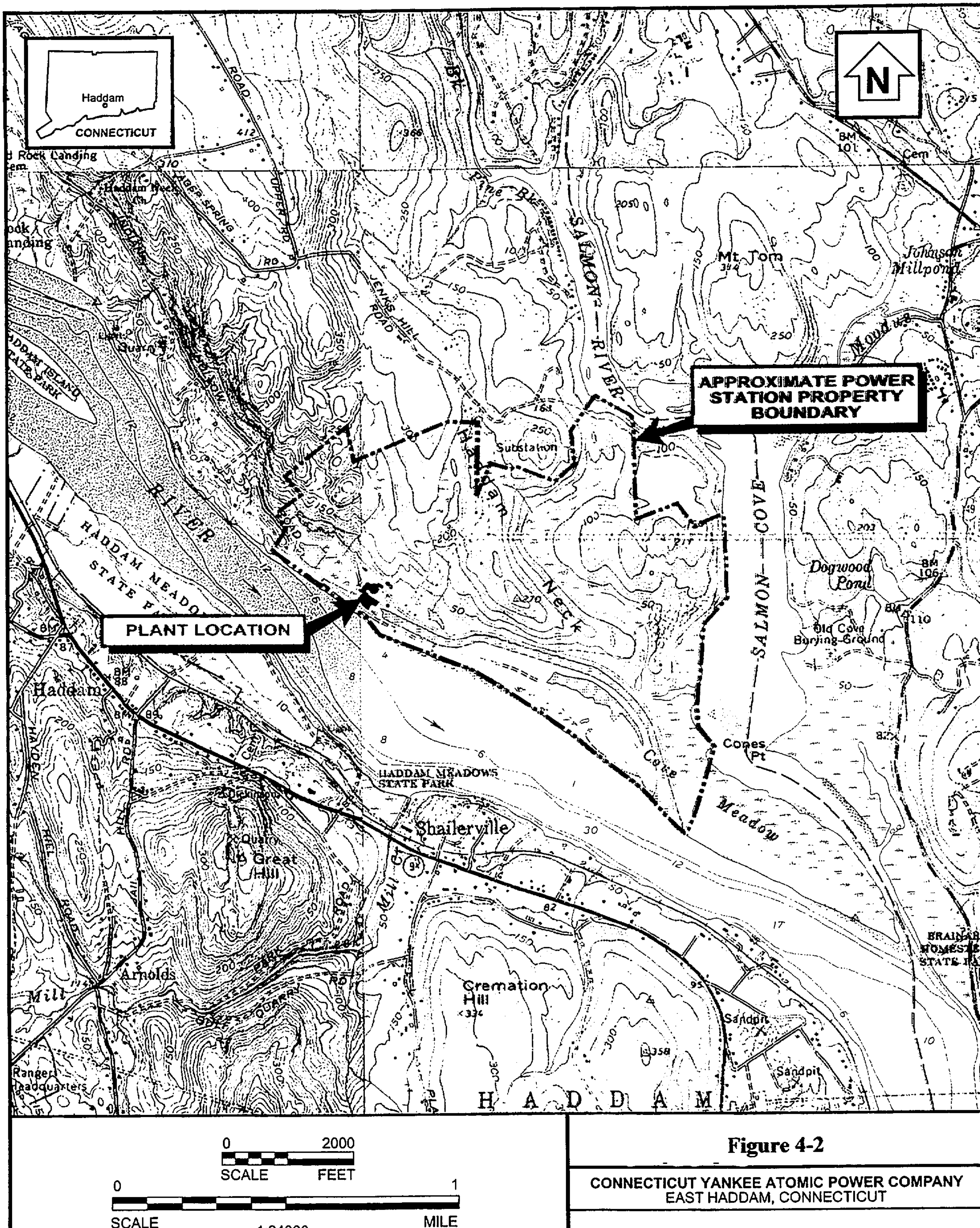


Figure 4-1

Produced By Survey Engineering, Northeast Utilities

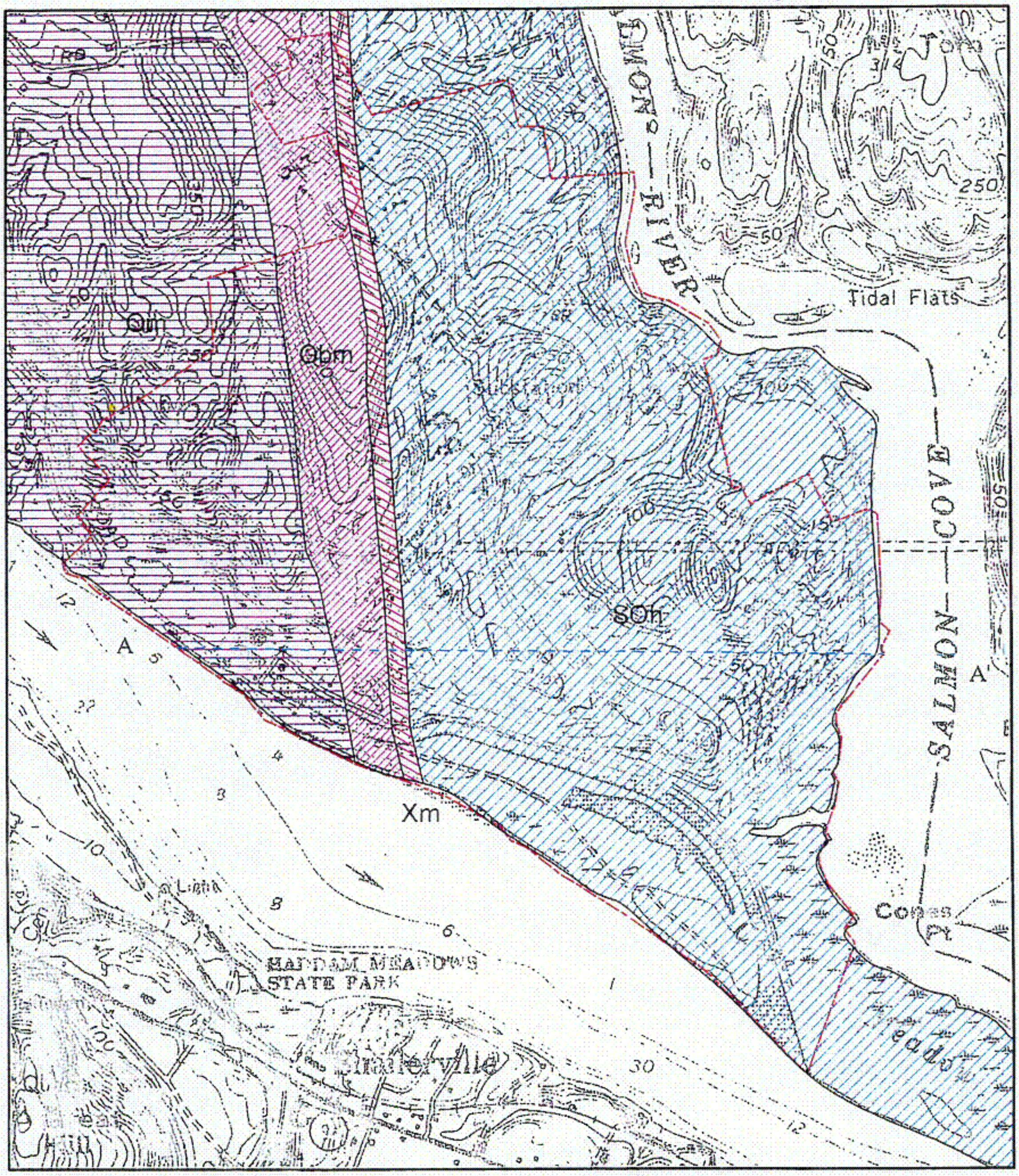


BASE CREATED WITH TOPO™ © 1996 WILDFLOWERS PRODUCTIONS, www.topo.com
DEEP RIVER AND HADDAM, CT - 7.5' USGS TOPOGRAPHIC MAP

Figure 4-2

CONNECTICUT YANKEE ATOMIC POWER COMPANY
EAST HADDAM, CONNECTICUT

SITE LOCATION MAP



CY Atomic Power Plant Site
BEDROCK MAP

Om : Monson gneiss

Obm: Brimfield formation

SOh : Hebron formation

Xm : Bonemill brook fault migmatite

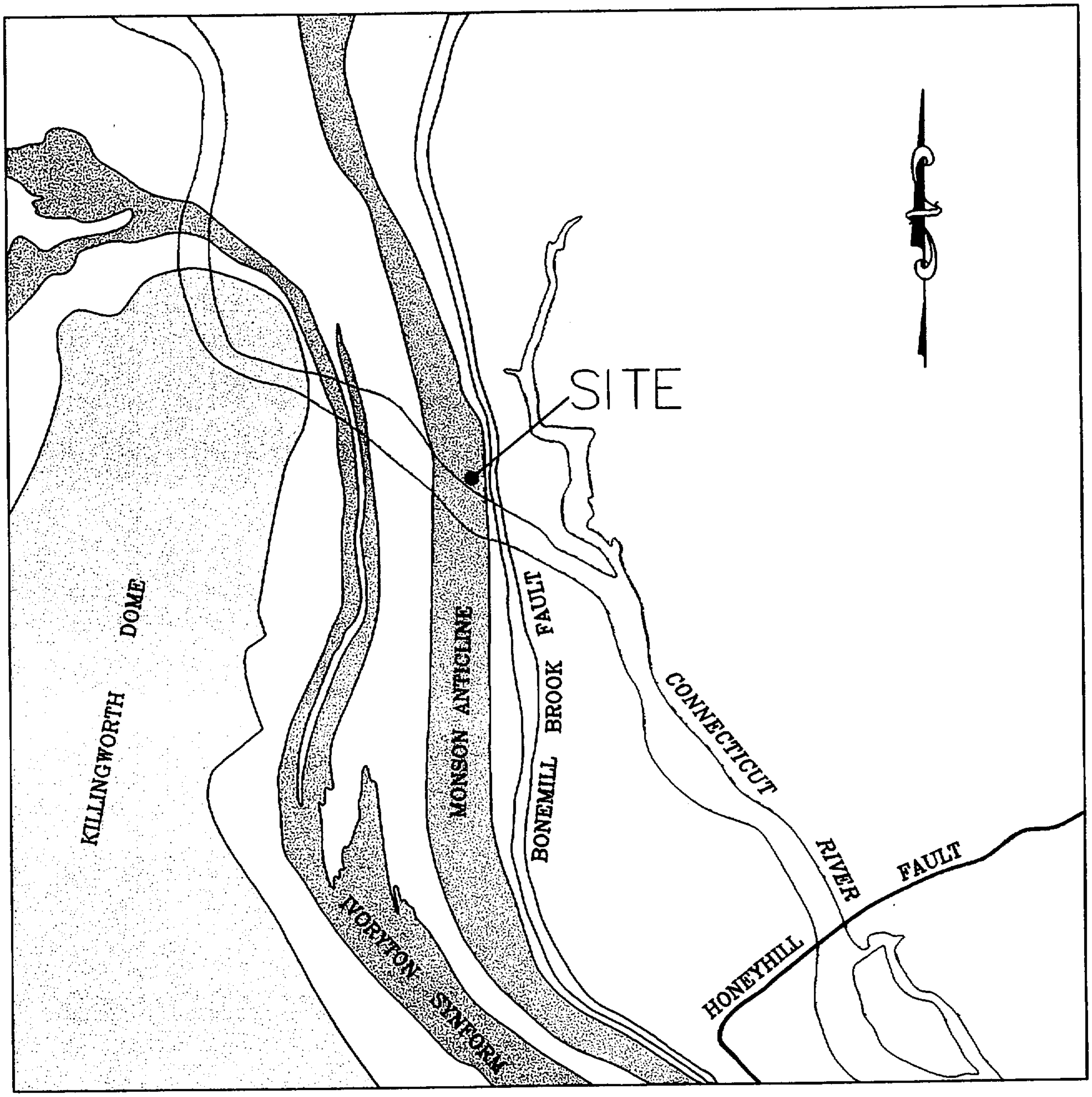
= CY Property Line

Produced By Survey Engineering, Northeast Utilities

Figure 4-3

C01

MAJOR GEOLOGIC STRUCTURAL ELEMENTS IN THE VICINITY OF CONNECTICUT YANKEE



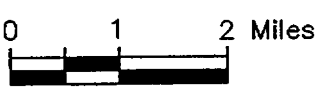


Figure 4-4

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GEOLOGIC TERRANES OF CONNECTICUT

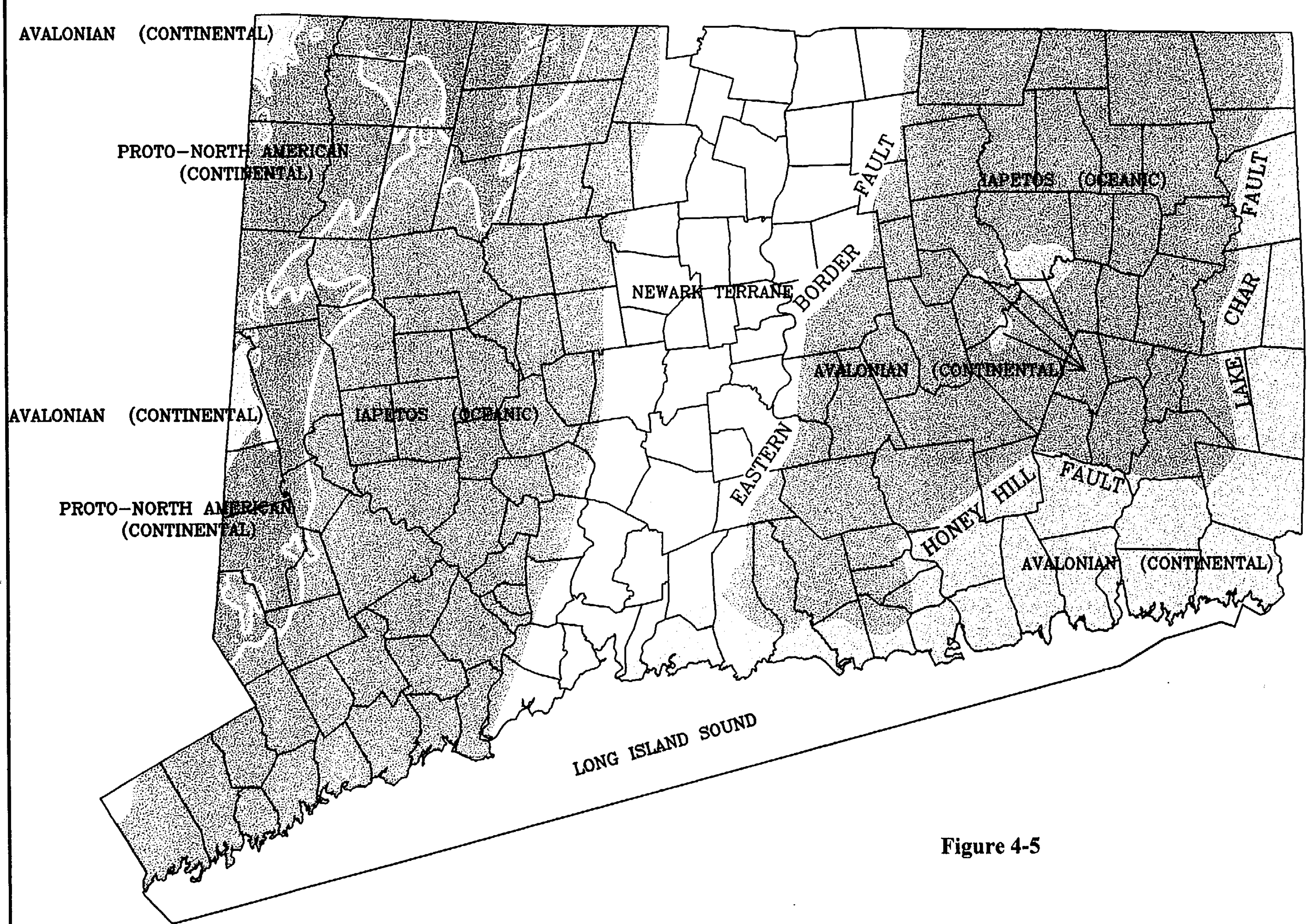
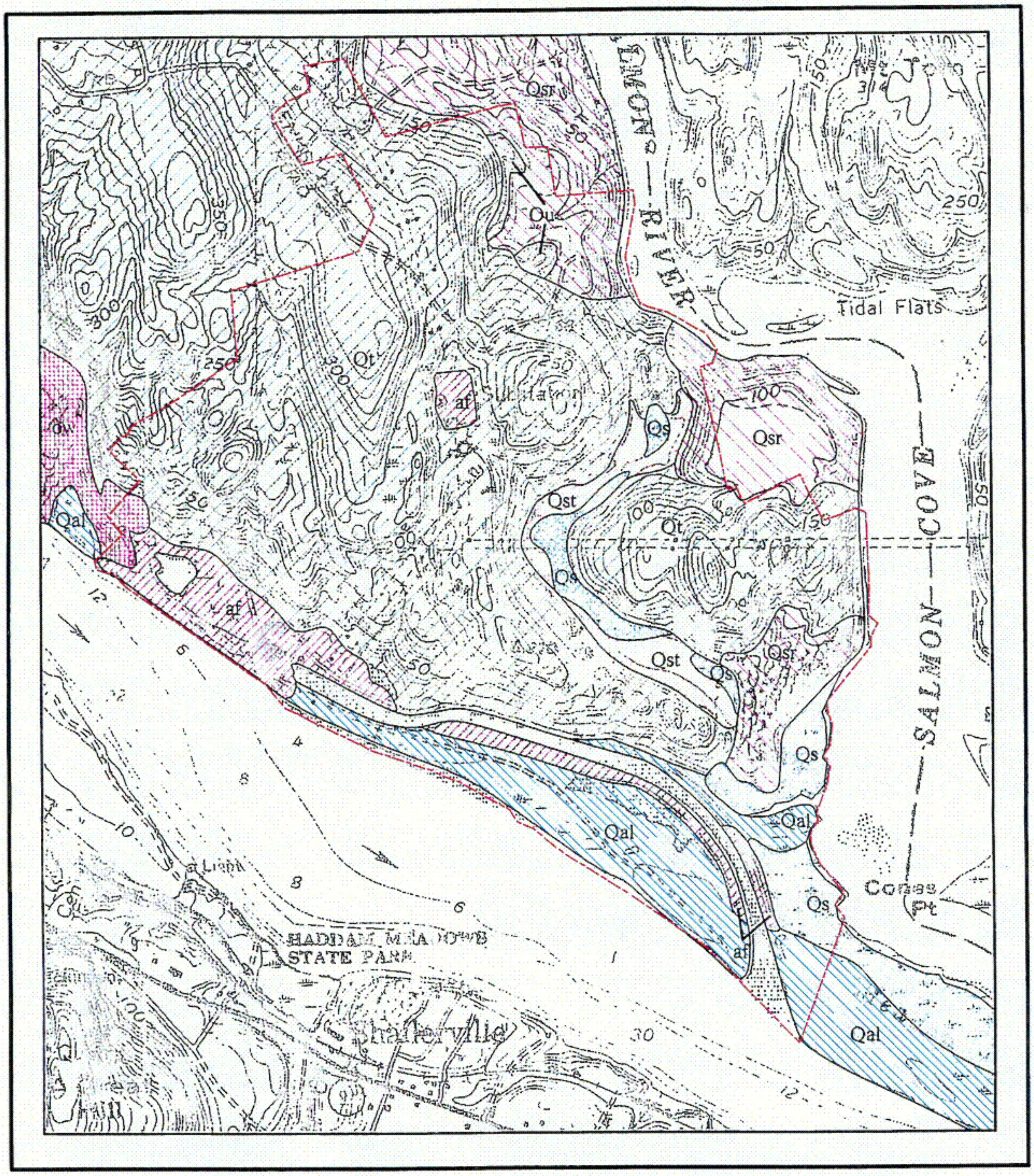


Figure 4-5



CY Atomic Power Plant Site

SURFICIAL GEOLOGIC MAP

- Ou : Uncorrelated Ice Contact Deposits
- Qal : Alluvium
- Qs : Swamp Deposits
- Qsr : Salmon River Deposits
- Qst : Stream Terrace Deposits
- Qt : Till
- af : Artificial Fill
- ow : Outwash Sediments

= CY Property Line

Produced By Survey Engineering, Northeast Utilities

Figure 4-6

C02

CONNECTICUT RIVER BASIN

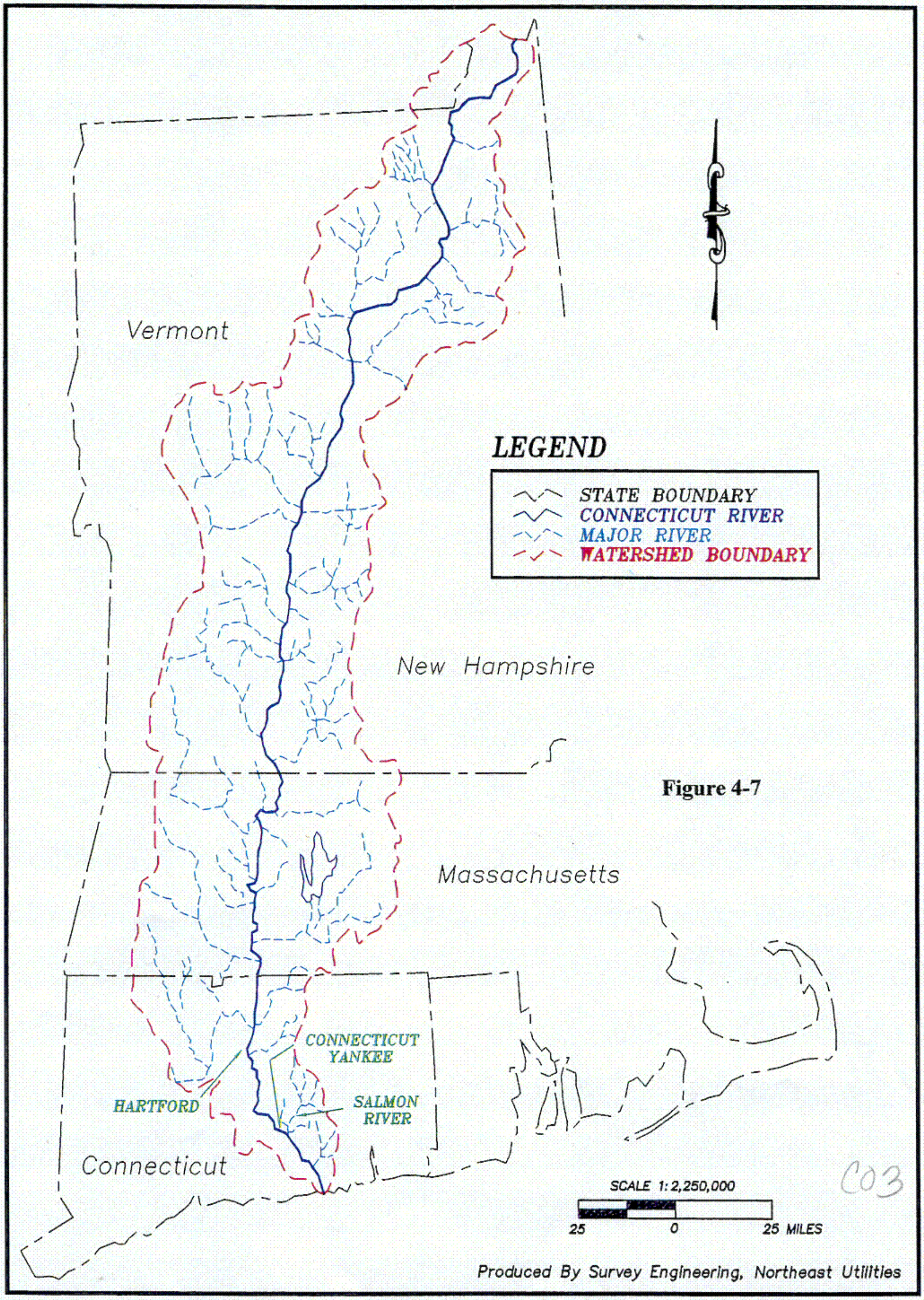
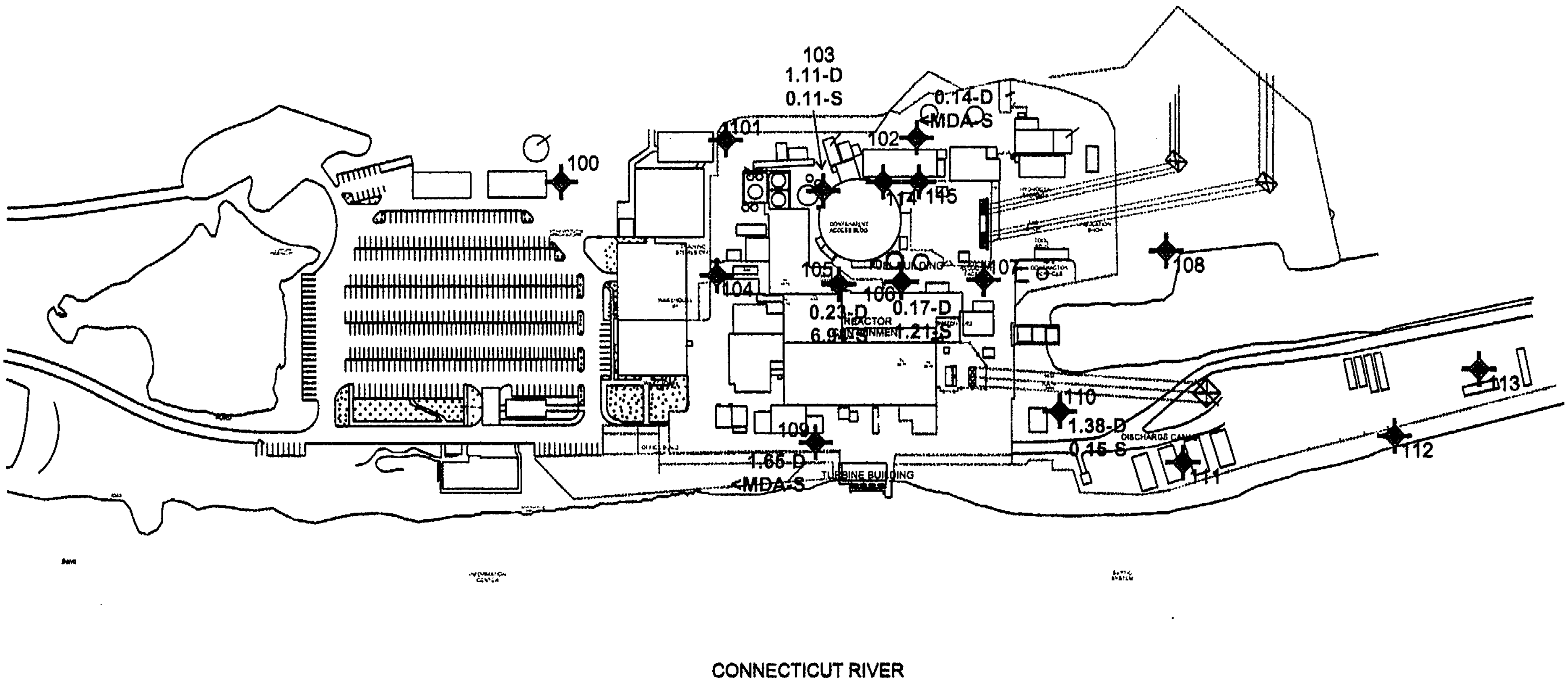


Figure 4-7

Figure 4-8 Preliminary Tritium Groundwater Results



Values are Multiples of the EPA drinking water standard of 20,000 pCi/liter **(Reference 4-2)**

Deep Well Designation = D

Shallow Well Designation = S

Well Location = ◆

All Other Wells Were <MDA (Minimum Detectable Activity)

Table 4-1

Haddam Neck Site 33-Foot
Wind Speed and Direction Joint Frequency Distributions
1991-1995

Direction	Wind Speed in Meters Per Second								
	0.5-1.5	1.6-3.3	3.4-5.5	5.6-8.2	8.3-10.8	10.9-15.0	15.1-20.0	>20.0	All
NNE	1.21	0.03	0.0	0.0	0.0	0.0	0.0	0.0	1.24
NE	1.19	0.03	0.0	0.0	0.0	0.0	0.0	0.0	1.22
ENE	2.13	0.07	0.0	0.0	0.0	0.0	0.0	0.0	2.2
E	4.51	0.47	0.04	0.0	0.0	0.0	0.0	0.0	5.01
ESE	3.79	0.67	0.06	0.0	0.0	0.0	0.0	0.0	4.53
SE	3.41	0.95	0.03	0.0	0.0	0.0	0.0	0.0	4.39
SSE	3.77	0.73	0.02	0.0	0.0	0.0	0.0	0.0	4.52
S	4.07	0.83	0.04	0.0	0.0	0.0	0.0	0.0	4.94
SSW	4.94	1.11	0.12	0.0	0.0	0.0	0.0	0.0	6.17
SW	4.84	1.04	0.11	0.0	0.0	0.0	0.0	0.0	5.98
WSW	4.25	1.43	0.1	0.0	0.0	0.0	0.0	0.0	5.79
W	4.31	3.58	0.6	0.06	0.0	0.0	0.0	0.0	8.55
WNW	5.9	6.41	2.8	0.23	0.0	0.0	0.0	0.0	15.34
NW	6.18	5.18	0.78	0.02	0.0	0.0	0.0	0.0	12.16
NNW	2.71	0.48	0.02	0.0	0.0	0.0	0.0	0.0	3.21
N	1.51	0.04	0.0	0.0	0.0	0.0	0.0	0.0	1.55
ALL	58.73	23.03	4.72	0.32	0.0	0.0	0.0	0.0	86.2

CALM (<0.5): 13.20

NOTE: Table entries are percentages of valid observations.

Reference: On-site program

Table 4-2

Haddam Neck Site 196-Foot
Wind Speed and Direction Joint Frequency Distributions
1991-1995

Direction	Wind Speed in Meters Per Second								
	0.5-1.5	1.6-3.3	3.4-5.5	5.6-8.2	8.3-10.8	10.9-15.0	15.1-20.0	>20.0	All
NNE	0.79	0.36	0.04	0.00	0.00	0.00	0.00	0.00	1.19
NE	0.71	0.50	0.07	0.01	0.00	0.00	0.00	0.00	1.30
ENE	0.72	0.99	0.71	0.18	0.04	0.02	0.00	0.00	2.65
E	1.38	1.17	0.51	0.12	0.01	0.00	0.00	0.00	3.20
ESE	1.67	2.35	0.66	0.13	0.02	0.01	0.00	0.00	4.85
SE	1.09	3.83	2.77	0.87	0.08	0.02	0.00	0.00	8.66
SSE	1.02	2.05	1.35	0.37	0.08	0.01	0.00	0.00	4.87
S	1.17	1.52	1.66	0.65	0.04	0.00	0.00	0.00	5.04
SSW	1.37	1.75	2.04	0.81	0.05	0.00	0.00	0.00	6.02
SW	1.54	1.14	1.15	0.43	0.03	0.00	0.00	0.00	4.29
WSW	2.01	1.06	0.95	0.42	0.06	0.01	0.00	0.00	4.51
W	2.87	1.80	1.37	0.92	0.33	0.11	0.00	0.00	7.41
WNW	4.12	5.35	4.43	2.61	1.00	0.30	0.01	0.00	17.81
NW	3.12	5.18	5.36	2.38	0.46	0.06	0.00	0.00	16.56
NNW	2.29	2.97	1.52	0.31	0.01	0.00	0.00	0.00	7.10
N	1.34	1.36	0.35	0.05	0.00	0.00	0.00	0.00	3.10
ALL	27.24	33.36	24.95	10.28	2.20	0.52	0.01	0.00	98.56

CALM (<0.5): 1.44

NOTE: Table entries are percentages of valid observations.

Reference: On-site program

5.0 Historical Site Assessment Methodology

The methodology of the HSA is as suggested by NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) and American Society for Testing and Materials Standards (ASTM)-Standard Practice for Environmental Site Assessment E 1527-94 and E 1528-93, respectively.

5.1 Approach and Rational

Historical research is an important element of a comprehensive site assessment. A well planned strategy of investigation can save time and provide focus for the site inspection, sampling and removal/remediation.

The assessment methods used to accomplish and prepare the HSA include:

- On-site investigations using past and current reports produced by the operating staff and regulators,
- Interviews with past and present employees regarding knowledge of chemical and radiological contamination of the environmental media,
- Review of regulatory actions against the site,
- Review of environmental investigations conducted by independent consulting firms,
- Review of Radiation Protection survey data, 1967 to present,
- Review of annual reports,
- On-site walk downs and inspections, and a
- Review of operating records.

The review of plant records consisted of routine radioactive effluent release reports, non-routine reports submitted to the Nuclear Regulatory Commission under provisions of the technical specifications, 10CFR20, or 10CFR50, plant incident reports or condition reports, radiological surveys and findings documented in accordance with other assessment processes such as the Quality Assurance Program and oversight activities. The information obtained through this process is a source of data to records maintained on site to satisfy the requirements of 10CFR50.75(g)(1).

The objective of the document reviews was to identify significant events that caused the contamination of systems, buildings, external surfaces, subsurface areas, or waterways, via atmospheric releases, liquid spills or releases, or the breakdown of control of solid radioactive material. For each event, available supporting documentation was collected and reviewed. The HNP nuclear records management system provided the primary source of information gathered through the HSA process.

During the writing of this HSA, excerpts from written reports, correspondence, documents and records were used to develop the text.

Limits and Exceptions

The HSA is designed with the four components described as follows:

- Records review- consisting of the listed references in Sections 9.0 and 10.0,
- Interviews- consisting of past and present employees to verify conditions as documented,
- Site Reconnaissance- consisting of numerous site inspections assisted by historic records, site prints, diagrams, and aerial photographs, and
- Report- the compiled data with evaluation.

During site characterization and remediation phases, additional sources of information may surface. A review of these sources will be performed as an integral part of the License Termination Process.

5.2 Boundaries of the Site

The site consists of approximately 525 acres, bounded by the property lines as shown on Site Location Map, Figure 4-2. The minimum distance overland from the reactor containment to the site boundary is 1,740 ft and the distance to the nearest residence is over 2,000 ft.

The location and orientation of principal plant structures within the site area are shown on the Site Plot Plan, Figure 5-1.

5.3 Documents Reviewed

During the development of this HSA over 40,000 documents were reviewed for environmental and radiological information that might have some bearing on decommissioning and site restoration. The review did not indicate that a gap in radiological data existed. However, documents and data not subject to the record keeping requirements of the NRC were only retained for five years.

Information for the HSA was taken from the documents and references listed in Section 9.0 and 10.0

5.4 Property Inspections

The site was intensely reviewed, and used as a base for observations of peripheral properties. Unfettered access to the site was achieved through qualifying evaluators for unescorted access.

Radiation protection surveys, dating from 1967 to June 30, 2000, and environmental studies/investigations prepared by engineering firms and regulators were reviewed and compared to reports and information produced by the operating staff to aid in the HSA development. "Walk-downs," inspections and informal interviews were conducted to verify reported conditions.

The survey of many inaccessible or not readily accessible areas or surfaces was deferred. Examples of areas where surveys were deferred are soils under structures, contaminated sumps, pipe trenches, and the containment dome. The decision to defer the survey of an area was based on one or more of the following conditions:

(1) The area is either a high radiation or high contamination area and additional data would likely not change the survey area or unit classification of the location or surrounding areas,

(2) Safety considerations for example, difficulty of access to the upper reaches of the containment dome due to height above the charging floor,

(3) Historical data and process knowledge shows that the area could be classified without further characterization,

(4) Access for characterization would require significant deconstruction of adjacent systems, structures or other obstacles the removal of which could result in an unsafe condition or interfere with continued operation of required components, and

(5) The ability to use engineering judgment in assigning the area a MARSSIM classification based on physical relationship to surrounding areas and the likelihood of the area to have radiological conditions represented by the conditions in these adjacent areas.

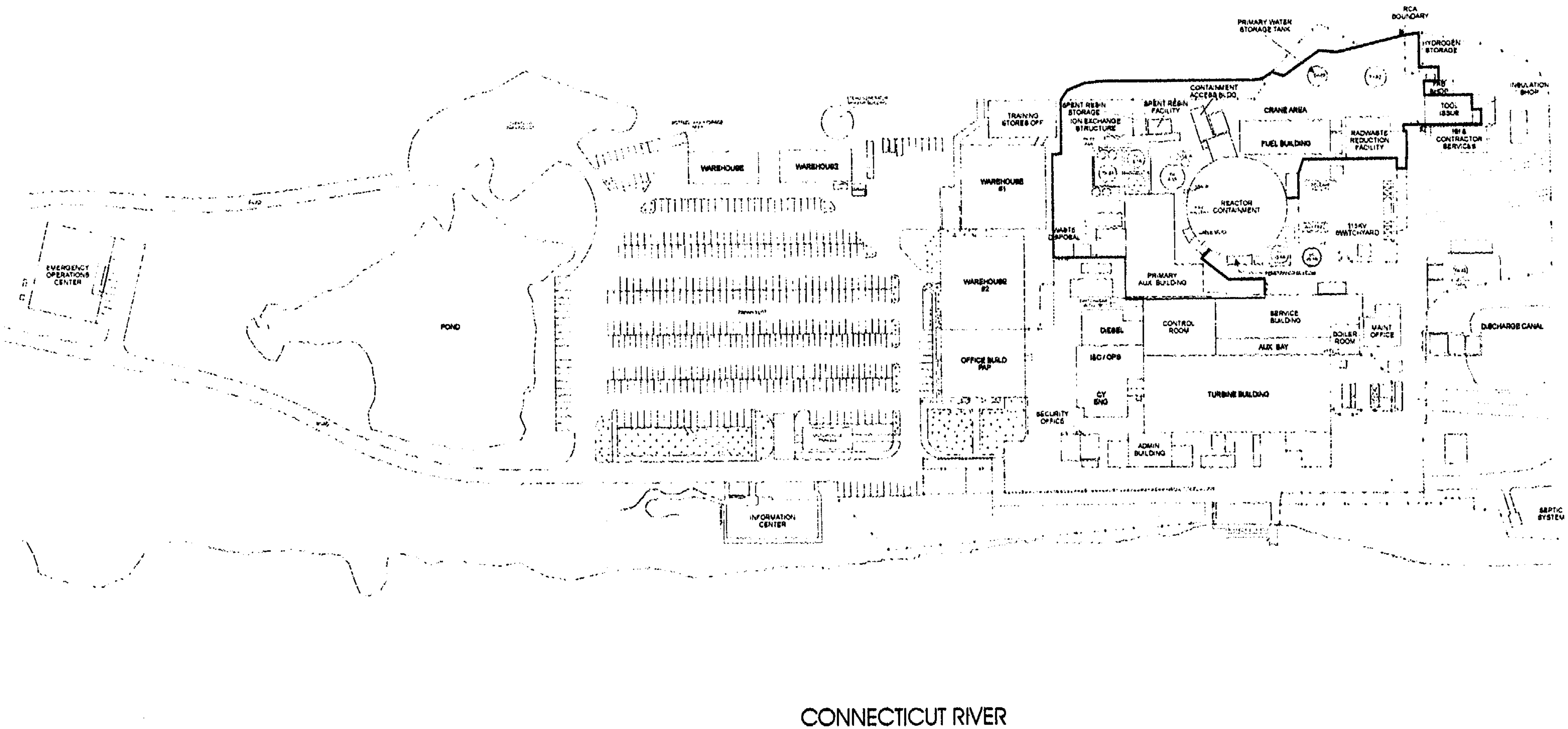
As decommissioning progresses these areas will become accessible as radiation sources are removed and scaffolding is built to accommodate equipment removal.

5.5 Personal Interviews

During the preparation of the HSA, numerous individuals from the operating staff, the present staff, as well as vendors and contractors were informally interviewed to verify, provide or clarify data used to develop the HSA document.

Requests were made via site and utility newsletters for any individuals who had information regarding past operations impact on site closure to present that information to the HSA/site characterization team.

Additionally, 47 formal interviews, based initially on questionnaires filled out by employees regarding contamination issues, were conducted. A report containing information derived from the interviews was reviewed and included in this HSA. (Reference 5-1)



Plant North

CONNECTICUT YANKEE ATOMIC POWER COMPANY
GENERAL ARRANGEMENT DRAWING
SITE PLOT PLAN
Figure 5-1

LEGEND:

FLOOR WALL INTERSECTION
RCA BOUNDARY

6.0 History and Current Usage

Interviews, site documents and various reports were reviewed to determine site history. Onsite inspections, audits and interviews identified and verified current usage.

(Note: The electrical production rating of the facility changes over time due to upgrades and modifications to the plant.)

6.1 History

Introduction
Prior to selection, in the mid to late 1700's, the site was marshy woodland utilized as a wood cutting lot by a freed slave. The foundation and ruins of the home are located on CYAPCO property.

In the 1800's, the Brainerd family built a home that was located on the CYAPCO property near the present day entrance to the facility. This home site was also referred to as the Barcal house in latter years.

Over the years, the Barcal family used the area as a pasture and eventually, in the late 1940's, a small, private airport was located on the site. CYAPCO demolished the house and airport as part of site construction.
(Reference 6-1)

The selection of the site for construction, an area on the east side of the Connecticut River, known as Haddam Neck, fulfilled all requirements for a nuclear power station. Important attributes of the area selected were the following:

1. Adequate volumes of cold water were available due to the flow in the Connecticut River and the tidal flow from Long Island Sound impressed on the normal flow. The tidal flow is more important in seasons of low water than the river flow itself.
2. The site was within a relatively short distance of the existing power grid and the consumers.
3. The site was a dominantly rural area with mostly idle, rocky ground of marginal agricultural productivity.
4. The site was accessible to river and highway transportation.
5. Population, diversity of skills in the vicinity, and manufacturing capability were such that workers, materials, and equipment were readily obtainable.

(Reference 6-2)

The Connecticut Yankee Atomic Power Company, formed from a group of New England electric utilities, applied to the Atomic Energy Commission (AEC) on September 6, 1963 for a permit to construct and operate a 1437 MWt (490MWe) nuclear power plant. The eleven utilities owning stock in the plant were the following:

Boston Edison Company	9.5%
Central Maine Power Company	6.0%
Central Vermont Public Service Corporation	2.0%
The Connecticut Light and Power Company	25%
The Hartford Electric Light Company	9.5%
Montaup Electric Company	4.5%
New England Power Company	15%
New England Gas and Electric Association	4.5%
Public Service Company of New Hampshire	5.0%
The Illumination Company	9.5%
Western Massachusetts Electric Company	9.5%

(Reference 6-2)

Years of Operation

The Advisory Committee on Reactor Safety Report was issued on February 19, 1964, which indicated that the reactor as designed would not present an undue safety hazard were it constructed and operated. The Public Hearing was held in Middletown, Connecticut, by the Atomic Safety and Licensing Board on April 1-2, 1964. An initial decision was rendered on May 14, 1964 and a Construction Permit No. CPRP-14 was issued by the AEC on May 26, 1964 in Docket 50-213. The AEC issued a Provisional Operating License, DPR-14, June 30, 1967, and initial criticality was achieved July 24, 1967. Power operation began on August 7, 1967. Commercial operations began on January 1, 1968. On March 11, 1969, the plant was licensed to operate at its designed rating of 1825 MWt or 600MW of gross electric power. The plant capacity factors for 1968 through 1971 were 73, 75, 71, and 84%, respectively. Reactor operation ended on July 22, 1996. An operating history for the Haddam Neck Plant is presented in Table 6-1. (Reference 6-2)

Facility Description and Operation

The Haddam Neck Plant, owned by Connecticut Yankee Atomic Power Company, is located on the east bank of the Connecticut River, approximately 21 miles south-southeast of Hartford.

The plant incorporated a 4-loop closed-cycle pressurized water type nuclear steam supply system (NSS system); a turbine generator and electrical systems; engineered safety features; radioactive waste systems; fuel handling systems; instrumentation and control systems; the necessary auxiliaries; and structures to house plant systems and other onsite facilities. HNP was designed to produce 1,825 MW of thermal power and 590 MW of gross electrical power.

Westinghouse Electric Corporation was responsible for design and fabrication of all nuclear steam supply and auxiliary systems and equipment, as well as design and supply of all secondary plant mechanical and electrical equipment, which it normally manufactures. Stone and Webster Engineering Corporation were responsible for site development, design of buildings and secondary systems, and all plant construction. Each of these contractors was responsible to the Connecticut Yankee Atomic Power Company for tasks performed in their respective areas of design and construction. Plant checkout, core loading, plant start-up and operation were the responsibility of the Connecticut Yankee Atomic Power Company.

In 1999, Bechtel Corporation was chosen as the Decommissioning Operations Contractor (DOC).
(Reference 6-3)

Regulatory Involvement

The Connecticut Yankee Atomic Power Plant has been closely regulated and monitored both internally by in house staff and contractors, and externally by regulators, industry groups, and independent outside assessors during its construction, operational and decommissioning phases.

There was an extensive focus at the plant for the monitoring of radiological issues; whereas, the lesser, and appropriate level of monitoring for Resource Conservation and Recover Act (RCRA) issues seems to be consistent with exposure potential.

Regulatory Affairs Department CYAPCO
To keep abreast of regulatory issues and meet industry standards that may concern and affect the utility, CYAPCO established the Regulatory Affairs Department.

The responsibilities of the Regulatory Affairs Department are:

- Coordination, preparation and submittal of correspondence to the NRC,
- Revisions to and maintenance of the Updated Final Safety Analysis Report, Technical Specifications and the Technical Requirements Manual,
- Ensures conformance to current operating license conditions; NRC regulations, Regulatory Guides, and all applicable federal, state, and local codes and standards,
- Evaluates regulatory agency requirements, proposes actions and provides interpretations to senior management,
- Develops actions to be taken on such proposals that may have a major impact on nuclear safety and decommissioning and,
- Responsible for administering the Industry Experience Program.

(Reference 6-4)

United States Atomic Energy Commission
Prior to the formation of the NRC, the AEC was the federal agency responsible for licensing and regulating nuclear power plants in the United States. AEC/Utility correspondences from 1962 to 1975 primarily concern license activities, reactor design, training, staff infrastructure, development of procedures and radiation protection issues. In 1974, the AEC transitioned to the NRC. (Reference 6-5, 6-6, 6-7)

United States Nuclear Regulatory Commission (NRC)
Replacing the AEC in 1975, the NRC is the primary federal regulator of nuclear power plants in the U.S. In 1980, the NRC increased surveillance of licensed utilities by stationing onsite inspectors at all nuclear power plants in the United States, including HNP. As part of their duties, the inspectors performed daily-routine inspections and assisted with regulatory issues.

Additionally, in 1980, the NRC started the Systematic Assessment of Licensee Performance (SALP) program to provide feedback to the utility on operating performance in four functional areas: plant operations, maintenance, engineering, and plant support. (Reference 6-8)

United States Environmental Protection Agency
The EPA is the federal agency responsible for authorization and oversight of CTDEP programs and primarily responsible for actions associated with RCRA Corrective Action Program Environmental Indicators.
(Reference 6-9)

Department of the Army, Corps of Engineers
The Department of the Army, Corps of Engineers, authorizes and permits water front construction activities along the Connecticut River. The Corps of Engineer issued permits for dredging and dock building at HNP. (Reference 6-9)

Connecticut Department of Environmental Protection
The CTDEP is responsible for environmental programs as authorized by the EPA and the state regulator for environmental affairs at HNP. (Reference 6-9)

Local Governments
The Township of Haddam issued permits for wetlands and construction activities that occurred at HNP. (Reference 6-9)

Permits and Licenses

Initial permits, licenses, or other approvals for construction and operation of the Connecticut Yankee Plant are listed below:

- Application to the Zoning Commission of the Town of Haddam to construct the plant was approved on September 15, 1962.
- A construction permit, CPPR-14, was issued by the Director, Division of Reactor Licensing, USAEC, on May 26, 1964.
- Permit for screenwell and dredging was issued by the State of Connecticut, Water Resources Commission on October 21, 1964.
- Permit for construction the screenwell and dredging in the Connecticut River issued by the Department of the Army, Corps of Engineers, October 30, 1964.
- A permit was granted by the Water Resources Commission, State of Connecticut, for constructing and maintaining a 115kV transmission line across the Connecticut River, November 17, 1964.
- A transmission line crossing was approved by the Department of the Army, New England Corps of Engineers on November 19,1964.
- The applicant certified to the Connecticut State Department of Health on January 25, 1965, that requirements of the Connecticut State Department of Health outlined in the publications listed below are met by the plant:

    1. Regulations regarding cross connections,
    2. Public Health Code concerning Wells and Springs for Public or Residential Use,
    3. Connecticut State Department of Health Regulations, sections 19-13-B3 through 13-30,
    4. Private Water Supplies 8^{th} ed. F.M. Foote, M.D.

- The Public Utilities Commission, State of Connecticut approved "Method and Manner of Constructing a 115kV Line in the Town of Haddam." February 11, 1965 and May 3, 1966.
- The Department of the Army, New England Corps of Engineers, granted a Federal Permit for authorizing construction of (2) 345kV transmission lines across the Connecticut River between Middletown and East Hampton, Connecticut, July 27, 1966.
- The Corps of Engineers also granted a Federal Permit for constructing a 345 kV transmission line crossing between Middletown and Portland, Connecticut the same day, July 27, 1966.
- The Public Utilities Commission, State of Connecticut, granted a permit June 23, 1966 to construct a 345kV transmission line between the Town of Haddam to Manchester, and one from the town of Haddam to the town of Southington Connecticut. (This permit was granted following a public hearing on May 31, 1966.
- The U.S. Atomic Energy Commission issued a Provisional Operating License June 30, 1967.
- A license to operate the plant at 1825 MWt (600 MWe) was granted by the U.S. Atomic Energy Commission on March 11, 1969.
- The Water Resources Commission, State of Connecticut, issued a Water Quality Certification to the applicant July 19, 1971.

(Reference 6-2)

Resource Conservation Recovery Act
The site is a generator of hazardous waste and a permitted Part A Treatment Storage facility to maintain storage of mixed and hazardous waste. Briefly, the history of CYAPCO permits for RCRA activities are as follows:

On November 18, 1980, the utility submitted a Part A Application for the Hazardous Waste Management Facility at the Haddam Neck Plant. By that submission, the facility at Haddam Neck Plant achieved interim status for the storage of hazardous wastes.

On October 27, 1987 CYAPCO revised the Part A Application to delete asbestos, and add various other hazardous wastes.

On November 7, 1988 CYAPCO submitted a closure plan for the existing hazardous waste container storage area to the EPA and CTDEP. Included with that submittal was a revised Part A Application, which again added and subtracted various hazardous wastes.

On March 23, 1989 CYAPCO submitted another revised Part A Application to comply with regulatory changes concerning mixed waste. The revised application qualified the Haddam Neck Plant for interim status to treat and store mixed waste.

On June 1, 1999, CYAPCO submitted to CTDEP a revised Part A Permit Application. The revision accommodates new waste streams derived from the decommissioning process and increases the storage capacity of the facility. (Reference 6-9)

Table 6-2 provides an overview of recent and current permits.

Waste Handling Procedures

Early on, the facility developed operating and administrative procedures as required by regulators and the NSS system vendor to:

- Protect the reactor and NSS system,
- Protect the general public and site personnel and,
- To operate within the rules, regulations and guidelines of local, state, and federal agencies.

Administrative Control
Written procedures were established, implemented and maintained in accordance with the HNP Technical Specifications and Connecticut Yankee Quality Assurance Program.

The HNP procedures cover a wide range of programs and areas. They include:

- Safe Storage of Spent Fuel,
- Operations and Maintenance,
- Decommissioning,
- Plant Security,
- Emergency Planning,
- Radiation Protection Program,
- Fire Protection Program,
- Process Control Program,
- Radiological Effluent Monitoring and Offsite Dose Calculation Manual,
- Radioactive Effluent Control Program,
- Radiological Environmental Monitoring Program, and
- Technical Specifications Bases Control Program.

Procedures specifically related to waste management are under the following categories:

- ACP- Administrative Control and Quality Assurance
- SNM- Special Nuclear Material
- Eng- Engineering
- NOP- Normal Operating
- AOP- Abnormal Operating
- SUR- Surveillance
- CHM- Chemical Control
- CMP- Corrective Maintenance
- ESP- Environmental Service
- HWM-Hazardous Waste Materials
- REM- Radioactive Effluent Monitoring
- RPM- Radiation Protection
- MPM- Material Procurement

(Reference 6-10)

Radioactive Material Controls

The earliest procedures available for review are Standardized Procedure #17, Unconditional Radiological Release of Material Offsite, Revision 0, dated October 20,1981; RAP 6.2-14, Unconditional Radiological Release of Material Offsite, Revision 0, dated January 28, 1982; and RPM 2.2-8, Unconditional Release Surveys, dated January 13, 1989. These procedures described how potentially contaminated material must be surveyed prior to being unconditionally released from the radiation control area.

The procedure was superseded by RPM 2.2-8. The procedures from 1982 and 1989 provided specific instructions for the radiation survey of solid materials that may have fixed and/or removable surface contamination. The procedures specify that material containing detectable radioactive material, defined as 100 counts per minute, for beta-gamma surveys and 4 counts per minute above background for alpha particle surveys, is not to be released for unconditional release. The procedural guidance is consistent with early 1980s industry practices and NRC guidance published in Information Notice 81-07, "Control of Radioactive Contaminated Material (5/81)

In 1985, the NRC updated its radiological survey guidance for the unconditional release of potentially contaminated material to reflect the growing concern about the inadvertent release of licensed radioactive material.

The update in Information Notice 85-92, "Surveys of Wastes Before Disposal from Nuclear Facilities (12/85)" addressed the need for licensee's to perform more sensitive surveys for large surfaces and packages of aggregated wastes. CYAPCO's procedure, written in 1987 did not address the updated NRC guidance. (Reference 6-11)

Process Control Program

The Process Control Program (PCP) for Haddam Neck was proposed in 1979 by CYAPCO and described the functions of the Liquid Waste System and Purification System. The purpose of the PCP was to ensure that the radioactive liquid solidification system was operated in accordance with burial site criteria and Title 10 requirements. The Radiation Protection Manual administratively controlled the PCP.

In 1985, plant procedures were modified to improve and correct radioactive waste programmatic issues such as scaling factors, training, shipping and the release of radioactive materials. Additionally, the utility reactivated the Radwaste Review Committee to improve program oversight.

In 1986, a NRC inspection identified four weaknesses in the waste management program. Corrective actions were implemented and closed out during an inspection in 1987. During a 1991 inspection, changes to the radwaste system, including the installation of a spent resin storage tank were reviewed. Controls were determined to be appropriate by the NRC inspector.

The 1998 NRC Historical Review Team Report concluded that the improvements in training, quality assurance inspection practices and documentation in the Process Control Program were adequate, thus resolving previous concerns. Some of the outdoor practices, however, may have resulted in the spread of contamination to areas on the CYAPCO property that were not included in the plant's survey program. (Note: These areas were surveyed and radiological survey data is on file.) (Reference 6-11)

Radioactive Waste Disposal
The Radiation Protection Manual administratively controlled the radioactive waste management program. After analysis, processing and packaging, radioactive wastes were shipped to one or more of the listed facilities for volume reduction, processing or final disposition:

- Barnwell Disposal Facility/Chem Nuclear
- ATCOR
- SEG
- American Ecology
- Quadrex
- GTS Duratek
- Manufacture Science Corp.
- Alaron
- Envirocare

(Reference 6-9)

Solid Waste (Non-Radioactive)
The HNP operated with numerous environmentally related procedures that were a mix of corporate and HNP controlled documents with the responsibility being shared as well. Little critical information exists on the quality of these procedures for environmental controls at HNP. Consequently, an evaluation of the effectiveness of these procedures could not be readily determined; however, adequate documentation existed to perform the assessment.

CYAPCO received a construction debris landfill permit from the State of Connecticut in 1974 for disposal of bulk waste, demolition debris, in the area known as "the shooting range" or sandpit. After use the area was closed as permitted. Contrary to the permit, the actual area used for disposal of the demolition debris was not the same area that the state permitted in 1974, an area adjacent to the site used by CYAPCO. The area continued to receive debris after the closure. Discovery of this issue by the CTDEP in 1997 resulted in an agreement to remediate and close this area at the end of decommissioning.
(Reference 6-12)

Used or out of date materials, considered scrap or surplus, were offered to salvage companies, recyclers, sold back to suppliers, offered to employees for home use or evaluated and disposed of as waste.

Household waste, food scraps and office debris, are collected locally, placed in dumpsters and then hauled to licensed landfills.

Within the last 10 years, the segregation and recycling of printer/copier paper has become a common practice on site. (Reference 6-9)

RCRA Waste Disposal
The DOC staff identifies, collects and ships hazardous waste to licensed treatment and disposal facilities for final destruction of the hazardous waste. The companies contracted to accept this waste from HNP for disposal are:

- AETS- (Onyx)
- Waste Management by Logano
- Diversified Scientific (DSSI)
- Fleet Environmental

Satellite Accumulation Areas, established to collect RCRA hazardous wastes, are routinely used at HNP. These areas are set up to accommodate the collection of regulated wastes resulting from maintenance and decommissioning operations. The accumulation areas are considered temporary and may be set up as needed. When the containers from the satellite areas are filled, they are moved to Container Storage Areas.

Container Storage Areas are established to store containers of hazardous waste prior to shipment to an off-site processor or disposal facility. HNP has four established Container Storage Areas:

- Lube Oil Room
- Rad Waste Reduction Facility
- Spent Resin Storage Area
- Hazardous Material Warehouse

(Reference 6-13)

Connecticut Regulated Wastes
Non-RCRA wastes, regulated by the State of Connecticut, are identified, collected and shipped to licensed disposal facilities for segregation, reclamation, and final disposition or destruction. The wastes are managed in the same manner as RCRA hazardous wastes at the HNP. (Reference 6-9)

6.2 Current Usage

On December 4, 1996, HNP permanently shut down after approximately 28 years of operation. On December 5, 1996, CYAPCO notified the Nuclear Regulatory Commission of the permanent cessation of operations at the HNP and the permanent removal of all fuel assemblies from the Reactor Pressure Vessel and their placement in the Spent Fuel Pool. Following the cessation of operations, CYAPCO began to decommission the HNP. The Post Shutdown Decommissioning Activities Report (PSDAR) was submitted, in accordance with 10CFR50.82 (a)(4), on August 22, 1997, and was accepted by the NRC. On January 26, 1998, CYAPCO transmitted an Updated Final Safety Analysis Report to reflect the plant's permanent shutdown status, and on June 30, 1998, the NRC amended the HNP Facility Operating License to reflect this plant condition. On October 19, 1999, the Operating License was amended to reflect the decommissioning status of the plant and long-term storage of the spent fuel in the spent fuel pool. Additional licensing basis documents were also revised and submitted to reflect long-term fuel storage in the spent fuel pool (Defueled Emergency Plan, Security Plan, QA program, and Operator Training Program). (Reference 6-14)

Decommissioning Cost Study
The purpose of the 1996 decommissioning cost study was to prepare estimates for the cost, schedule, occupational exposure and the waste volume generated in decommissioning the HNP. Immediate decommissioning, safe storage, and entombment were evaluated for feasibility and cost.

After conducting a thorough review of the estimated costs and other factors involved in the decommissioning methods currently available, the major conclusion of the study is that decommissioning can be accomplished technically, as well as in the most cost-effective manner, by the prompt dismantlement or immediate method. (Reference 6-15)

Site Characterization
The site characterization for HNP includes the results of surveys and evaluations conducted to determine the extent and nature of the contamination at the site. The initial characterization, performed in accordance with the guidelines of the "Multi-Agency Radiation Survey and Site Investigation Manual," began in 1997 and was completed in 1999. The initial characterization included a review of historical documents, and measurements, samples, and analyses to further define the current conditions of the site. The effort also evaluated hazardous and state-regulated non-radioactive materials at the site that may require remediation and disposal.

The information developed during the initial HNP characterization program represents a radiological and hazardous material assessment based on the knowledge and information available at the end of 1999. The objectives of the initial characterization program were:

1. To divide the HNP site into manageable sections or areas for survey and classification purposes;

2. To identify the potential and known sources of radioactive contamination in systems, on structures, in surface or subsurface soils, and in ground water;

3. To determine the initial classification of each survey area or unit as non-impacted or impacted Class 1, 2, or 3 as defined in MARSSIM;

4. To develop the initial radiological and hazardous material information to support decommissioning planning including building decontamination, demolition, and waste disposal;

5. To develop the information to support Final Status Survey design including instrument performance standards and quality requirements; and

6. To identify any unique radiological or hazardous material health and safety issues associated with decommissioning.

(Reference 6-16)

Assignment of System Survey Code

The Site Characterization Team performed the assignment of surveys units, system survey codes and site area classification. A survey unit is a physical area consisting of structures or land areas of specified size and shape for which a separate decision will be made as to whether or not residual contamination in that area exceeds the release criterion. A survey unit does not include areas that have different classifications, and its characteristics should be generally consistent with the exposure pathway modeling. Then each survey unit was assigned a unique four digit System Survey Code that will be used to identify the area for documentation and tracking. The survey areas identified in Table 6-3 have been established based on logical physical boundaries and site landmarks for the purpose of documenting and conveying initial characterization information for the HNP site. The survey areas are depicted in the maps presented as Section 10.0.

Site Area Classification
Classification is the process that an area or survey unit is described according to its radiological characteristics. The significance of classification is that this process determines the final status survey design and the procedures used to develop this design. In classifying areas, those that have no reasonable potential for residual contamination are classified as non-impacted areas. These areas have no radiological impact from site operations and are typically identified early in decommissioning. Areas with some potential for residual contamination are classified as impacted areas. Impacted areas are further divided into one of three classifications:

- Class 1 areas: Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiological surveys) above derived concentration guideline levels. Examples of Class 1 areas include:

  1. Site areas previously subjected to remedial actions,
  2. Locations where leaks or spills are known to have occurred,
  3. Former burial or disposal sites,
  4. Waste storage sites, and
  5. Areas with contaminants in discrete solid pieces of material with high specific activity.

- Class 2 areas: Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed derived concentration guideline levels. To justify changing the classification from Class 1 to Class 2, there should be measurement data that provides a high degree of confidence that no individual measurement would exceed the derived concentration guideline levels. Other justifications for reclassifying an area as Class 2 may be appropriate, based on site-specific considerations. Examples of areas that might be classified as Class 2 for the final status survey include:

  1. Locations where radioactive materials were present in an unsealed form (e.g., process facilities),
  2. Potentially contaminated transport routes,
  3. Areas downwind from stack release points,
  4. Upper walls and ceilings of some buildings or rooms subjected to airborne radioactivity,
  5. Areas where low concentrations of radioactive materials were handled, and

6. Areas on the perimeter of former contamination control areas.

- Class 3 areas: Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the derived concentration guideline levels, based on site operating history and previous radiological surveys. Examples of areas that might be classified as Class 3 include buffer zones around Class 1 or Class 2 areas, and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

The classifications provided in Table 6-3 apply to all survey units within the survey area and were developed as part of the conceptual model in Section 10.0

Conceptual Model
The model for classification of the HNP site, presented in Section 10.0, uses the existing breakdown and numbering scheme for site grounds and structures. The area definitions were established for decommissioning and were used and expanded upon during subsequent site characterization activities. Information obtained from the site radiation protection surveys, samples and events were used to develop this model and establish area classifications.

RCS Decontamination
To reduce radiation exposure during decommissioning, CYAPCO management elected to perform chemical decontamination on major systems prior to the start of decommissioning activities. The Siemens' CORD process was selected. The decontamination was performed in a single application of two cycles over a 28-day period. An average decontamination factor of 15.9 was obtained. The average initial contact radiation field or 234 mR/hr was reduced to 27 mR/hr. Total waste ion exchange resin was 465 cubic feet, only 115 cubic feet was attributed to decontamination. The balance was due to the desire to avoid greater that Class C waste as a result of transuranic radionuclides present in the system from previous fuel failures. A total of 182 lbs. of metal and 131 Curies of activity was removed. Table 6-4 provides a summary of activity removed. (Reference 6-17)

Identification of Remaining Site Dismantlement Activities
CYAPCO's primary goals are to decommission the HNP safely and to maintain the safe storage of spent fuel. Facility materials and surfaces will be decontaminated to allow beneficial reuse.

Materials that cannot be decontaminated will be sent to an offsite radioactive waste processor to recycle or to a low-level waste disposal site.

Completion of decommissioning the HNP site depends on the availability of low-level waste disposal sites. Currently, HNP has access to low-level waste disposal facilities in Barnwell, South Carolina, and in South Clive, Utah. (Reference 6-9)

Onsite Demolition
As of March 2000, ten support buildings have been demolished and the debris removed. These buildings located in the Industrial Area were released under CYAPCO procedure- RPM 2.2-22 Vehicle and Material Release from Radiologically Controlled Areas and Restricted Areas or sent to a waste segregation processor for final disposition. These buildings and facilities are:

- Fabrication Shop,
- Maintenance Offices
- Butler Building Maintenance Shop,
- Butler Building Insulation Shop and Storage,
- NUSCO Module,
- MYROCK Fabrication Shop,
- Fitness Center,
- Security Office, and
- Security Lockers.

(Reference 6-18)

Waste Type and Volumes

Connecticut Regulated Wastes
There are several types of industrial wastes produced at HNP that are considered to be Non-RCRA hazardous wastes by the State of Connecticut. Examples of HNP wastes are:

- Waste oil and lubricants from machinery,
- Construction debris,
- Antifreeze
- Asbestos from insulation
- Solid paint waste resulting from the drying of paints,
- Waste Polychlorinated Biphenyls (PCBs) from articles, paints and plastics,
- Spill residues and contaminated soil not meeting RCRA criteria.

RCRA Wastes
Waste material determined to contain or meet the description of hazardous wastes as defined by Title 40 CFR part 261 are generated at HNP as part of maintenance and decommissioning activities.

Examples of HNP produced RCRA wastes are:

- Spent solvents from lab processes
- Chrome containing process liquids
- Lead waste from shielding and paints
- Mercury waste from instruments
- Cadmium waste from filter frames, and batteries
- Chlorinated Solvents from lab and cleaning processes
- Corrosive wastes from lab and cleaning processes
- Spent aerosol cans from maintenance activities
- Ignitable waste liquids from labs and maintenance activities
- Paint related solvents from maintenance activities

(Reference 6-19)

Radioactive Wastes
Wastes determined to contain radioactive materials are collected, evaluated and segregated according to waste form. The waste forms at HNP are:

- Dry Active Waste- Paper, wood, used protective clothing, sweepings and so forth
- Asbestos- Coatings, insulations radioactively contaminated,
- Soils, Concrete, Asphalt from yard areas, offsite recovery and subsurface,
- Equipment, tanks, pumps, steam generators, reactor parts, and major components,
- Sludge- Organic and non-organic materials from the bottom of tanks and sumps
- Charcoal- Filter media used in the filtration of liquid wastes to remove organic materials in the process stream,
- Filters- Filter materials or items used in the filtration of liquid wastes or process fluids,
- PCB containing paints, plastics, components contaminated with radioactive materials,
- Resins- Polymer resins used to condition or “clean” liquid wastes or process fluids,
- Metals- Piping, sheet metals, conduit and so forth
- Liquids- Contaminated process liquids or liquids,
- Oils, lubricants contaminated with radioactive material,
- Mixed Waste- materials or liquids containing radioactive materials and RCRA characteristic, listed or process wastes,

- Spent Fuels- Nuclear fuels no longer useable,
- Greater than Class C wastes- irradiated reactor parts and pieces.
- Sources- Non-exempt source materials

(Reference 6-19)

Class A and B Radioactive Wastes

Class A and B wastes primarily contain types and quantities of radionuclides that will decay within 100 or 300 years respectively, with Class B waste having more rigorous requirements on waste form to ensure stability. A majority of this waste produced during decommissioning will be metals and concrete. (Excluding reactor internals, liquids and volume reduction.) (Reference 6-15)

Class C Wastes

Class C waste requires more additional measures at the disposal facility to protect against inadvertent intrusion for up to 500 years. Spent demineralizer resins will comprise a majority of the Class C wastes produced during decommissioning.. (Excluding reactor internals) (Reference 6-15)

Greater than Class C Wastes

Greater than Class C wastes are radioactive wastes containing specific radionuclides in excess of Title 10CFR61 regulatory limits for Class C wastes and considered not suitable for disposal in a shallow land-burial disposal facility licensed for radioactive waste. The site does not have a "declared inventory" of greater than Class C waste. Several waste containers stored in the Spent Fuel Pool contain items not characterized and are suspected to be greater than Class C waste. During decommissioning, reactor vessel internals are expected to produce the majority of greater than Class C waste. (Reference 6-15)

Contaminated Liquids

Approximately 400,000 gallons of waste-radioactive liquid, and several cubic meters of radioactively contaminated sludge are stored awaiting disposition. The waste-radioactive liquid was created when primary system decontamination liquids were mixed with other process liquids, including rain and snowmelt, system drain-down and tank cleaning. The sludge was removed from the bottoms of tanks and sumps during decontamination and decommissioning. (Reference 6-20)

Projected Volumes for Decommissioning

Process Water
Initial pre-decommissioning estimates are that 475,200 gallons of water will result from the decommissioning. (Reference 6-20)

Concrete/Asphalt
Initial pre-decommissioning estimates are that 604,000 pounds of activated concrete; 4,739,253 pounds of radioactively contaminated concrete and asphalt, and 2,758,468 pounds of non-radiologically contaminated asphalt will be disposed of from decommissioning. (Reference 6-20)

Metals
Initial pre-decommissioning estimates are that the following metals will be disposed of during decommissioning:

- Activated metals 28,000 pounds
- Structural Steel 2,187,700 pounds
- Metal Piping 1,864,000 pounds
- Conduit 396,000 pounds
- Cable Tray 1,202,000 pounds
- HVAV 380,000 pounds
- Equipment 5,683,048 pounds
- RCS piping 350,000 pounds
- Decommissioning equipment 300,000 pounds
- Reactor Coolant Vessel 836,248 pounds
- Steam Generators 2,094,000 pounds
- Pressurizer Vessel 256,000 pounds
- Reactor Coolant Pumps 656,000 pounds

(Reference 6-20)

Contaminated Soils
Initial pre-decommissioning estimates are that approximately 4,903,900 pounds of radioactively contaminated soils will require treatment, remediation or be disposed of as radioactive waste. The contamination occurred during the operating period as a result of leaking pipes, tanks and spills. (Reference 6-20)

Contaminated Ion-exchange Resins
Initial pre-decommissioning estimates are that approximately 1320 cubic feet of used resins will be disposed of as radioactive wastes. This resin will originate from radioactive wastewater processing. (Reference 6-20)

Dry Active Waste (DAW)
Initial pre-decommissioning estimates are that approximately 600,000 pounds of radioactively contaminated DAW will be produced during the decommissioning. This waste will originate from normal activities and typically includes, paper, plastic, and discarded protective clothing, and so forth. (Reference 6-20)

Sewage Sludge
Approximately 33,334 gallons of sewage sludge, in TK-38-1A and TK-38-1B septic tanks, contaminated with detectable amounts of radioactive materials, Co-60 and Cs-137, awaits disposition. The contamination is thought to have originated over a period of years from contaminated mop-water being dumped down drains that led to the septic tank. (Reference 6-20)

Radioactively Contaminated Lead Metal
Approximately 246,000 pounds of contaminated lead shield in the forms of sheet, blankets and bricks will have to be disposed of or decontaminated and recycled during decommissioning. (Reference 6-20)

Radioactively Contaminated Oil
Approximately, 600 gallons of contaminated lubricating oils will be sent to disposal facilities during the decommissioning. These lubricants originated from contaminated systems pumps. (Reference 6-20)

Batteries
Approximately 115,200 pounds of lead acid batteries will be recycled during the decommissioning. These batteries were used in emergency/backup systems during plant operations. (Reference 6-20)

Asbestos Containing Material (ACM)-waste
The original plant insulation contains 6% to 8% asbestos with a calcium silicate binder. Asbestos insulating material has been identified on many plant systems and in most areas and buildings. Whenever maintenance activities were conducted that required insulation removal, ACM was replaced with non-asbestos material and labeled accordingly. Most of the systems originally covered with asbestos insulating materials now have portions covered with non-asbestos containing insulating materials. Minor quantities of ACM, in the form of gaskets and packing, remain in numerous systems at the plant. Roofing materials may contain ACM.

Licensed contractors removed the ACM, which was taken to asbestos permitted landfills for disposal. ACM contaminated with radioactive materials will be disposed of as low-level radioactive waste. It is estimated that 3,636,000 pounds of ACM will be removed during the decommissioning. (Reference 6-20)

Mercury
Mercury containing devices such as switches and instruments will be removed and collected prior to final disposal of the equipment. The mercury will be reclaimed or reprocessed by an authorized and licensed contractor. It is expected that about 260-280 pounds of mercury will be produced from decommissioning. (Reference 6-20)

Paints containing Lead, PCBs
Lead based paints were used at CY to coat steel components, some concrete structures, and underground steel piping. During the operating life of the plant, some of the lead-based paints have been covered with several coats of non-lead based paint. In other cases, non-lead based painted surfaces have been touched-up or covered with lead-based paint. The lead-based paints on nonrecyclable components will be removed, processed, and disposed of by authorized and licensed contractors.

The potential for paints to contain PCBs has been identified. Paints containing PCBs will be managed according to federal and state regulations. The amount of PCB and lead waste that will be produced by decommissioning has yet to be determined. (Reference 6-20)

Probable Source Types and Sizes

The source of radioactive contamination at the Haddam Neck Plant was the nuclear reaction process used in the generation of electricity. The estimated quantity of radioactive material presented is derived from the activity of the solid radioactive wastes expected to be produced and disposed of during the years 1999 to 2004, the decommissioning period. This estimate does not include activity contained in NPDES discharges, spent fuels, greater than Class C wastes, contaminated soils or ground water. Data from 1999 and 2000, along with projections for the years 2001 to 2004, estimate that 67,456 Curies of radioactive material will be sent from the HNP to licensed disposal facilities during the decommissioning.
(Reference 6-19)

Reactor Sources
There are 56 reactor core source rods stored in the Spent Fuel Pool awaiting disposition. Two of these source rods are primary source rods, Polonium-Beryllium type; the remaining are Antimony-Beryllium type.
(Reference 6-21)

Calibration Sources
As of June 2000, sixty radioactive sources are used in the radiation protection program for instrument calibration. These sources are inspected and maintained in accordance with procedure 24265-000-GPP-GGGR S4150-000 SUR 5.6-16 Receipt, Inventory Leak Test and Disposition of Non-exempt Radioactive Sources. Table 6.5 provides an inventory of the sources. (Reference 6-22)

Smoke Detectors
The fire protection system, at HNP, has 21 ion chamber smoke detectors, containing source material americium-241, in service. The detectors are sent to a re-processor at the end of life or when the detector fails electronically or mechanically. Abandonment in place or concentration of the source material, by dismantling and removing the americium-241 source, was not a practice at HNP. (Reference 6-23)

<u>Description of Spills and Releases</u>

NRC Historical Site Assessment Concerns
In an effort to understand the scope and extent of the history at Haddam Neck Plant related to spills and contamination, an NRC team, in 1998, reviewed CYAPCO's internal and external reports and notifications regarding events in the areas of radiological spills/releases and release of potentially contaminated materials from the facility. During the review the NRC noted a number of past CYAPCO actions that may not have been in compliance with NRC requirements existing at the time. These items were reviewed by the NRC to determine if enforcement actions were appropriate. The NRC team was able to conclude that the scope and depth of CYAPCO's staff efforts to review past radiological occurrences and assess significance were found to be appropriate and sufficiently comprehensive for the site characterization activities. Additionally the NRC team determined that for most radiological events, NRC follow-up was commensurate with the expected safety impact and was, therefore, appropriate. (Reference 6-11)

CTDEP Environmental Indicators
In March 1998, the CTDEP completed the Environmental Indicators Report submitting it to CYAPCO. The report provided a brief background on the HNP and detailed 18 areas of concern (AOC) that CTDEP had on EI issues. Of these 18 areas, three had radiological contamination that, according to CTDEP, represent a potential hazard to humans through direct contact and one area that most likely has groundwater contaminated with tritium.

These areas are reported as AOC 12- "shooting range", AOC 16-mat drain sump release area, and AOC 18-cooling water discharge canal dredge spoils disposal area.

Interim measures included the installation of a fence around the "shooting range" area, AOC 12. Other areas of concern are located below grade or located within a secure area. (AOC 16 and 18)

The report stated that due to the nature and geology of the site-wide groundwater, the groundwater release (tritium) cannot be considered controlled. Table 6-6 lists the CTDEP Areas of Concern.
Figure 6-1 shows the AOC locations. (Reference 6-24)

RCRA Corrective Action Program-Environmental Indicators
Environmental Indicators (EI) are measures being used by the RCRA Corrective Action Program (CAP) to go beyond programmatic activity measures to track changes in the quality of the environment. The two EIs developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater.

On October 8, 1999, the utility responded to the EPA's RCRA CAP Questionnaire stating, "Our review of this data, Environmental Indicators, indicates that for both chemical and radiological parameters, no appropriate risked-based levels are exceeded at the site. This evaluation supports the EI response that current exposures to people and migration of contaminated ground water is controlled."

Additionally, in recognition of the limited amount of environmental monitoring data for RCRA hazardous constituents (i.e. chemicals) parameters, CY voluntarily initiated the collection of groundwater samples from existing monitoring wells for analysis. These data will be incorporated in the site characterization activities that are being performed in support of decommissioning. New or re-evaluated data resulting from this monitoring will be submitted to the EPA for review. (Reference 6-25)

10CFR50.75(g) Index
In 1990, the utility initiated the 10CFR50.75(g) Index by compiling lists of previous events reported to the NRC and from the Plant Incident Reporting System (now the ACR system). Non-radiological chemical and environmental spills are included in the index as well.

In October 1999, the responsibility for updating and maintaining the Index was transferred to the DOC. As of mid-2000, 364 spill events have been documented. A copy of the Index is in Section 10.0.

Radiological
From 1969 to mid-2000, 226 radiological spill and release events have been documented.

Petroleum and Hydraulic Fluids
There are 88 documented petroleum and hydraulic spill events between 1969 and mid-2000. Spills ranged from several hundred milliliters of oil to 1500 gallons of diesel fuel overflow that remained inside the plant.

Regulated Substances
There are 34 documented spills between 1969 and mid-2000. Examples of the spills include mercury, gasoline, oil, and 3800 gallons of sodium hypochlorite solution.

Miscellaneous
There are 16 documented spills of miscellaneous materials between 1969 to mid-2000. Examples of spills and releases include the release of water through an unmonitored discharge point, concrete spoils discharged to the ground while rinsing a concrete mixing truck or vendors discharging water on site without permission. (Reference 6-26)

Operational Events

Airborne Releases
During the initial years of operation at HNP, several events involving unplanned releases of airborne radioactivity occurred due to equipment failures or human error. From 1971 through 1979, releases occurred in various areas of the plant, with the resulting radioactive discharges to the environment primarily involving inert gases and iodine. The releases were documented in station abnormal occurrence (AO) reports or plant incident reports (PIR), with the discharges included in the Semi-Annual Effluent Release Reports.

The occurrences involved short-lived radioactive gases and iodine that did not result in contamination of site areas that would impact decommissioning activities. A copy of the Index is in Section 10.0.

Atmospheric releases that have impacted portions of the site area include a series of events that occurred in 1979. Stack discharges involving particulate activity occurred in February and December of 1979 as a result of the failure of a level controller in the letdown degassifier, flooding of the degassifier, and actuation of the degassifier rupture disk.

The letdown liquid (primary coolant) then overflowed the degassifier. The discharge line from the rupture disk was routed directly to the main discharge stack.
Efforts to clean the stack following the first incident may also have resulted in particulate releases. Surveys identified a number of radioactive particles within the Radiologically Controlled Area, in the fenced area of the plant site, and in the parking lot and hillside east of the plant. The majority of the radioactive particles were found on the roof areas of buildings close to the stack, and on the ground within the Radiologically Controlled Area. The extent of area outside the Radiologically Controlled Area impacted by the releases includes the parking lot north of the industrial area, the hillside east of the plant out to 200 meters, and areas adjacent to the discharge canal.

Atmospheric releases, following the particulate releases of 1979, included gaseous and iodine releases documented in the Annual Effluent Reports submitted in accordance with the plant Technical Specifications. The releases consisted of inert gases and radioiodine with short half-lives, radionuclides that do not impact the site relative to decommissioning. The 10CFR50.75(g) Index in Section 10.0 provides a complete listing of site events. (Reference 6-26)

Unplanned Liquid Releases

Investigations identified a number of leaks and unplanned liquid releases that have occurred during the operational lifetime of HNP. The majority of the occurrences were confined to the Radiologically Controlled Area. The leaks and unplanned releases were associated with equipment failures and operational events associated with components within the Containment Building, Primary Auxiliary Building, outside storage tanks, and the radioactive waste processing systems. The most significant unplanned liquid release, in terms of water volume involved, occurred in 1984, the result of a failure of the reactor cavity seal.

An unplanned liquid release of approximately 200,000 gallons of primary grade water, containing radioactive materials and boric acid, was contained in the lower level of the Containment Building and subsequently pumped to the RWST. Smears of the seal ring area at the reactor vessel flange indicated 350-mR/hr beta-gamma, 5.4-rad/hr beta with 120,000-dpm alpha. RWST radiation levels ranged from 65 to 200 mR/hr as the result of relocating water during this period. Surveys in the basement of Containment on August 23, 1984, indicated contamination levels to 295-mrad/hr beta and 6300 dpm/100 cm^2 alpha.

At that time, sampling of the yard drains concluded that no liquid or radioactivity was released to the environment.

The principal impact of other release events is to the ground within the Radiologically Controlled Area (RCA). Migration of radioactivity to subsurface soils has occurred in the area of the Primary Auxiliary Building and the Refueling Water Storage Tank, adjacent to the Containment Building. Radioactivity has also been detected in ground water wells on site. Radioactive materials from leaks also may have impacted an area in the southeast corner of the protected area, a leach field south of the protected area (but within the owner controlled area), and drain systems leading from the RCA. All of these areas were within the owner-controlled area. The 10CFR50.75(g) Index in Section 10.0 provides a complete listing of site events. (Reference 6-26)

Contamination of Buildings

The HNP design includes several structures, engineered and constructed to contain radioactive material. These structures include the Containment Building, the Primary Auxiliary Building, the Service Building, the Waste Storage Building, Ion Exchange Structure, Spent Resin Facility, and structures containing tanks for storage of radioactive liquids. Operations and maintenance activities in these buildings have resulted in surface contamination typical of nuclear power plants. Additionally, a number of events were identified that affected the radiological status of these structures, specifically failed fuel and primary to secondary leakage in the steam generators. Information indicates that on two occasions—one in 1979 and one in 1989—the plant operated with failed fuel at a level that resulted in an increase in the level of alpha emitting radionuclides in the Reactor Coolant System (RCS) and liquid systems that interface with the RCS, as well as areas inside buildings that house these systems.

There were several primary-to-secondary leakage events resulting from steam generator tube leakage. The events occurred during several operating cycles, with the first leakage identified in 1973 and the final events occurring in 1990. The leakage has resulted in measurable radioactivity in small areas of the secondary system piping, primarily in the high-pressure steam components within the Turbine Building. Results of surveys from the Turbine Building or secondary side systems contained in that building show no indications of alpha emitting radionuclides from failed fuel, with the exception of the Auxiliary Boilers.

Additionally, in 1998, extensive characterization surveys of the operating floor and grade level of the Turbine Building for both beta and gamma emitting radionuclides identified only 1 small area in excess of Regulatory Guide 1.86 criteria.

A discussion of the radiological impact on each building is presented in Section 7.0. (Reference 6-26)

Contamination of Soils

Over its operating history the HNP site experienced a distribution and buildup of low levels of residual plant related radioactivity within and adjacent to the Radiation Controlled Area (RCA).

In December of 1979 there was a release of radioactive steam and liquid from the Primary Ventilation Stack that resulted in distribution of plant related radioactivity to both the RCA and non-RCA portion of the CY site. The plant related radioactivity associated with this event was remediated in March of 1980.

In February of 1989 there was a release of radioactive liquid from the Spent Fuel Building drainpipe that resulted in distribution of plant related radioactivity to the drain trench located in the 115 KV Switchyard, the storm drain system components and soils at the storm drain outfall. Remediation of the plant related radioactivity associated with this event resulted in decontamination of the drain trench, the storm drain system and removal of a significant volume of soil. The soil was taken to the peninsula area and eventually prepared for shipment to disposal.

A third event is the distribution of plant related radioactivity to the sanitary sewer system. Introduction of radioactive liquid into certain inputs to the sanitary sewer system resulted in distribution of radioactivity in the sanitary sewer system from the input through the system out to and including subsurface soils at the perimeter of the leach field.

A fourth condition resulting in distribution of plant related radioactivity is associated with surface water run-off containing plant related radioactivity from within the RCA to non-RCA areas. This condition was identified by a review of site aerial photographs in the CY history. The photographs show the run-off flow pattern of the CY site after a rainstorm.

An examination of run-off flow patterns identified areas where the RCA run-off resulted in accumulation of plant related radioactivity in deposited sediment; site modification activities performed in these areas generated spoils likely to contain low levels of plant related radioactivity. Site modifications made in the RCA have changed the pitch and grade of the surface in the RCA and consequently changed the run-off flow pattern resulting in additional locations that may contain radioactive material distributed by RCA run-off. Site modifications that changed the RCA run-off flow pattern were performed in the mid to late 1980s.

Modifications performed adjacent to or in portions of the site with low levels of residual plant related radioactivity resulted in spoils that could contain or were found to contain plant related radioactivity. Spoils from such areas typically were sampled and analyzed prior to disposition. Generally this material was retained onsite as fill material or disposed of as radioactive waste. The material disposed of as radioactive waste is identified in the material description section of historic radioactive waste shipment documentation. Not all such material is accounted for in radioactive waste shipment records. Unaccounted material was later found in storage in the peninsula, "shooting range" and an area under the transmission lines known as the "Ballfield." A discussion of the radiological impact on site soils is discussed in Section 7.0. (Reference 6-27, 6-28)

Release of Radioactive Materials
There were several occurrences where radioactive material was found outside the Radiologically Controlled Area. The primary locations of discovery were the southwest peninsula, and the shooting range landfill area. These areas are currently controlled as "Radioactive Material Areas" with restricted access. During plant operations, the peninsula area has been used for storage of materials. The materials have been typically associated with maintenance activities performed during outages or plant modifications. Documentation indicates that surface radioactive material was detected in 1980, 1985, and 1989. Surveys performed in 1998, indicated some remaining materials stored on the peninsula contained detectable radioactivity.

Other instances of minor levels of contamination being identified in areas outside the Radiologically Controlled Area but within the site boundary have been documented. The areas affected were areas of high personnel traffic, such as the Administration Building or the Steam Generator Mock-up Building. Upon discovery, remediation occurred and more extensive surveys of the areas were performed to ensure no detectable radioactivity remained. (Reference 6-33)

Offsite Material Recovery Program (ORMP)
Additional events have been documented, indicating the release of contaminated material from the site. Specifically it was determined that a concrete block shield wall around the resin processing area had been removed from the plant site in 1975. The survey records available were inadequate to identify if the concrete shield blocks had been appropriately surveyed for unconditional release.

Initial assessments were conducted at selected offsite locations containing concrete shield blocks. Low levels of licensed material were detected at each of the properties. As a result of the discovery of licensed material at an off site location, the Offsite Materials Recovery Program was implemented to identify and recover CYAPCO licensed material and concrete shield blocks that were inappropriately released to off site locations.

The project estimated that approximately 5100 concrete blocks were removed from site. Additionally, there was the potential that contaminated soils (fill dirt) and equipment had been released from the site.

As of mid-2000, the OMRP retrieved 5500 concrete blocks, approximately 2000 cubic yards of soil, approximately 80 cubic yards of wood, metals and debris, and a contaminated electric welder. The OMRP started in 1997.
(Reference 6-28)

Emergency or Removal Actions

National Pollution Discharge Elimination System (NPDES)
The NPDES program limits, by a permit system, the discharge of industrial pollutants into waters of the United States. From 1981 to 1984, the utility frequently reported to the CTDEP that hydrazine discharged to the Connecticut River exceeded NPDES limits. In response, the CTDEP issued an order to Abate Pollution. Records on the corrective actions are not available for review.

In 1990, CTDEP performed two announced NPDES inspections. The inspections identified:

- A minor weakness in the data reporting methodology of vendor laboratories, (corrected by vendor)
- The method of analysis used by HNP for oils and grease may be inappropriate,
- The current use of the EPA DMR Monthly report forms may be inappropriate,

- The site should pursue Laboratory State Certification.

The 1991 NPDES inspection commented that the HNP labs are not state certified. Certification was never pursued by the utility. Minor infractions were corrected by the utility.

In 1994, several discharges not described in the NPDES permit were reported. These are:

- Fire pump discharge into the Connecticut River through a fixed drain pipe,
- Gland seal filter backwash for circulating water pumps discharged into the Connecticut River, and
- Well water flushes to storm drains.

In September 1997 CYAPCO realized the required pH sample for NPDES discharge point 001-A, Test Tank was being drawn at the wrong sample location. The chemistry department revised associated procedures and immediately began sampling 001-A, Test Tanks at the source, as required by NPDES permit CT00003123. CTDEP was notified as to actions taken. CYAPCO and CTDEP are working to resolve this issue.

The reporting of NPDES information was an ongoing issue between the State of Connecticut and CYAPCO. In January 1998, Quality Surveillance Report No. 98-006 reported that the CYAPCO had not established an effective reporting process to ensure that all required information associated with the NPDES Permit is accurately transmitted to the CTDEP, Water Management Bureau as required by NPDES Permit CT003123. This was assigned to ACR 98-0057 for tracking and correction. Evaluation of this issue indicated that while there were data reporting issues, there was not an impact on the receiving waters. (Reference 6-9)

National Emission Standards for Hazardous Air Pollutants (NESHAPS)
The NESHAPS program, through a permit system, limits the discharge of toxins and carcinogens into the air. On October 11, 1989 an Immediate Compliance Order was issued to the utility based on findings that CYAPCO violated National Emission Standard for Asbestos during a demolition project. Corrective actions were taken by the utility. (Reference 6-9)

Air Management
An inspection on December 13, 1993, by the Connecticut Department of Environmental Protection- Air Compliance Unit resulted in three Notice of Violation (NOV) concerning solvent cleaning units (parts washers) at Connecticut Yankee. Based on ground water samples, this non-compliance did not impact soils or groundwater. Corrective actions were performed by the utility. (Reference 6-9)

RCRA-Hazardous Waste Management
Five RCRA inspections were conducted by the Connecticut Department of Environmental Protection from 1983 to 1995. No significant enforcement issues were found from the inspections. A NOV was issued for minor RCRA violations, which were subsequently corrected.

A review of available RCRA inspections performed by CTDEP reported the following concerns:

- Manifests
- Hazardous Waste Determination
- Waste Analysis Plan
- Container Management
- Permit Application
- Training Records
- Record keeping

(Reference 6-9)

NRC
On March 4, 1997, the NRC issued a Confirmatory Action Letter No. 1-97-007. The letter stated that since November 2, 1996, the NRC observed and found that the radiation protection program indicated continuing weakness in managing and controlling radiological work at the HNP. The following weaknesses were reported:

- Significant deficiencies and problems relative to the implementation of the Radiation Protection Program,
- Long-standing discrepancies in the calibration of several radiation monitor that are used to monitor and control radiological effluent releases to the environment,
- Inadequacies in control of radioactive material that resulted in the undetected release of contaminated equipment to a non-licensed vendor.

In response, CYAPCO implemented a corrective action plan that revised the health physics program. Operational constraints imposed by the Confirmatory Action Letter were lifted in May of 1998.
(Reference 6-29, 6-30)

6.3 Adjacent Land Usage

The Connecticut Yankee Atomic Power Plant is situated on the east bank of the Connecticut River. The river is used for recreation and shipping. Recreational use of the river includes pleasure boating, fishing, occasional swimming, water skiing, personal watercraft (jet-ski), canoeing, kayaking, and waterfowl hunting.

Several marinas are located along the Connecticut River between Hartford and the HNP. It is difficult to estimate the number of boat hours in the area of the plant, primarily because of the transient boats from above the site and boats launched in the Haddam Neck Meadows Park and the Salmon River.

Aside from a scattering of small towns and villages and a portion of the city of Middletown, the area within a ten-mile radius of the site is predominantly rural and residential. About 80% of this area is wooded and much of it is state parks and forests. The remaining area is devoted primarily to general farming and some minor industry.

The Town of Haddam, in which the Haddam Neck Plant is located, has a total population of 7,157 (2000 census) with an average population density of 157.1 people per square mile Haddam has experienced a modest population growth since 1990 (5.7%) (Reference 6-31)

Two schools are located within the 5-mile area of the site in the Town of East Haddam. The Nathan Hale-Ray Middle School has an enrollment of 420 students in 2000. The Nathan Hale-Ray High School has an enrollment of 337 students in 2000. (Reference 6-32)

There is a seasonal increase in population in the area surrounding the site due to a number of summer resorts and lakeside and riverside cottages located within a 10-mile radius.

The transient population within a 10-mile radius of the site mainly consists of employees of local industry, school enrollments, and daily visitors to recreational facilities.

The nearest population center to the Haddam Neck Plant is the city of Middletown, Connecticut, with a 2000 census population of 43,167 and an average density of 1,051.1 people per square mile. The distance from the site to the center of Middletown is 9.5 miles, which is outside the former low population zone distance of 2.7 miles.

Middlesex County, where HNP is located, has a population of 155,071. Connecticut has a population of 3,405,565 and an average density of 420.2 people per square mile. (Reference 6-31)

Public Lands/Conservation Areas
Cove Meadow State Park, an undeveloped riverfront area, abuts the southeast property line of the plant at the confluence of the Salmon River and the Connecticut River. Hurd State Park, an undeveloped wooded area including river frontage, is about 3 miles north of the plant property.

An undeveloped island, Haddam Island State Park, is in the middle of the Connecticut River, about 3,500 ft. upstream from the plant. On the west bank of the Connecticut River, directly across from the plant, is Haddam Meadows State Park, with parking and boat launching facilities. Inland from the west bank is the Cockaponset State Park, used primarily for hiking. (Reference 6-3)

Cultural
No known prehistoric or historic Native American sites are located on the CYAPCO grounds or within a 5-mile radius of the Haddam Neck facility. (Reference 6-1)

The homestead ruins, of a freed slave, Venture Smith, is known to exist on the property. These ruins date from the mid-1700s.

The Brainerd/Barcal House built in the mid 1800's was located near the entrance to the facility. This house was demolished as part of the HNP site construction. (Reference 6-1)

Several stonewalls of some age, exist on the site. No archaeological data exists on these structures. This type of masonry construction, used to mark property boundaries or as animal fences, was popular in the area prior to the 1900's. (Reference 6-1)

Several historically significant points of interest exist in the vicinity of the Haddam Neck site. The Goodspeed Opera House in East Haddam is in the National Register of Historic Landmarks. The Goodspeed Opera House is located 3 miles downriver from the site on the same side of the river, near the east Haddam Bridge. Due to the bend in the Connecticut River immediately south of the entrance to Salmon River, the Haddam Neck Station cannot be seen from the Opera House.

Nearby homes of colonial vintage include the Epophroditus and Henry Champion House located on Route 149, near the Brainard Homestead State Park in East Haddam, and the Amasa Day House in Moodus, as well as the General Mansfield House in Middletown. Other historic sites of interest in the area include Gillette Castle and the Hadlyme-Chester Ferry, which crosses the Connecticut River on Route 148 between Chester and Hadlyme just south of the Gillette Castle State Park. (Reference 6-1)

Highways
The nearest major highway is State Route 9 located across the river at a distance of about 4 miles from the site.

Railroads/Airways
There are no commercial railroad lines within 5 miles of the Haddam Neck Plant. A vintage tourist ride, the Essex Steam Train, is approximately 3 miles from the plant. Goodspeed Airport in East Haddam, Connecticut, is a general aviation facility with one runway located approximately 3 miles from the plant. The airport is used primarily for light, single-engine aircraft activities such as business and pleasure flying. The location of the airport physically prohibits significant expansion. (Reference 6-3)

Water Supplies
Public drinking water supplies are not taken from the Connecticut River near or below the plant area. Public water supplies are taken from wells or reservoirs on tributary streams. There are many private wells in the region that draw primarily upon groundwater rather than on springs or other surface sources. The closest non-domestic community supply well is approximately three miles from the plant.
(Reference 6-3)

Table 6-1 Operating History for the Haddam Neck Plant

Cycle Number	Start-up Date	Shutdown Date	Cycle Burn-up (MWD/Mtu)	Effective Full Power Days	Thermal Capacity Factor (%)
1	Aug. 7, 1967	Apr.17, 1970	16,965	691	81.0
2	Jun.25, 1970	Apr. 16,1971	7,602	272.2	92.3
3	May 25,1971	Jun. 10, 1972	10,201	361.9	94.7
4	Jul. 14, 1972	Jul. 08, 1973	9,157	323.1	90.0
5	Dec.14, 1973	May 17,1975	13,152	465.3	89.7
6	Jun. 30, 1975	May 18,1976	8,738	309.3	95.8
7	Jul. 18, 1976	Oct. 15, 1977	12,283	434.9	95.6
8	Dec. 1, 1977	Jan. 27, 1979	11,105	393.4	93.0
9	Mar.12, 1979	May 3, 1980	11,044	391.6	93.7
10	Jul. 27, 1980	Sep. 26,1981	11,342	402.1	94.2
11	Nov.11, 1981	Jan. 22, 1983	11,081	392.7	90.2
12	Apr.11, 1983	Aug. 1, 1984	12,987	459.8	96.3
13	Nov. 9, 1984	Jan. 4, 1986	10,987	388.1	92.2
14	May 10,1986	Jul. 18, 1987	10,039	354.8	81.7
15	Mar.26, 1988	Sep. 2, 1989	12,982	459.8	87.3
16	Aug.15, 1990	Oct. 17,1991	10,095	358.2	83.6
17	Mar.15, 1992	May 15,1993	12,035	412.0	96.8
18	Jul.20, 1993	Jan.28, 1995	13,588	445.8	80.1
19	Apr.19, 1995	Jul. 22, 1996	13,844	443.8	96.3

(Reference 6-3)

Table 6-2 Permits Issued to CYAPCO for the Haddam Neck Plant

Agency	Description	Permit Number
USAEC	Facility Operating License	AEC DPR-61
USEPA	Refrigerant Recovery or Recycle Device	
USNRC	Radioactive Materials	Amend. #13, 06-11682-02
USNRC	Radioactive Materials	Amend. #12, 06-17235-02
USEPA	RCRA Part A App	File # D03652
USEPA (CTDEP)	RCRA EPA ID	CTD042306720
USEPA (CTDEP)	RCRA Closure	CTD042306720
USDOT	Hazardous Materials Registration	052199 702 029H
DHHS CLIA	Lab Cert. of Waiver	CLIA ID# 07D0882623
State of Connecticut	Domestic Water Consent Order	WSS-00-061-071
State of Connecticut	Ground Water Diversion	DIV-85-25
State of Connecticut	Asbestos removal notifications	
State of Connecticut	Industrial Stormwater	GSI001377
State of Connecticut	General Permit to Limit Potential to Emit (air)	072-011-GPLPE
State of Connecticut	Dock Repair	SD-TS-89-199
State of Connecticut	Industrial Health Facility	#208 renewal
State of Connecticut	Solid Waste Landfill	Issued 1974
State of Connecticut	Permit for Fuel Burning Equipment (EDG)	0005
State of Connecticut	UST notification	D03380
State of Connecticut	NPDES	CT003123
State of Connecticut	Water-Diversion Intake	4000-18
State of Connecticut	Wells	4000-19
State of Connecticut	Groundwater Diversion	DIV-85-25
State of Connecticut	House Heating A	072-0003-0008
State of Connecticut	House Heating B	072-0003-0009
State of Connecticut	Gen. Diesel	072-0003-0010
State of Connecticut	Gen. Diesel 999-20	072-0003-0011
Tenn. Dep. Env. Health	Deliver of Rad. Waste	T-CT002-L99
Tenn. Dep. Env. Health	Rad. Waste transport	T-CT002-C92
Wash. Dept. of Ecology	Low-level Radioactive Waste Disposal	#2323
State of S.C. DHEC	Radioactive waste transport	0012-06-99X
Virginia Dept. of Em. Services	Hazardous Rad. Materials Transportation	CY-S-103199
Town of Haddam Wetlands Commission	Barge slip refurbishment	M27L800

(Reference 6-34)

Table 6-3
Area Descriptions and Classifications

Survey Area	Survey Area Code Description	MARSSIM Classification
1102	Fuel Building Laydown Area	1
1104	Fuel Building Fuel Cask Decon Area	1
1106	Fuel Building Skimmer Pump and Sump Area	1
1202	Fuel Building New Fuel Storage Area	1
1204	Fuel Building Exhaust Filters and Fan	1
1302	Fuel Building Patio Area	1
1304	Fuel Building New Fuel Storage Area	1
1306	Fuel Building Cask Laydown Area	1
1308	Fuel Building Spent Fuel Pool Pit	1
1404	Fuel Building Roof Area	1
2002	Auxiliary Building RHR Pump Room A	1
2004	Auxiliary Building RHR Pump Room B	1
2006	Auxiliary Building RHR Heat Exchangers	1
2008	Auxiliary Building Primary Drain Tank Pump Room	1
2010	Auxiliary Building Primary Drain Tank Room	1
2012	Auxiliary Building Aerated Drain Tank Room	1
2102	PAB Mezzanine Area	1
2104	Auxiliary Building Pipe Chase Under Hallway	1
2106	Auxiliary Building Pipe Chase Under Valve Room	1
2108	Auxiliary Building Boric Acid Evaporator Area TK EV1-1A, EV2-1A	1
2110	Auxiliary Building Pipe Chase East & West Outside	1
2202	Auxiliary Building Hallway	1
2204	Auxiliary Building Component Cooling Area	1
2206	Auxiliary Building Boric Acid Evaporator Area	1
2208	Auxiliary Building Boric Acid Mix Tank Area	1
2210	Auxiliary Building "B" Charging Pump Area	1
2212	Auxiliary Building "A" Charging Pump Area	1
2214	Auxiliary Building Metering Pump Area	1
2216	Auxiliary Building Purification Pump Area	1
2218	Auxiliary Building Primary Water Transfer Pump Area	1
2220	Auxiliary Building Sample Room	1
2222	Auxiliary Building Steam Generator Blowdown Room	1
2224	Auxiliary Building HPSI Cubicle Area	1
2226	Auxiliary Building LPSI Cubicle Area	1
2228	Auxiliary Building Drumming Room	1
2302	Auxiliary Building Component Cooling Area	1
2304	Auxiliary Building Boric Acid Evaporator Area	1
2306	Auxiliary Building Boric Acid Mix Tank Area	1
2308	Auxiliary Building Volume Control Tank Room	1
2310	Auxiliary Building Purge and Dilution Fans	1

Table 6-3
Area Descriptions and Classifications

Survey Area	Survey Area Code Description	MARSSIM Classification
2312	Auxiliary Building Service Water Strainer Area	1
2314	Auxiliary Building HEPA Filter and Hall Area	1
2316	Auxiliary Building Boric Acid Storage Room	1
2402	Auxiliary Building Roof Area	1
3002	Containment Enclosure Under Reactor Vessel	1
3004	Containment Enclosure Sump Area Under Reactor Vessel	1
3101	Containment Enclosure #4 Outer Annulus Lower Level NE	1
3102	Containment Enclosure #1 Outer Annulus Lower Level NW	1
3103	Containment Enclosure #2 Outer Annulus Lower Level SW	1
3104	Containment Enclosure #3 Outer Annulus Lower Level SE	1
3105	Containment Enclosure Containment Sump Area	1
3107	Containment Enclosure Cable Vault Outside Containment	1
3111	Containment Enclosure Loop #1 Inner Annulus Lower Level NE	1
3112	Containment Enclosure Loop #2 Inner Annulus Lower Level NW	1
3113	Containment Enclosure Loop #3 Inner Annulus Lower Level SW	1
3114	Containment Enclosure Loop #4 Inner Annulus Lower Level SE	1
3201	Containment Enclosure #1 Outer Annulus Ground Level NE	1
3202	Containment Enclosure #2 Outer Annulus Ground Level NW	1
3203	Containment Enclosure #3 Outer Annulus Ground Level SW	1
3204	Containment Enclosure #4 Outer Annulus Ground Level SE	1
3205	Containment Enclosure Containment Foyer Area Ground Level	1
3206	Containment Enclosure Containment Hatch Area Ground Level	1
3211	Containment Enclosure Loop #1 Inner Annulus Mid Ground NE	1
3212	Containment Enclosure Loop #2 Inner Annulus Mid Ground NW	1
3213	Containment Enclosure Loop #3 Inner Annulus Mid Ground SW	1
3214	Containment Enclosure Loop #4 Inner Annulus Mid Ground SE	1
3301	Containment Enclosure #1 Outside Crane Charging Floor	1
3302	Containment Enclosure #2 Outside Crane Charging Floor	1
3303	Containment Enclosure #3 Outside Crane Charging Floor	1
3304	Containment Enclosure #4 Outside Crane Charging Floor	1
3311	Containment Enclosure #1 Inside Crane Charging Floor	1
3312	Containment Enclosure #2 Inside Crane Charging Floor	1
3313	Containment Enclosure #3 Inside Crane Charging Floor	1
3314	Containment Enclosure #4 Inside Crane Charging Floor	1
3315	Containment Enclosure Removable Grating for RX Head Staging	1
3320	Containment Enclosure CTMT Rx Refuel Canal to Spent Fuel Pit	1
3322	Containment Enclosure CTMT Reactor Refueling Cavity	1
3324	Containment Enclosure CTMT Reactor Vessel Area	1
3326	Containment Enclosure Upper Core Package Storage Area	1
3403	Containment Enclosure Inside Surfaces	2

Table 6-3
Area Descriptions and Classifications

Survey Area	Survey Area Code Description	MARSSIM Classification
3502	Containment Enclosure Outside Surfaces	2
4102	Turbine Building North Floor Area	2
4104	Turbine Building Oil Room, Heater Drains, Emergency Power	2
4106	Turbine Building Air Compressor Area	2
4108	Turbine Building Steam Generator Feed Pump Area	2
4110	Turbine Building Chemistry/Closed Cooling Water Area	2
4112	Turbine Building Water Treatment Area	2
4114	Turbine Building Condenser Pump and South Floor Area	2
4116	Turbine Building Hoist/Equipment Laydown Area	2
4118	Turbine Building Condenser "A" Water Box "A & B" Area	2
4120	Turbine Building Condenser "B" Water Box "C & D" Area	2
4121	Turbine Building Secondary Chem Lab	2
4202	Turbine Building North End Open Area (Walls & supports)	2
4204	Turbine Building Oil Reservoir Area	2
4206	Turbine Building S/G Feedwater Heater 2A and 2B Area	2
4208	Turbine Building S/G Feedwater Heater 1A and 1B Area	2
4210	Turbine Building Steam Generator Feedwater Control Valve Area	2
4212	Turbine Building South End/Turbine Hall	2
4216	Turbine Building S/G Feedwater Heater 6B and 5B Area	2
4218	Turbine Building S/G Feedwater Heater 6A and 5A Area	2
4302	Turbine Building 30" Main Steam Line Area	2
4304	Turbine Building 24" Main Steam Line Area	2
4306	Turbine Building MSRHR 1A and 1B Area Reheater	2
4308	Turbine Building MSRHR 1C and 1D Area Reheater	2
4402	Turbine Building Laydown Area North Floor	2
4404	Turbine Building Steam Generator Feedwater Heater 3A Area	2
4406	Turbine Building Steam Generator Feedwater Heater 4A Area	2
4408	Turbine Building Steam Generator Feedwater Heater 3B Area	2
4410	Turbine Building Steam Generator Feedwater Heater 4B Area	2
4412	Turbine Building H.P. Turbine Area	2
4414	Turbine Building L.P. #1 Turbine Area	2
4416	Turbine Building L.P. #2 Turbine Area	2
4418	Turbine Building Generator Area	2
4420	Turbine Building Exciter Area	2
4422	Turbine Building Laydown Area South Floor	2
4424	Turbine Building Open Hoist Area	2
4502	Turbine Building Ceiling Area	2
4603	Turbine Building Roof Area	2
5102	Service Building "A" Diesel Generator Area	3
5104	Service Building "B" Diesel Generator Area	3

Table 6-3
Area Descriptions and Classifications

Survey Area	Survey Area Code Description	MARSSIM Classification
5106	Service Building Clean Locker Room Area	2
5108	Service Building Hot Locker Room Area	2
5110	Service Building HP Control Point and Office Areas	2
5112	Service Building Woman's Locker Room Area	2
5114	Service Building Hot Chemistry Area	1
5118	Service Building Maintenance Decon Area	1
5120	Service Building Machine Shop Clean Area	2
5122	Service Building Machine Shop Hot Area	1
5124	Service Building Maintenance Clean Shop Area	2
5126	Service Building "A" Auxiliary Boiler Area	2
5128	Service Building "B" Auxiliary Boiler Area	2
5130	Service Building East Hallway	2
5132	Service Building Health Physics Facility 1st Floor	2
5134	Service Building Health Physics Facility 2nd Floor	2
5202	Service Building Switch Gear Area	3
5302	Service Building Control Room Area	3
5304	Service Building Computer, Operations, Security Area	3
5306	Service Building Machine and Equipment Area	2
5308	Service Building Work Control Center	2
5402	Service Building Roof	2
5502	CW System Trench	2
6002	Waste Disposal Building Hall Area Lower Level	1
6004	Waste Disposal Building Area Outside Reboiler Room	1
6006	Waste Disposal Building Bottoms Pump and Reboiler Area	1
6008	Waste Disposal Building Sump Trench Area Lower Level	1
6010	Waste Disposal Building-Waste Decay Tank A,B,C Area	1
6012	Waste Disposal Building Surge Tank Area Lower Level	1
6102	Waste Disposal Building Hall Area	1
6202	Waste Disposal Building Hallway Area	1
6304	Waste Disposal Building Evaporator Area	1
6306	Waste Disposal Building Radwaste Liquid Evaporator	1
6308	Waste Disposal Building Degassifier Transfer Pump Area	1
6312	Waste Disposal Building Degassifier and Associated Valves	1
6404	Waste Disposal Building Evaporator Area	1
6406	Waste Disposal Building Liquid Evaporator Area	1
6408	Waste Disposal-Waste Gas Compressor A&B Area	1
6412	Waste Disposal Building Degassifier Area and Associated Valves	1
6502	Waste Disposal Building Roof Area	1
7002	CW Circ Pump A&B Head	3
7004	CW Circ Pump C&D Head	3

Table 6-3
Area Descriptions and Classifications

Survey Area	Survey Area Code Description	MARSSIM Classification
7102	CW Circ Pump Motor A&B	3
7104	CW Circ Pump Motor C&D	3
7106	CW Hypochlorite Tank Area	3
7108	CW Intake and Screen Area	3
7202	CW Roof Area	3
8100	FW/STM Penetration Building Upper Level	1
8200	FW/STM Penetration Building Mid Level	1
8300	FW/STM Penetration Building Lower Level	1
9102	YD 115KV Switchyard Area	1
9104	YD Main Transformer Area	3
9106	Discharge Canal	2
9108	YD North Tank Farm Area	1
9110	YD South Tank Farm Area	1
9112	YD Boron Storage Tank Area	1
9114	YD Ion Exchange Area	1
9116	YD Resin Slurry Area	1
9118	YD Fuel Oil Tank Area	3
9120	YD Primary Vent Stack	1
9122	YD Primary Water Storage Tank Area	1
9124	YD Backup Primary Water Storage Tank Area	1
9126	YD Large Yard Crane Area	1
9128	YD Demin Water Storage Tank Area	1
9202	Switchgear Building "B"	3
9208	Administration Building	3
9214	Shutdown Auxiliary Feed Pump House	2
9226	Radwaste Reduction Facility	1
9227	Bus10 Pad and Ground Underneath	1
9228	Unconditional Release Facility	2
9234	HP Project Trailer	2
9236	HP Count Module	2
9302	Northwest Protected Area Grounds	3
9304	Southwest Protected Area Grounds	3
9306	South Central Protected Area Grounds	2
9307	PAB / Service Building Alleyway	1
9308	Southeast Protected Area Grounds	2
9310	East Protected Area Grounds	1
9312	Northeast Protected Area Grounds	1
9313	Central Site Grounds	3
9402	Emergency Operations Facility	3
9403	Emergency Operations Center Roof	3

Table 6-3
Area Descriptions and Classifications

Survey Area	Survey Area Code Description	MARSSIM Classification
9404	North Warehouse	3
9406	South Warehouse	3
9408	Miscellaneous Trailer Complex	3
9410	Steam Generator Mockup Building	3
9412	Training Stores Office Building	2
9414	Warehouse #1	3
9416	Warehouse #2	3
9418	Office Building #3 and PAP	3
9420	Office Trailer	3
9422	Information Center	3
9423	Information Center Roof	3
9424	All Buildings Contained in the Southwest Site Storage Area	3
9502	Northeast Site Grounds (Non-Protected Area)	3
9504	Bypass Road / Secondary Parking Lot	3
9506	North Site Grounds (Non-Protected Area)	3
9508	Pond	3
9510	Access Road	3
9512	Northwest site Grounds (Non-Protected Area)	3
9514	Primary Parking Lot	3
9518	Southwest Site Grounds (Non-Protected Area)	2
9520	Southwest Site Storage Area	2
9521	Southeast Pond	3
9522	Southeast Site Grounds (Non-Protected Area)	2
9523	Southeast Wetland Area	3
9524	South Site Grounds (Non-Protected Area)	3
9525	Southeast Site Road	3
9526	Northeast Mountain Side	3
9527	East Mountain Side	2
9528	Southeast Mountain Side	3
9530	Central Peninsula Area	2
9531	South End of Peninsula	3
9532	East Site Grounds (Non-Protected Area)	Non-impacted
9535	South East Landfill Area	1
9536	Construction Piles Near Rifle Range	2
9537	Permitted Landfill Area	2
9538	Material Storage Area	2

Table 6-4 Activity Removed During the HNP Reactor Coolant System Chemical Decontamination

	Radionuclides	Activity (Ci)	Reference/Basis
A. Gamma Emitting Radionuclides	Co-60	128.7	Final Report "Reactor Coolant System Decontamination with the Siemens CORD D UV Process," dated 11/9/98.
	Am-241	0.32	"
	Mn-54	1.36	"
	Ag-110m	0.24	"
	Co-57	0.12	Liquid Sample #980727029 taken during the Chem Decon. Value is calculated by scaling from Co-60 activity in sample.
	Subtotal	**130.74**	
B. Alpha Emitting Radionuclides	Pu-238	0.30	Liquid #x10723 (Part50/61) taken during the Chem Decon. Value is calculated by scaling from Am-241
	Pu-239	0.10	"
	Cm-242	0.0016	"
	Cm-243	0.12	"
	Am-241	See "A" above	
	Subtotal (without Am-241)	**0.5216**	
C. Other Radionuclides Including Hard to detect nuclides	Fe-55	42.97	Chem Decon Stainless Steel Artifact, sample #z10449 (Part 50/61) – Analyzed May 15, 1998 Value is calculated by scaling from Co-60 activity in this sample.
	Ni-63	9.50	"
	Sr-90	0.024	"
	Pu-241	5.01	"
	Subtotal	**57.504**	

(Reference 6-17)

Table 6-5 Radioactive Sources at Haddam Neck Plant (6/30/00)

CY Id #	Leak Test	Nuclide	Activity micro Curies	Assay Date	Storage Location
CY-1	N/A	Am-241	1000000	9/20/66	Serv. Bldg
CY-2	N/A	Am-241	3480000	1/15/74	Serv Bldg
CY-5	Yes	Co-60	5860	10/1/74	HP Cal. Fac.
CY-11	Yes	Depleted Uranium	237 mrad/hr	11/28/84	HP Cal. Fac.
CY-13	N/A	Co-60	295000	11/16/78	Serv Bldg.
CY-25	Yes	Am-241	25000	4/1/79	HP Cal. Fac.
CY-26	Yes	Am-241	10.8	4/1/79	HP Cal. Fac.
CY-31	Yes	Cs-137	400000000	1/1/83	HP Cal. Fac.
CY-31	Yes	Cs-137	130000	1/1/83	HP Cal. Fac.
CY-32	Yes	Cs-137	120000	8/22/85	Serv.Bld.Hall
CY-33	Yes	Cs-137	120000	8/22/85	HP Cal Fac
CY-34	N/A	Depleted Uranium	238 mrad/hr	9/1/85	HP Cal. Fac.
CY-35	N/A	Cs-137	120000	9/23/88	Serv Bldg
CY-36	N/A	Cs-137	300000	7/5/89	Serv Bldg
CY-37	N/A	Cs-137	20000	7/10/89	Serv Bldg
CY-38	Yes	Cs-137	20000	7/10/89	HP Cal. Fac.
CY-39	N/A	Cs-137	20000	7/10/89	Serv Bldg
CY-40	N/A	Cs-137	20000	7/10/89	Serv Bldg
CY-44	N/A	Am-241	0.074	7/5/91	Chem Lab #1
CY-45	N/A	Am-241	0.0691	8/24/92	Chem Lab #1
CY-47	N/A	Sr-90	20	3/19/93	HP Cal Fac
CY-48	N/A	Am-241	0.007	1/1/89	HP Cal Fac
CY-49	N/A	Eu-152	2.9	2/1/96	EOF
CY-50	N/A	Eu-152	1.017	8/6/96	HP Count Rm
CY-52	N/A	Mixed Gamma	2.018	7/1/97	HP Count Rm
CY-52	N/A	Am-241	2.018	7/1/97	HP Count Rm
CY-63	N/A	Am-241	0.007	4/15/97	HP Count Rm
CY-64	N/A	Am-241	0.01	4/15/97	Site Char.
CY-65	Yes	Co-60	25.052	4/15/97	Chem Cab #2
CY-66	Yes	Cs-137	25.052	4/15/97	Chem Cab #2

Table 6-5 Radioactive Sources at Haddam Neck Plant (6/30/2000)

CY Id #	Leak Test	Nuclide	Activity micro Curies	Assay Date	Storage Location
CY-67	Yes	Sr-90	2000	5/1/97	Serv. Bld.Hall
CY-68	N/A	Sr-90	2000	5/1/97	HP Cal Fac
CY-69	Yes	Co-60	25.058	5/14/97	Chem Cab #2
CY-70	Yes	Cs-137	5.0E-4		Chem Cab #2
CY-71	N/A	Am-241	0.03	5/14/97	HP Cal Fac
CY-72	Yes	Ra-226	6.25		HP Cal Fac
CY-73	N/A	Cm-244	1.0	5/14/96	HP Cal Fac
CY-74	N/A	Cm-244	1.0	5/14/96	HP Cal Fac
CY-75	Yes	Cd-109	10000	5/15/98	Site Char
CY-76	N/A	Mixed Gamma	3.056	4/1/98	HP Count Rm
CY-76	N/A	Am-241	3.056	4/1/98	HP Count Rm
CY-77	N/A	Mixed Gamma	3.045	4/1/98	Chem Cab #1
CY-77	N/A	Am-241	3.045	4/1/98	Chem Cab #1
CY-78	N/A	Am-241	0.005	4/1/98	Site Char.
CY-79	N/A	Am-241	0.063	5/29/98	HP Count Rm
CY-80	N/A	Am-241	.0001993	7/13/98	Chem Lab #1
CY-80	N/A	Co-60	.1009	7/13/98	Chem Lab #1
CY-81	N/A	Am-241	.0001127	7/16/98	Chem Lab #1
CY-81	N/A	Co-60	.05719	7/16/98	Chem Lab #1
CY-82	N/A	Mixed Gamma	2.899	4/1/99	Chem Lab #1
CY-82	N/A	Am-241	2.899	4/1/99	Chem Lab #1
CY-83	N/A	Mixed Gamma	3.087	4/1/99	Chem Lab #1
CY-83	N/A	Am-241	3.087	4/1/99	Chem Lab #1
CY-84	N/A	Am-241	0.005	9/16/99	Chem Lab #1
CY-85	N/A	Mixed Gamma	1.983	7/1/99	Chem Lab #1
CY-86	Yes	Cd-109	10000	10/15/99	Turbine Bld.
CY-87	N/A	Am-241	3.318	4/1/00	Chem Lab #1
CY-87	N/A	Mixed Gamma	3.318	4/1/00	Chem Lab #1
CY-88	N/A	Am-241	3.34	4/1/00	Chem Lab #1
CY-88	N/A	Mixed Gamma	3.34	4/1/00	Chem Lab #1
CY-89	YES	Co-57	40000	7/93	Serv. Bldg.

(Reference 6-22

Table 6-6 CTDEP EI Areas of Concern

AOC No.	Size/Type	Product/Waste	Location
1-A	6000 gal UST	Unleaded	NW near warehouse (removed)
1-B	4000 gal UST	#2 heating oil	NW near warehouse
1-C, D	2- 5000 gal UST	Diesel fuel	Near Diesel Bld.
1-E	42000gal AGST	No. 2 oil (drained)	Near Discharge Bld.
1-F, G, H	3- 275 gal AGST	Diesel fuel	F- in chemistry storage Bld. G- In Guard House H- Emergency Operations Facility
1-I, J	2- 500 gal AGST	Diesel fuel	In Diesel Bldg.
2-A, B	2- 1250 gal AGST	Sodium Hypochlorite	Screen well house
2-C	350 gal AGST	Sodium Hypochlorite	Screen well house
2-D	275 gal AGST	Diesel fuel	Screen well house
3-A	Main Power transformer	Non-PCB Transformer	East of reactor containment building
3-B	Spare Power Transformer	Non-PCB Transformer Oil	East of reactor containment building
3-C	Station Service Station Transformer	Non-PCB Transformer Oil	East of Turbine Building
4-A	Container Storage RCRA part A	50 gal toluene-tritium waste. 50 gal. Xylene (scint) waste; both are mixed hazardous waste	Maintenance Shop in Butler Bldg. (Hot Side)
4-B	500 gal AGST	Diesel	Maintenance Shop in Service Bldg. (cold side)
4-B	50 gal degreaser	111-TCE product	Maintenance Shop in Service Bldg. (cold side)
4-B	1 drum	Lead paint solids, waste	Maintenance Shop in Service Bldg. (cold side)
4-B	3 drums	Paint, aerosol cans, solvent rags, waste	Maintenance Shop in Service Bldg. (cold side)

Table 6-6 CTDEP EI Areas of Concern

AOC No.	Size/Type	Product/Waste	Location
5-A	Storage cabinets	Explosives, flammables, solvents	Turbine Bldg.
5-B	Aux. Heating system	Burns Diesel fuel	Turbine Bldg. Boiler Room
5-C	1000 gal AGST	Hydrazine	Turbine Building
5-D	345 gal AGST	Hydrazine	Turbine Building
5-E	Containers	Acid/Caustic Storage	Turbine Bldg.
5-F	Two drainage sumps 400 gal.	Drainage from inside Turbine Bldg.	Turbine Bldg.
5-G	Oil/water separator	Drainage from inside Turbine Bldg.	Turbine Bldg.
5-H	Two 12,000 AGST	Waste water neutralization	Turbine Bldg.
6-A	Boric Acid bulk storage	50 bags boric acid pallets	Primary Auxiliary Bldg.
6-B	Chem. Lab	Water analysis chemicals for wet chemistry	Primary Auxiliary Bldg.
7-A	12,500 gal AGST	Lube oil	Turbine Bldg.
7-B	12,500 gal AGST	Waste oil	Turbine Bldg.
7-C	2000 gal AGST	Waste oil	Turbine Bldg.
7-D	10,000 gal AGST	Turbine lube oil	Turbine Bldg.
7-E	25- 5 gal. can	Gasoline	Turbine Bldg.
7-F	RCRA Container Storage Area 1760 gal (32 * 50 drums)	Solvents, corrosives, ignitable	Turbine Bldg.
8-A	Two 14,000 gal AGST	Waste test water (radioactive)	Reactor Containment Building
8-B	2 * 14,000 gal AGST	Recycled wastewater post-treatment storage prior to discharge to CT river.	Reactor Containment Bldg.
8-C	Waste treatment system	Filters, ion exchange	Reactor Containment Bldg.

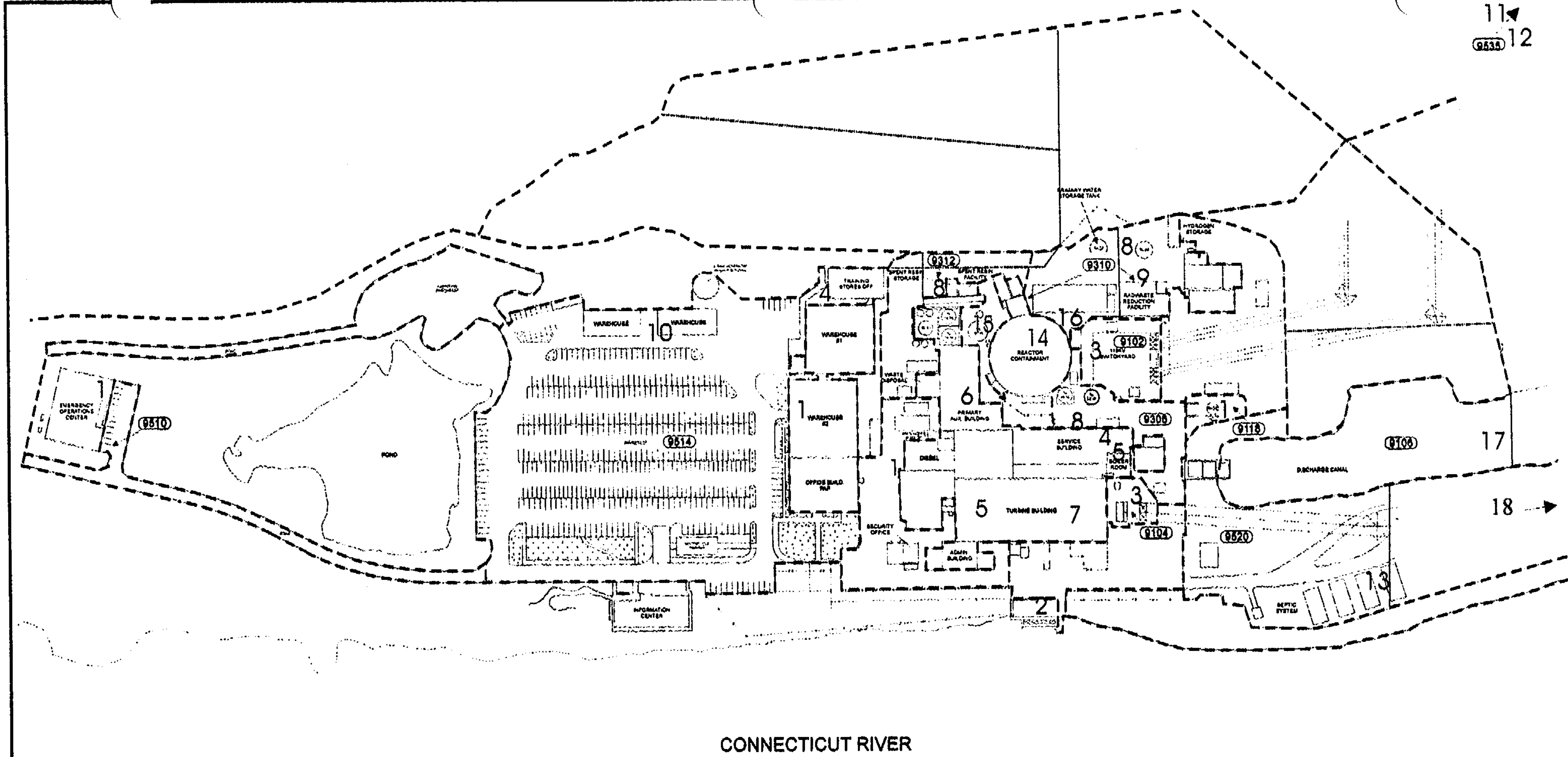
Table 6-6 CTDEP EI Areas of Concern

AOC No.	Size/Type	Product/Waste	Location
9	RCRA 230 gal container storage area 2 metal-solvent storage cabinets Indefinite storage-no place to dispose of this waste now	Mixed waste (radioactive & RCRA): xylene, solvent degreaser, mercury, varnish, paint	Radiation waste Reduction Facility (Hot)
10	1500 gal container storage area drum & containers on shelves	Virgin product resins, 111 TCE, paints lubricants, motor oils, flammables, explosives, acids, caustics	Hazardous chemical warehouse
11	Shooting range	Assumed lead shot	In barrow pit area located approx. 4500 ft. east of main plant
12	Bulky waste landfill	Construction debris, bulky waste from plant. Recently discovered to contain elevated levels of radioactivity	In barrow pit area located approx. 4500 ft. east of main plant
13	Three on-site septic systems	Domestic wastewater	Floodplain between discharge canal and Ct. River
14	Reactor Containment Building and Mat Drain sump	Radioactive (tritium) groundwater from reactor containment building foundation dewatering	Adjacent to reactor containment building east side
15	Refueling Water Storage Tank AGST; size not reported	Reactor Water	Adjacent to reactor containment building northeast side
16	1989 mat drain sump release area	Radioactive (tritium) groundwater from reactor containment building foundation dewater	Floodplain between discharge canal and hillside, 500 ft. SE of reactor

Table 6-6 CTDEP EI Areas of Concern

AOC No.	Size/Type	Product/Waste	Location
17	Cooling Water discharge canal 5500 ft. long	Cooling water from reactor	Runs from plant to river
18	Cooling water discharge canal dredge spoils area	Dredge spoils from canal	On peninsula between discharge canal and Ct. River

(Reference 6-24)



(Reference 6-24)

Plant North

CONNECTICUT YANKEE ATOMIC POWER COMPANY
GENERAL ARRANGEMENT DRAWING

Figure 6-1 SITE GROUNDS

CTDEP Areas of Concern

INITIAL CREATION DATE:	04/25/97
REVISION DATE:	06/06/01
REVISION #:	16
MAP #:	[illegible]

LEGEND:

FLOOR WALL INTERSECTION	——
SURVEY AREA BOUNDARY	— —
SURVEY AREA	#

7.0 Assessment Findings

7.1 Potential Contaminates

Chemical

An evaluation of records, past practices and processes identified potential chemical pollutants that may be present in measurable quantities in site area soils, ground water and decommissioning debris. Table 7-1 summarizes these chemicals and related processes. (Reference 7-1)

Radionuclides

Site surveys, analysis of components and waste characterization data have identified radionuclides that may be present in measurable quantities in site areas and soils and that are likely associated with licensed plant material. Table 7-2 summarizes these radionuclides and their half-lives, which have the potential to contribute to the residual dose from HNP. (Reference 7-2)

7.2 Potential Contaminated Areas

This section provides descriptions of those areas and systems that have been determined to be radiologically impacted by operation of the Haddam Neck Plant. Plant system information has been included for completeness. Plant areas are discussed with reference to Survey Area numbers that are identified in Table 6-3. Maps showing the specific locations of the survey areas are included as Section 10.0. Impacted buildings and land areas are separated into those that are classified as Class 1 or 2 survey areas, followed by a general discussion of those that are Class 3. The Class 3 areas are those that have radiological samples or measurements that indicate levels far below the expected DCGLs. These areas are considered impacted due to their location (buffer areas), or frequent foot or vehicle traffic from the Class 1 or 2 areas, such that a final status survey is warranted. One survey area is considered to be non-impacted and is discussed in Section 7.2.2.

7.2.1 Impacted Areas

Systems

An extensive review of systems was conducted to determine those systems that contain radioactive materials or in which radioactive material was detected at some time during the operating history of the plant. Systems that are identified as "affected" require additional surveys to define the extent and magnitude of radioactivity.

For those systems that may have been impacted due to steam generator tube leakage or other operational events in the past, but for which subsequent samples have not identified radioactivity, the "affected" status is maintained. Table 7-3 provides a listing of plant systems and their status relative to the potential for radioactivity. The assessment considers the internal portions of the systems. Systems that might be assessed as "unaffected" and are located in contaminated areas may be externally contaminated.

For those systems designed to contain radioactivity, such as the Reactor Coolant System and Radioactive Waste Processing Systems, the associated radiological conditions are continuously changing, with the most recent information necessary to support radiation protection activities maintained by the site Radiation Protection Department. These systems will be evaluated for remediation or disposal as radioactive waste based on economic evaluation of the alternatives.

Several components, such as the gland seal and turbine casing, have been identified as "affected" based on primary-to-secondary leakage identified in operating cycles as recent as 1990. These components contain low levels of radioactivity. The extent of the contamination, although appearing to be limited to small portions of the high-pressure steam portion of the system, will be further defined as the systems are disassembled and the internal surfaces become accessible. These items are identified in the characterization reports associated with the areas containing the systems.

Buildings

The extent and nature of radioactive material in Class 1 and Class 2 primary structures on site are discussed in the following paragraphs. Buildings considered buffer areas, situated next to a contaminated area or may have temporarily contained radioactive materials, are included in this section.

Primary Auxiliary Building-Area 2002 to 2402

The Primary Auxiliary Building (PAB) is designed to house systems containing radioactive materials. The building is designed to contain and control leakage occurring during routine operations as well as unusual conditions. The radiation protection department staff through surveys performed in support of daily plant activities maintains the radiological status of the building.

Surveys indicate beta/gamma contamination levels in the PAB range from less than 1000 dpm/100 cm^2 up to hundreds of thousands of dpm/100 cm^2. Alpha contamination levels range from less than 50 dpm/100 cm^2 to several thousand-dpm/100 cm^2. Radiation levels in the PAB range from less than 5 mR/hr up to several thousand mR/h.

With the exceptions of the service water, primary de-ionized water, control air, fire protection, nitrogen gas and service air, all of the systems within the PAB are radiologically contaminated. Contamination levels in several of these systems are such that high radiation areas exist in their vicinity. Most of the cubicles that contain major systems were posted as contaminated areas identifying removable radioactive material.

The PAB contains pipe trench and pump pit areas, in which conditions in these areas include high dose rates, possibility for high airborne contamination levels and alpha-emitting radionuclides. The lower level of the PAB under the boron recovery equipment is contaminated due to past spills involving evaporator bottoms.

The PAB, fuel building and containment air handling systems all contain contaminated filter elements that will have to be removed and disposed of once these systems are declared abandoned.

The roof of the PAB has been radiologically impacted by historical plant events. Contamination of the PAB roof has occurred on multiple occasions due to emissions from the PAB roof exhaust and identified problems with the exhaust ducting. In 1980, an epoxy coating was used to fix contamination identified on the PAB roof.

Historically, leaks have been found at the junction between the steam generator blow down line and the service water discharge line beneath the floor of the PAB drumming room. On at least one occasion, a leak has resulted in contamination of the soil beneath the drumming room floor.

Based on the building design basis, events that have occurred within the building, and the present status of areas that are controlled as contaminated areas, much of the interior surfaces of the PAB are expected to contain radioactivity above the Derived Concentration Guideline Level.

Concrete core bore information has identified that typical penetration depth is about 0.5 inch, however a depth of up to 2 inches has been identified in an area expected to contain contamination among the highest in the building.

Concrete core bore information was obtained for three locations in the Primary Auxiliary Building (PAB). The cores were cut into half-inch thick wafers and analyzed for gamma emitting radionuclides. One core was taken in the floor area of Area 2104 near the access ladder that leads down to the pipe chase. Essentially, the radioactivity was detected in the top half inch of the core with only Co-60, Cs-137 and Cs-134 detected. The Co-60 concentration was 34.1 pCi/g, Cs-137 concentration was 74.0 pCi/g and the Cs-134 concentration was 5.18 pCi/g. A second core was taken on the wall of Survey Area 2002 approximately 4 feet from the floor. Once again, the radioactivity was detected in the top half inch of the core, with only Co-60 and Cs-137 detected. The Co-60 concentration was 6.93 pCi/g and the Cs-137 concentration was 5.38 pCi/gm. A third core bore location was in the floor of Survey Area 2008 in a trough running along the west wall. Radioactivity levels in the 1.5- to 2-inch wafer were approximately 10% of the levels in the top half-inch wafer. The Co-60 concentration in the 1.5- to 2-inch wafer was 0.54 pCi/g and the Cs-137 concentration was 1.35 pCi/g.

Based upon the known leaks from drain lines under the PAB, one area under the PAB Drumming Room floor was sampled. This sub-floor area is a small crawl space with process piping of different systems running through the area. Samples were collected down to a depth of 4 feet. Sample results indicated plant-related radioactivity down to approximately 3 to 4 feet.

No neutron activation analysis was performed on any components of the PAB due to the distance and extensive shielding from the reactor.

Characterization of the PAB roof material was performed in 1998 given the known history of contamination near the ventilation ducting and the use of epoxy paint to cover areas of "fixed" contamination in the tar and fixed stone covering. Only one of five samples reported licensed material, (i.e., Co-60) above background, albeit at relatively minor levels (3.3E-4 μCi or approximately 750 dpm).

The roof material analytical results were not geometry corrected and are therefore qualitative. Although not definitive, these results indicate that no individual measurement will likely exceed anticipated actions levels, Derived Concentration Guideline Level (DCGL). Other roofing materials have been sampled and analyzed recently to support decommissioning activities. Gamma spectroscopy analytical results have not identified licensed materials above background in these samples. Nonetheless, the history of the area, the use of epoxy to cover contamination on the roof and industry experience with the deposition of radioactive material on horizontal surfaces from gravitational settling indicates the potential for one or more samples to exceed action levels, DCGL, in the vicinity of the ventilation ducts.

Containment Building-Area 3002 to 3502

The Containment Building houses numerous systems containing primary coolant as well as radioactively contaminated support systems. System leakage and maintenance activities over the operating life of the plant have resulted in radiological conditions similar to the containment buildings at other pressurized water reactors of similar vintage. As in the PAB, beta/gamma contamination levels in the Containment Building range from less than 1000 dpm/100 cm^2 up to hundreds of thousands of dpm/100 cm^2. Alpha contamination levels range from less than 50 dpm/100 cm^2 to several thousand-dpm/100 cm^2. Radiation levels in the Containment Building range from less than 5 mR/hr up to several thousand mR/h. Some components, equipment, structural steel and concrete have become radioactive due to neutron activation.

Concrete core bores were obtained in three locations in Survey Area 3104 at the 1ft - 6-inch elevation. The cores were cut into half-inch thick wafers and analyzed. The first core was in the floor. All of the radioactivity was detected in the top half inch of the core with a Co-60 concentration of 23.4 pCi/g, Cs-137 concentration of 279.0 pCi/g and a Cs-134 concentration of 2.76 pCi/g.

The second core was taken on a vertical surface 1 foot above the floor with essentially all the contamination found in the top half inch of the core. The Co-60 concentration was 1.68 pCi/g, Cs-137 concentration was 13.66 pCi/g and the Cs-134 concentration was 0.21 pCi/g.

The third core was taken on a vertical surface 3 feet above the floor with essentially all the contamination found in the top half-inch of the core. The Co-60 concentration was 0.39 pCi/g and the Cs-137 concentration was 2.12 pCi/g. No Cs-134 was detected.

Additional cores will be obtained to establish radioactivity levels of materials subjected to neutron flux after the reactor vessel and other highly radioactivity components have been removed.

During 1998, a site characterization study was performed for PCBs, RCRA metals, and radioactivity in paints used on the structures on primary and secondary sides of the HNP. Many paint-chip and concrete-chip samples from containment were collected and analyzed.

The purpose of the sampling program was to determine the extent of remediation required, and the waste management requirements due to potential PCB or RCRA metals in paint used in the Containment Building. A summary of the results is as follows:

- The average concentrations of radioactivity in paint on the steel liner are about 1200 pCi/g on the charging floor level and about 300 pCi/g on the grade level. The primary radionuclides are Cs-137, Co-60 and Cs-134.

- The concentrations of radioactivity in paints on equipment vary markedly in both total activity and radionuclide distribution, depending on location and use. For example, the core barrel lift rig contained approximately 25,000 pCi/g of Co-60 in paint while the polar crane contained 30 pCi/g of Co-60 in paint.

- The total radioactivity in floor paint averaged approximately 8200 pCi/g and is essentially the same from the charging floor, grade level and lower level.

- The total radioactivity in wall paint averaged approximately 490 pCi/g and is essentially the same from the charging floor, grade level and lower level.

- The radioactivity in the paint/concrete samples is greater than the radioactivity in the underlying concrete samples. The radioactivity in the paint/concrete and concrete only samples is greater on the floors than in the corresponding samples from the walls.

Containment Dome-Area 3403
This survey area contains the upper walls and ceiling (dome) of the primary containment. The initial classification of this area considered the upper walls as extending above 2.4 meters (8 feet) from the Charging Floor (Containment elevation 48.5') for additional conservatism.

The initial classification also assumed that all paint (which is required to be removed for other reasons, namely because it contains PCBs) had been removed from the inner steel liner.

A review of historical data, including interviews with Connecticut Yankee health physics management, indicates that the upper walls and ceiling of Containment were subjected to airborne radioactivity during the lifetime of the unit; however, industry experience with the deposition of radioactive material on ceilings and vertical surfaces has shown that these surfaces have a lower contamination potential primarily due to the gravitational settling.

For example, a review of recent contamination surveys performed on the Containment polar crane upper structure (Containment elevation 89.5') shows that loose surface contamination levels are at least five times less on vertical surfaces than on nearby horizontal surfaces which is consistent with the redeposition process described above.

Airborne radioactivity in the Containment upper structure during plant operation would most likely have resulted in uniform distribution of contamination. There is no history of events leading to the spraying of primary coolant directly onto portions of the upper Containment walls or dome.

Furthermore, the design of the Containment Charging Floor makes direct communication between primary coolant and the Containment upper structure unlikely. Therefore, isolated pockets of contamination or "hot spots" are not expected on the upper walls or ceiling of Containment and should not be a major factor in the design of the survey plan for the Containment structure Final Status Survey.

Finally, concrete core bores (and the Containment inner steel liner) were obtained from ten locations during the alternate containment access installation in 1998. Analyses of these samples provided qualitative results, that is, they identified radionuclides and not the concentration. However, correcting these data for mass, although not definitive, indicates that no individual measurement will exceed the anticipated action levels, DCGL.

The initial classification of this area as a Class 2 is consistent with MARSSIM based on site-specific considerations including process knowledge, industry experience and data collected during the installation of an alternate access point to Containment at the 57 foot elevation.

Based on the building design basis and the operation history as well, much of the interior surfaces of the containment building, except Area 3403, are expected to contain radioactivity at or above anticipated action levels established for decommissioning.

Radiological conditions within this area change on a frequent basis due to ongoing dismantlement activities.

Radwaste Reduction Facility-Area 9226

The Radwaste Reduction Facility is a structure used for staging and packaging various radioactive, and RCRA mixed waste streams. The Radwaste Reduction Facility contained radiologically contaminated items, both as radioactive waste and processing equipment. Therefore, the potential for residual contamination exists throughout the building. The Radwaste Reduction Facility historically contained a variety of equipment such as a waste shredder/compactor previously used for waste processing. The shredder/compactor was internally contaminated.

This equipment is typical of equipment used throughout the life of the facility since the primary purpose was the sorting and volume reduction of radioactive material. Additionally, there was a permitted lead work booth that is radiologically contaminated and may represent a mixed waste concern. The floors and the floor drains of the facility represent the primary concerns for residual contamination. The Radwaste Reduction Facility contains no plant related process systems (such as service air, control air, and so forth). The systems within the building are support systems such as electrical service and ventilation. Historical surveys of the building show contamination levels range from non-detectable up to 2000 dpm/100cm^2- beta-gamma.

Fuel Storage Building-Area 1102 to 1404
The Fuel Storage Building is a structure designed for the storage of new and spent fuel. The spent fuel handling area encloses the spent fuel pool and the equipment necessary for safe handling and storage of spent fuel. The spent fuel pool is a 36 ft long by 37 ft wide by 35 ft deep pool located in the northern half of the building. The pool is filled with borated water and contains storage racks for the spent fuel assemblies stored there.

Highly irradiated reactor components and other debris are stored in the pool as well.

The Fuel Storage Building contains radiologically contaminated items and process equipment. The potential for residual contamination exists through out the building. Historical surveys of the building show that contamination levels range from non-detectable (ND) to >100000 dpm/100cm^2- beta-gamma; alpha contamination levels range from non-detectable (ND) to > 500 dpm/100cm^2. The highest alpha contamination levels were measured in the Spent Fuel Pool area.

Waste Disposal Building-Area 6002 to 6502
The waste disposal building contains handling and processing systems for liquid and gaseous waste streams. These systems include the waste gas decay system, the liquid waste evaporator systems, the floor and equipment drain system, the Degassifier system, the distillate system, and so forth. All of these systems are contaminated, and many were frequently posted as high-radiation areas. Some lines had radiological hot spots where dose rates exceed 100 mR/hr.

There is evidence of historical system leakage in many areas. There is also evidence of boron in the waste gas system. Contaminated floor drains are located throughout the building. Historical surveys of the building show that contamination levels range from ND to >100000 dpm/100cm^2- beta/gamma; alpha contamination levels range from ND to > 500 dpm/100cm^2.

Turbine Building-Area 4102 to 4603
Primary to secondary leakage has resulted in measurable radioactivity in small areas of the secondary system piping, primarily in the high-pressure steam components within the turbine building.

In the fall of 1997, systems in the Turbine Building were systematically sampled at several locations (e.g., sumps, filters, pumps, valves) to evaluate internal contamination levels. Scans and Total Surface Contamination measurements as well as smears were obtained at the access locations. Positive sample results ranged from 0.01 pCi/g up to several picocuries per gram of Cs-137 and Co-60.

Surveys of accessible areas of the systems have shown fixed radioactive material in levels up to approximately 10,000-dpm/100 cm^2. Isotopic analysis has identified that Cs-137 is the principal radionuclide that has carried over in the steam following primary to secondary leakage.

No alpha emitting radionuclides have been identified in any surveys for either fixed or removable radioactivity.

Scoping surveys performed in the turbine building, covering more than 30,000 square feet of the surfaces of the operating floor and grade level in 1997 identified only one small area of elevated activity. That area, near the normal entrance/egress path to the Radiologically Controlled Area, was remediated at the time of the survey.

Service Building-Area 5102 to 5402
Most of the service building areas are, and have always been, subject to routine health physics surveys. Many years worth of these survey records, covering the operating life of the plant, were reviewed to identify areas found to have had radionuclide contamination in the past.

Such areas include the sampling room located on the first floor of the H.P. facilities building (contaminated via spills from the Post Accident Sampling System), the clean side machine shop, the hot side machine shop, the decontamination room, the radiochemistry lab, the men's RCA shower area, and the myriad of miscellaneous cable trays and duct work that traverse the area above the radiochemistry lab. With the exception of the sampling room, the decontamination room and the hot side machine shop, areas were radiologically impacted at levels below the expected DCGLs, or were remediated with subsequent surveys indicating less than detectable levels. The area underneath the H.P. facilities building is also suspect due to historical events (ruptured lines) that resulted in contamination of the soil beneath the floor of the drumming room located in the PAB. The subsurface conditions will be evaluated as part of the effort to fully characterize the area below the drumming room. It should be noted that the service building has been reconfigured on multiple occasions to either re-locate or add facilities, resulting in areas that were previously under radiological control becoming "clean" areas and areas that were previously clean coming under radiological control.

One caveat associated with this fact is that there are contaminated floor drains and drain lines asserted by long time staff members to be under the floor of what is now the maintenance shop kitchen/break area. The drain lines will be evaluated during subsequent characterization activities.

Unconditional Release Facility-Area 9228

The Unconditional Release Facility (URF) is located fully within the RCA and is currently not in use. The URF was used to survey materials prior to free release from the RCA. The free release surveys were aided by the Small Articles Monitor, a large articles monitor and the sorting table, all of which still reside in the URF. Until recently, the URF also functioned as the RCA gate to facilitate cool-down breaks within the URF for workers during heat stress jobs. The Personnel Contamination Monitor, which was used for temporary exit from the RCA, was located along the north wall of the URF and is partially isolated by a semi-circular wall.

Historical surveys of the building show that contamination levels range from non-detectable up to 5000-dpm/100 cm^2 - beta/gamma. Routine 1998 and 1999 surveys that were reviewed indicate no detectable contamination activity on smears taken from surfaces in the URF.

Feed Water/Steam Penetration Building (FW/STM) Area 8100, 8200, 8300

The FW/STM Penetration Building as defined in this report includes the "Terry Turbine Building." The building has three basic levels. The lower level room contains the steam driven auxiliary Feedwater pumps and Feedwater piping. The middle level room contains atmospheric main steam dump valves encased by vented metal doors and walls. The upper level room contains main steam stop valves and an outside catwalk that extends to the Service Building located directly above main steam and Feedwater transfer piping. The upper level also serves as the alternate access HP control point to the containment building via an opening cut through the containment wall.

Routine 1998 and 1999 surveys that were reviewed indicate no detectable contamination activity on smears taken from surfaces in the FW/STM Penetration Building.

HP Project Office, HP Count Module, -Area 9234, 9236

The HP Project Office and the HP Count Module are detached modular units situated within the RCA just north of the Waste Disposal Building. The areas of interest for both buildings are bounded by the respective outer walls, floors and roof. The HP Project Office is commonly referred to as the Mac Shack.

Note that the HP Project Office should be distinguished from the HP Break Trailer that has been dismantled.

The HP Count Module houses gas proportional counters and germanium detectors that are used for the analysis HP smears, air filters and samples intended for free release. Prior to analysis, samples are stored in metal cabinets located in a room within the module. Samples that have been counted are stored underneath the table located to the left of the entrance.

An approximately 3'x 3' section of the countertop, located along the west wall of the module, is dedicated for smear and air filter sample preparation for analysis. The center cabinet located under the countertop contains all the detector calibration standards.

Weekly surveys of the Count Module, dating from January 1998 thru September 1999, indicate all smear results to be less than 1000 dpm/100 cm^2 for beta/gamma and less than 20 dpm/100 cm^2 for alpha. Although a majority of the smears indicated no detectable activity, a few results above the minimum detectable activity (MDA) were observed in the range of 30 to 250 dpm/100 cm^2 for beta/gamma on smears taken at or near the sample prep countertop. Areas with smearable activity above MDA were cleaned and resurveyed. The follow-up surveys did not indicate any activity on the smears above the MDA. Exposure rate surveys were less than 0.2 mrem/h. The function of the count module, i.e. low-level counting, required that the area be maintained with a low background.

The H.P Project Office is currently used as a storage location for HP supplies. In the past, it has been primarily used as an additional office area by HP staff.

Routine surveys of this area, dating from January 1998 thru August 1999, indicate all smear results to be less than 1000 dpm/100 cm^2 for beta/gamma and less than 20 dpm/100 cm^2 for alpha.

With the exception of one smear that indicated 76-dpm/100 cm^2 for beta/gamma, all other results were below the MDA. Exposure rate surveys were less than 0.2 mrem/hr.

Shutdown Auxiliary Feed Pump House-Area 9214
The Electric Shutdown Auxiliary Feed Pump House contains pump P-32-1C. Above ground DWST piping is connected to this pump. This building is an independent structure with outer aluminum siding, inner sheetrock walls, slightly tapered sheet metal roof, asphalt floor, building exhaust ventilation, heat traced piping, electrical control panels/wiring and a concrete support base beneath the pump.

No significant radiological events have been identified regarding this area.

The most probable mechanism for affecting this building with radioactive material has been by transfer of loose surface contamination from personnel or equipment.

Training Stores Office Building-Area 9412

No radiological-related activities have been known to occur within the Training Stores Office Building. The building was initially used as a warehouse prior to being converted into classrooms and offices. The routine radiological surveys, that have been reviewed, indicate smear results to be less than 1000 dpm/100 cm^2 for beta/gammay and less than 100 dpm/100 cm^2 for alpha contamination. Annual random frisk surveys taken in 1998 and 1999 indicate no detectable radioactive contamination activity.

Radiologically Controlled Area Grounds

At present, the Radiologically Controlled Area Grounds consist of paved areas around the containment building, primary auxiliary building, RWST and waste storage tanks, and the spent fuel building. Several events were identified involving unplanned liquid releases that have radiologically impacted the area. Portions of the area have been posted as contaminated (removable contamination greater than 1000 dpm/100 cm^2) due to system leakage. The contents of the tanks caused radiation areas to exist. The paved areas served as the pathways for personnel movement between buildings and for vehicles moving materials, including radioactive waste. The area has also been used for temporary processing equipment in support of operations and maintenance activities during outages. Radiological surveys performed during the plant operating years have identified areas of removable contamination. For example, a temporary resin storage area was operated in the areas south of the Spent Fuel Building (Area 9227). Contaminated pavement and soil resulting from its use have been identified and remediated.

Primary Auxiliary Building /Service Building Alleyway Area 9110, 9120, 9126, 9307

The asphalt covered Primary Auxiliary Building /Service Building Alleyway extends along the northern circumference of the Containment building from west to east. It includes the ground, all subsurface piping/conduit and all equipment and structures present in the alleyway. Covered/shielded pipe trenches traverse this area. The primary vent stack and south tank farm are included. The south tank farm is located in the northeastern section of the alleyway and consists of the Refueling Water Storage Tank (RWST) and the Waste Test Tanks A & B (TK-17 1A & 1B).

Several documented events, which have occurred during the course of plant operation, have led to contamination of the alleyway. Summarized descriptions of these events are given below:

- In January 1973, the top flange of the thermo siphon heater leaked radioactive liquid onto the RWST side.
- The rupture of a rubberized diaphragm in the RWST thermo siphon heater in November 1973 and another compromise of the diaphragm valve in February 1976 led to leakages of contaminated water in the alleyway. In December 1976, a weld break on a thermo siphon heater pipe resulted in water leakage onto the alleyway. A head gasket leak from the thermo siphon heater caused water spillage in February 1978. Another rupture of a diaphragm valve on the thermo siphon heater in January 1979 led to contaminated water spillage onto the alleyway.
- Contaminated water overflowed from the RWST hatch onto the nearby ground in September and October 1981 due to a valve that was left open (9/81) and the activation of the thermo siphon heater (10/81).
- A frozen degassifier line in February 1979 caused the rupture of the diaphragm disc and led to leakage of reactor cavity water into the main stack drain and subsequently onto the surrounding area in the alleyway. Some of the water was removed while the remainder was washed into the storm drain system. CY calculations show a release of 1.26E4 μCi of mixed fission and activation products into the storm drains and ultimately the discharge canal.
- In March 1979, contaminated water leaked from the main stack hatchway because of a plugged drain and a leaking gasket on the hatchway. No information on type/amount of activity or remediation efforts was available for review

- During an accelerated steam generator blowdown in July 1979, contaminated water dripped onto the stack and surrounding area from the Primary Auxiliary Building ventilation system. Although α contamination was found to be less than 100 dpm/100 cm^2, β/γ contamination in the alleyway, stack surface and pedestal ranged from 1008 to 61,600 dpm/100 cm^2. The smear surveys indicated contamination to be present only in the immediate vicinity of the stack. Similarly, the storm drain was also found to be unimpacted. The stack surface was cleaned and painted and the ducts from the blowdown line to the stack were replaced in September 1979.

- The July 1979 event also led to a flash steam event up through the stack and the subsequent release of contaminated particulates within the CY site.
- A series of events in September 1979 resulted in the release of steam generator contents into the stack. The steam condensed in the stack ductwork and subsequent leaked 50 to 75 gallons of contaminated water onto the alleyway. Smear surveys indicated contamination levels from 5k to 10k dpm at the perimeter of the leak. Cs–134 and Cs–137 were identified in the water at approx. 8E-4 µCi/ml each. All of the liquid was removed and the area was decontaminated.
- The degassifier rupture diaphragm actuated in December 1979 and vented gaseous contents up the stack and liquid contents near the base of the stack. The impacted areas and systems were storm sewers, roof drain lines, stack, stack duct and drain lines and the PAB roof. All impacted areas were remediated.
- A routine sample taken in February 1980 from yard drain #4 indicated positive Cs–134 at 1.45E-5 µCi/ml and Cs–137 at 2.17E-5 µCi/ml. Another sample taken in April 1980 from the same drain indicated Cs–137 at 9.7E-07 µCi/ml and Co–60 at 2.96E-6 µCi/ml. The yard drain was flushed and the contaminated mud was removed. Further sampling indicated no detectable activity.
- Three releases from the stack occurred in May 1980. Waste gas and resin slurry were vented through the stack and a small amount of contaminated water leaked from the base of the stack. The impacts of these releases were limited to the RCA and were within technical specifications.
- Contaminated water from RWST cleanup hoses leaked onto the alleyway in April 1990. The area was decontaminated and released.
- In September 1990 and July 1994, cracks in the welds located in the base of the RWST led to leakage of contaminated water onto the tank pedestal.

- An improperly fabricated flange led to water leakage from the RWST in November 1991 and January 1992.
- During a rainstorm in August 1997, an overflow of water from the RWST catch basin area to an uncontrolled sand area was observed. The runoff posed an uncontrolled release pathway into the environment. Gamma spectrometry of the sand revealed the presence of Co-60, Cs-134/137 and Mn-54. Analysis of the water indicated tritium, Co–60 and Cs-137. This ACR identifies the catch basin overflow as a potential source of historical tritium contamination of the yard drains and external containment sump.
- In June 1998, leakages from the RWST floor plates and manway port flanged joints were observed. The water accumulated around the tank foundation and trough areas on the western side of the tank. Analysis of water samples from both leaking areas identified the source of both leakages as the RWST.
- An HP survey in October 1998 revealed loose contamination at levels above the MDA inside the catch containment at the base of the RWST. Follow up surveys of the RWST concrete pedestal, which was observed to be powdery, indicated up to 10,000 dpm/100 cm^2 of loose contamination.
- In March and April 1999, samples were collected from the deep and shallow collection points in MW #103 & #105. Tritium, Cs-137 and gross α/β activity were found in the samples.

It is very likely that the events listed above have impacted all or most underground and aboveground systems in the alleyway.

Resin Slurry and Ion Exchange Area-Areas 9114 and 9116

The Resin Slurry and Ion Exchange Area includes the "Ion Exchange Structure" (9114), "Spent Resin Facility" and "Spent Resin Storage Facility" (9116). This area is located in the yard on the east side of the Radwaste Building.

The Resin Slurry and Ion Exchange Area is located in the radiological control area. This area has had an ongoing documented history of containing highly radioactive material.

All surfaces within this area have been contaminated or have had a high probability of being contaminated.

During filter change-outs and resin processing activities spread of alpha, beta and gamma contamination has occurred on multiple occasions.

Historical surveys of the area show that contamination levels range from non-detectable to >100,000 dpm/100cm^2-beta/gamma. Alpha contamination levels range for non-detectable to >500 dpm/100cm^2.

The area of the original concrete pad and the soil around it showed positive radioactivity, Cs-134/Cs-137/Co-60 (approx. 3.5E-5 uCi/ml), during modifications done in 1980.

Aerated Drains Holdup Tank, Borated Waste Storage Tank -Area 9108, 9112

The Aerated Drains Holdup Tank (ADHUT), 9108, and Borated Waste Storage Tank (BWST), 9112, areas are diked areas east of the PAB that include the ADHUT, the Recycle Test Tanks (RTT's) and the BWST's. The walls of their respective rupture-containment dikes bound these areas.

While the plant was operating, the ADHUT served as a holdup for liquid wastes from the aerated drains system to allow for radioactive decay and sampling prior to the waste being sent through the waste treatment system. However, the ADHUT was "contaminated" with water from the chemical decontamination process that was a part of early decommissioning activities.

In the past, the BWST's held borated waste water from the RCS letdown system to allow for boron recovery. The other serves as the holdup point for water from the ADT system, taking the place of the ADHUT that is no longer available for this function.

Previously, the RTT's were the holdup point for water processed for boron recovery to allow for assay prior to discharge.

All of these tanks have received radioactive liquids over their history and are highly contaminated. In addition, there is a history of leaks in the BWST area from both the siphon heater system and the tank piping.

Likewise, there is a history of spills from the RTT's. Both the ADHUT and the BWST areas are posted high-radiation and contamination areas. Leaks from the dike surrounding the ADHUT and the RTT's were discovered in 1998 and 1999. The spills were reported as required by permit.

The area contains several drains for rainwater runoff. During several events involving leakage of radioactive materials in the area, samples of materials from the bottom of the drains identified detectable radioactivity.

Historical surveys of Area 9108 show that contamination levels range from non-detectable to 10,000 dpm/100cm^2-beta/gamma. Alpha contamination levels range for non-detectable to 60 dpm/100cm$^{2.}$

Historical surveys of Area 9112 show that contamination levels range from non-detectable to >100,000 dpm/100cm^2-beta/gamma. Alpha contamination levels range for non-detectable to >500 dpm/100cm$^{2.}$

Demin Water Storage Tank, Condensate Storage Tank Area 9128

The Demin Water Storage Tank (DWST), Condensate Storage Tank (CST), as defined includes the "Demin Water Storage Tank TK-25-1A" and "Condensate Storage Tank TK-25-1B."

The DWST is located in the radiologically controlled area and the CST is in the clean area of the yard. These tanks have a documented history of normally containing non-radioactive water and at times radiologically contaminated water. Events that have contributed to introduction of contaminated water to the secondary system are steam generator tube failures and misalignment of valves.

Historical surveys of Area 9128 show that contamination is <1000 dpm/100cm^2- beta/gamma. During March and April 1999, on the west side of tank TK-25-1A, shallow monitoring well and deep monitoring well samples were obtained and analyzed. The data show positive results for tritium.

Industrial and Yard Areas

115 kV Switchyard-Area 9102

The 115 kV Switchyard is situated outside the RCA just south of the Containment building. Although this area is outside the RCA, several documented events that occurred during the course of plant operation have led to known contamination of sections within the 115 kV Switchyard.

Summarized descriptions of these events are given below:

- A hot particle was discovered during a routine survey of the area adjacent to the 115 kV Switchyard on June 9, 1977. The contaminant was removed and resurvey of the entire area and equipment recently removed from the area indicated no detectable activity. Gamma spectrometry of the speck indicated it to be Co-60. It is theorized that the speck was a fragment of activated Stellite.
- A routine survey of the RCA boundary on February 24, 1989, alerted HP to exposure rates ranging from as low as 0.5 mR/h inside the RCA up to contact exposure rate of 160 mR/h at the switchyard trench. The source of contamination was discovered to be a 50-gallon discharge of radioactive liquid into an uncontrolled drain from the Spent Fuel Building. The discharge occurred following filtration of sludge removed from the containment sump. The drain discharged the liquid into the trench at the southeast corner of the 115 kV Switchyard and subsequently into the leach field east of the discharge canal. Smear surveys of the trench along the east and north sides of the yard indicated contamination ranging from less than 1k to 400,000 dpm/100 cm^2 for β/γ and 33 to 1,300 dpm/100 cm^2 for α. Contaminated soil in the trench area, which indicated survey results at 100 corrected counts per minute above background, was removed.
- During an annual survey performed on August 1, 1995, radioactive particles were found in and around the switchyard area. Some of the particles were embedded in the pavement around the switchyard. The β/γ contamination found in the switchyard was 36,000 dpm/100 cm^2 in one area and an off scale RM-14 reading in another location. Fixed contamination at 1200 corrected counts per minute β/γ was found on the trench seam 10 feet north of the drainage pipe outlet described above. Gamma spectrometry of dirt samples collected

from the switchyard identified Co-60 and Cs-137. Loose contamination, ranging from 100 to 1200 ccpm, was discovered under the switchyard fence and removed. The contaminated soil in the switchyard and portions of pavement were removed. Subsequent surveys indicated less than 100 counts above background.

The radioactive materials released within this area have impacted the storm drains that run next to the switchyard.

East Industrial Area-Area 9310
The East Industrial Area refers to the eastern section inside the security fence. The survey area is bounded on the north by an imaginary line running from the north end of the Spent Fuel Building to the eastern security fence; on the east by the security fence, on the west by the 115kV Switchyard fence; and on the south by the Radiological Control Area (RCA) boundary.

Summarized descriptions of radioactive contamination events and subsequent surveys are given below:

- Routine survey 10/19/76 identifies contaminated "pea stones" near the SFB concrete pad. Survey data reports fixed contamination levels between 0.8 and 1.0 mR/hr and that the stones were remediated and stored in drums in the "Drum Room".
- Survey conducted 6/30/79 reports remediation of four barrels of contaminated soil from the grassy area near the Hydrogen Storage Area. Gamma spectroscopy analyses of eight samples report Co-60 and Cs-137 (maximum 1.32E-3 μCi/cc and 1.06E-3 μCi/cc respectively) with some samples indicating Ce-141, Ru-103, Zr-95, Nb-95, Co-58 and Cs-134. One sample reported NDA (No Detectable Activity), however, the NDA reporting level was not included with the data.
- Survey conducted 10/4/81 indicates loose surface contamination between 1000 and 14000 dpm/100cm^2 (disintegrations per minute per hundred square centimeters) on the rails outside the SFB following a spill from the SFB lower level (source or system unidentified).
- Area contaminated while hydrolazing tracks outside of the SFB in 1995.
- Gamma spectroscopy analyses of three barrels of liquid from monitor well drilling report less than the LLD (Lower Level of Detection) for the measurement process

as specified by station procedures. One barrel reported tritium at 14000 pCi/l. The other two barrels reported tritium as less than the MDA (Minimum Detectable Activity) although the value for the analyses was not provided.

- Gamma spectroscopy analyses of two monitoring well water samples report less than the LLD (Lower Level of Detection) for the measurement process as specified by station procedures. Both samples indicate tritium (8020 pCi/l maximum).
- Gamma spectroscopy analyses of eight out of eleven soil samples taken to support Bus 13 modification report less than the LLD (Lower Level of Detection) for the measurement process as specified by station procedures. The other three samples indicate Cs-137 and Co-60 (maximum 0.734 pCi/gm and 0.092 pCi/gm respectively).
- Gamma spectroscopy analyses of fourteen soil samples taken in the area adjacent to the former Bus-10 indicate Co-60 and Cs-137.
- Gamma spectroscopy analyses of fifty-five asphalt and soil samples taken to support SFB hardening modifications indicate Co-60 and Cs-137.
- Surveys during RRF construction showed contaminated soil.

Northeast Industrial Area-Area 9312
The asphalt covered Northeast Industrial Area extends eastward from the Waste Disposal Building to the east fence and then southward to the area just beyond the Containment Access Building.

Several documented events, which have occurred during the course of plant operation, have led to contamination of the NE yard area.

Summarized descriptions of these events are given below:

- The portal monitor alarm in December 1972 alerted CY staff to contamination of construction workers who were breaking up rock for the relocation of the fire main. Contamination was found on the face, hands and clothing of the workers. A small trench that runs parallel to the ion exchange cubicle was suspected as the contamination source.

- Contaminated concrete, asphalt and soil were removed from this area in March 1981 in preparation for the construction of the new Spent Resin Storage Area. The contaminated material was placed in barrels and may have been transferred to the peninsula.

- Following a resin slurry, valves were not closed and subsequently caused resin overflow from the liner onto the yard area in the vicinity of the resin pit. Resin was removed from the pit and the sump and the affected areas were decontaminated.
- The monitoring wells were sampled for radioanalyses in March and April 1999. Although the tritium and gamma spectrometry results were below their respective MDCs, positive gross α/β results were reported.

This area was covered only with "pea-stone" prior to the asphalt topping. Any spills would have penetrated to the soil beneath.

Area Grounds-Area 9522, 9527, 9528
Recent radiological surveys resulted in the identification of radioactive contamination on the hillside east and southeast of the industrial area. Earlier surveys performed in March 1980 also identified particles located throughout these survey areas. It is not known if this contamination was the result of chronic releases or one or more episodic events. Given the area where the contamination was found, potential sources include both plant main stack discharges that occurred in 1979 and outdoor resin handling activities.

Survey Area 9522 was also contaminated in February 1989, following the overflow of contaminated water from the Spent Fuel Building, through the 115kV Yard trench out to the low area next to the south access road. The area still contains low levels of Cs-137 and Co-60 in the soil.

Samples and surveys of Area 9527 have not indicated levels of radioactivity greater than 50% of the expected DCGLs.

Middle Peninsula-Area 9530
The Peninsula Area as defined in this report refers to the peninsula that exists between the discharge canal and the Connecticut River.

The area includes the grounds along the east bank of the Connecticut River outside the industrial area fence south of the screenwell house and the grounds surrounding the northern end of the discharge canal. This report covers the grounds, all subsurface piping/conduit and all equipment and structures present or located on the grounds. Areas 9531, 9304, 9306, 9118, and 9308 bound this "peninsula area", by the discharge canal and by the Connecticut River.

The middle peninsula , Area 9530, includes a large area where spoils from dredging of the discharge canal were placed when the canal was deepened in the 1980's to accommodate a turbine rotor replacement. This area has been sampled for radionuclide contamination in the past with no activity being found. In 1989, contaminated soil was found along the peninsula access road in both the upper and middle peninsula areas (Areas 9520 and 9530). The soil was subsequently removed, and was determined to have come from the "ball field" area south of the 115 kV switchyard. The soil was drummed and prepared for disposal. As stated previously, radioactive particles were found in both the middle and lower peninsula areas following the stack release event in December of 1979.

The middle peninsula contained the site's meteorological tower and its associated instrumentation shack. It also contains four domestic water wells, their associated pump shacks and subsurface piping, and one shallow groundwater monitoring well. All of these wells were sampled in March and April of 1999, with no tritium being detected in any of them.

Woodland Areas- Area 9535, 9536, 9537, 9538
The "woodland areas" refer to the woodlands east of the discharge canal bounded by the shooting range/landfill access road, the Salmon River and the site boundary.

The survey areas include both open woodland areas and areas sub-divided out of these areas to encompass features such as solid waste disposal areas and the shooting range used by site personnel. Specifically, Areas 9535, 9536, 9537 and 9538 are areas sub-divided from Area 9524 to account for such features.

Area 9535 was used by the site for solid waste disposal and as a storage area for items such as rollback containers and bulk shipping bags, referred to as Bonanza Bags.

The area was posted radioactive materials area due to the storage of slightly contaminated soil and objects retrieved from offsite locations under the ORMP.

Radiological surveys conducted in this area have also identified contaminated items that were placed in this area prior to it becoming a radioactive materials area. Review of historical plant documents has indicated that the area used for solid waste disposal (Area 9535) is not the same location as the area specified in the solid waste disposal permit issued in 1974. The area specified in the 1974 permit is encompassed by survey Area 9536, 9537 and 9538.

Investigations have identified that some radioactively contaminated material was placed in the shooting range landfill area along with construction debris. The assessment identified that between 1974 and 1996, construction materials from approximately 32 site projects had been placed in the landfill. Examples of materials identified are discharge canal dredging spoils, excavated soils, construction debris and sand. The materials originated from areas both within and outside the Radiologically Controlled Area boundary. The landfill area had been permitted by the State of Connecticut for disposal of bulk wastes. Based on available information, no evidence of authorized or unauthorized burial of radioactive materials on the HNP site exists.

The site characterization group performed radiological surveys of the landfill area with confirmatory surveys conducted by ORISE (Oak Ridge Institute for Science and Engineering). The initial characterization surveys were completed in 1997. Results of the radiological survey and ground penetrating radar survey established the size of the landfill area to be approximately 5000 square meters and an approximate depth of 3 meters.

Survey Areas 9536, 9537, and 9538 consist of areas that are part of the permitted landfill area. These areas have been used as target ranges for pistol, rifle and shotgun training programs for the site security force as well as hunting clubs and local law enforcement agencies. Because of the use of these areas, they are considered as impacted areas. This fenced area is located about 1 mile southeast of the containment building on higher elevations between the Salmon River and the discharge canal on owner-controlled property.

Radiological results indicated the presence of both Co-60 and Cs-137, with maximum concentrations in soil of 5.0 pCi/g and 52.9 pCi/g respectively. A study was completed to determine the extent and magnitude of the plant-derived radionuclides or hazardous materials that might have accompanied the construction debris into the landfill area. This radiological characterization consisted of:

- Gamma scan surveys centered on 9 m^2 areas;
- Exposure rate measurements at 1 m above the surface; and
- Soil samples collected for analysis from the surface, and at depths within the ranges 0-1 m, 1-2 m, and 2-3 m.

The results of the survey identified 8 samples with positive Co-60 results between the minimum detectable activity of 0.15 pCi/g (environmental LLD) and a maximum of 2.8 pCi/g. Additionally, 40 samples measured positive Cs-137 results between the minimum detectable activity of 0.18 pCi/g (environmental LLD) and a maximum of 31.4 pCi/g. Only 10 of the 40 positive Cs-137 results were greater than the local background level of 1.68 pCi/g due to historical fallout from weapons testing.

The gamma scan results showed a variance of a factor of 4 or 5 times the lowest levels that are indicative of background. The exposure rate measurements ranged from 9.1 to 15.6 μR/hr. The scan and exposure rate measurements both indicate the presence of low levels of radioactive material but are not able to establish if the variance is due to plant derived radionuclides or represent variations in naturally occurring radionuclides.

A hazardous materials assessment was also performed in the survey area. Two composite samples were analyzed for the Envirocare Suite of Analytes. A 10CFR61 series of analyses were also performed on the composite samples. The test results indicated that all the analyses were below the CTDEP Remediation Standards for soil except for the chemical thallium. Additional investigations will be performed. Co-60 and Cs-137 were the only plant-derived radionuclides present in the composite samples.

Discharge Canal- Area 9106
The Discharge Canal is the area from the point at which the cooling water is discharged from the south end of the plant and flows the approximate one-mile length of the man-made canal south to where the canal rejoins the Connecticut River.

Radiological-related activities have occurred within this area. Radioactive liquid waste releases from test tanks and incidentally contaminated Yard Drain outfall flow through the Discharge Canal.

The radiological survey information, that was available for review, is summarized below:

- Notification to CTDEP in 1973 of discharges of processed plant liquids containing Xe-133 and tritium.
- Routine sampling in 1977 identified tritium in river water near the discharge area. Canal dredging spoils from 1979 and 1987 deposited on the peninsula reportedly contained trace amounts of radioactive material.
- Environmental Monitoring Programs reports indicate that Cs-137 and Co-60 were identified in bottom sediment,
- Samples taken in 1997 indicate Co-60 0.5 pCi/g, Cs-134 0.024 pCi/g, and Cs-137 0.722 pCi/g.

(Reference 7-2)

Class 3 Survey Areas
The listing and general radiological descriptions of impacted areas determined to be Class 3 are provided in Section 10.0, Table 10-1. The Class 3 area designation was assigned despite the fact that none of the historical radiological survey data or other historical site documents reviewed for these areas showed that any radiological contamination has been detected. All Class 3 areas are outside the radiologically controlled area of the plant site.

The decision to make these areas Class 3 is based on the proximity of these areas to Class 1 or 2 impacted areas and the fact that personnel move freely between various areas of the site. Buildings considered to be Class 3 impacted include support structures that contained no radioactive systems or materials, such as the intake and screen area (7108), circulating pump area (7002, 7004, 7102 7104) and Switchgear Building B (9202).

Other support buildings such as the Administration Building (9208), Emergency Operations Facility (9402, 9403) and Information Center (9422, 9423) are also included in this category. Land areas include areas remote from the facility such as the Northeast and Southeast Mountain Side (9526, 9528), south end of the peninsula (9531) and the Primary Parking Lot (9514).

The release of material from the plant stack in 1979 was considered in the evaluation of the potential impact and classification for these areas. Although particles were detected in many of these Class 3 areas during a 1980 survey, the particles consisted of relatively short lived radionuclides, and were of such a magnitude that radioactive decay would result in levels that would be a small fraction of the expected DCGLs. Also, in support of initial decommissioning activities, free release surveys of other building exteriors, closer to the source of the 1979 release have not detected radioactivity. Although the 1979 release event precludes designation of these areas as non-impacted, a Class 3 impacted area classification is considered appropriate.

7.2.2 Non-Impacted Area Assessment

Non-impacted areas are those areas having no reasonable potential for residual contamination. Non-impacted areas are typically identified during initial classification using historical data and past or current radiological surveillance. Non-impacted areas should have no history of using, storing, or burying radioactive materials. Records and surveillances, including those required by 10CFR50.75(g)(1), should show that unplanned liquid releases, discharges and other occurrences have not resulted in the spread of contamination in these areas.

East Site Grounds- Area 9532
The Connecticut Yankee Haddam Neck Characterization Report has classified the East Site Grounds as non-impacted. This area consists of approximately ninety-three (93) acres of uninhabited, undeveloped land located about a third of a mile (466 meters) from the RCA (Radiologically Controlled Area).

The East Site Grounds are bounded by steep, wooded hillsides to the east, an open clearing for power distribution lines to the south and west, and an access road (Wood Road) from the substation to the discharge canal to the north.

Access to the interior of the South East Grounds area is limited to a gated road (Cove Road) to the east, abandoned or seldom used logging paths and trails, and the power transmission clearing to the west.

A walk down and visual inspection of the East Site Grounds area indicates the land was not used to store materials from the Haddam Neck Plant. There were no identified soil disturbances that would indicate dumping or burial of materials.

Historical data do not indicate that plant operations had an impact on the East Site Grounds area. Historical data and radiological surveys have identified contamination from plant operations on the east hillside from the RCA boundary out to a distance of 200 meters or roughly an eighth of a mile (0.12 miles). Following identification of the contamination further surveys were conducted to a distance of approximately 400 meters, with no additional plant related radioactivity identified.

Given the topography of the eastern hillside in general, and the distance from the RCA to the nearest boundary of the East Site Grounds area (0.29 miles), occurrences from plant operations have not had any radiological impact on the East Site Grounds.

Radiological environmental monitoring and sampling was performed in the East Site Grounds area in accordance with the Radiological Effluent Monitoring and Off-site Dose Calculation Manual. Radiological analyses have been performed with gamma exposure measuring devices, on samples for radio-nuclide airborne particulates and for reactor produced iodine, and on broad leaf vegetation.

The Haddam Neck Station Annual Radiological Reports show no long-lived radionuclides other than Sr-90 and Cs-137 above the MDL (Minimum Detectable Level). These radionuclides (Sr-90 and Cs-137) are measured at levels consistent with those found throughout the central Connecticut area and are attributed to past atmospheric nuclear weapons testing. It is important to note that the Haddam Neck Station Annual Radiological Reports consider all data statistically valid, including negative values, zeros, numbers below the MDL and those values with reporting

errors greater than two standard deviations. The Haddam Neck Station Annual Radiological Reports present all valid data for strictly counting statistics purposes and to indicate background biases. The historical data, use and topography of the land and radiological environmental monitoring results support the classification of the East Site Grounds area as a non-impacted area.
(Reference 7-2)

7.3 Potential Contaminated Media

Soils

Three onsite locations that received spoils material are the peninsula, located west of the discharge canal (Areas 9520 and 9530), the area presently within the security fence under the 115kV power lines (Area 9308) and the shooting range or land-fill located about a ½ mile southeast of the plant (Area 9535). There is documentation in the history of the plant that identifies the shooting range as a permitted landfill for clean construction spoils. There are records of material release that describe the relocation of construction debris from the Radiation Controlled Area (RCA) to Areas 9520 and 9530.

Area 9308 was at one time open land immediately adjacent to the southern boundary of RCA and security fences. Subsequently this area was filled in with soil that may have originated from on-site, raising the elevation up to site grade, facilitating a reconfiguration and expansion of the RCA and security protected area. Initially only a small section of the north side of the unit was paved, with the remainder of the unit gradually sloping down to the original site elevation. As the result of plant operations, there was a need to expand the industrial area to support plant operations and to control exposure to radiation. A review of plant photos reveals that the area was gradually filled in from approximately 1972 to between 1974 and 1976. Photos taken in 1976 show that the area was landscaped with grass and small trees and was probably given the name "ballfield" at that time. Over the next several years, additional fill was brought in. By 1987, photos show that the survey area was in its current configuration; paved and occupied with buildings. It is estimated that the elevation in the survey unit may have increased by up to 5 feet from the original site grade. Plant Incident Report 80-37 identified that several particles were discovered in March 1980 on the ballfield, along with other areas of the site. The investigation into the incident concluded that the particles were most likely ejected from the Primary Vent Stack as a result of several operational events in 1979. Isotopic analysis of the particles indicated that the short-lived fission products Ce-144 and Ru-106 dominated the particle radioactivity. All particles were removed upon detection. A second event documented the contamination of the 115KV-switchyard trench which then drained into the outfall area, Survey Area 9522. The only potential affect of this event on Survey Area 9308 was that the drain runs through 9308. If the drain is intact, there would be no impact. A third event occurred in 1995 when several particles were found outside of the Radiation Control Area. Three particles were discovered in Survey Area 9308. They were removed upon discovery. This survey area was primarily impacted by rainwater runoff from the adjacent Radiological Control Area, prior to the addition of fill. In addition, if the area was filled with onsite construction spoils, low levels of radioactive materials may have been present in the spoils.

The following is a summary of specific site modification or series of modifications that generated construction spoils, the time frame when implemented, their expected constituents, and an assessment of the likelihood of the spoils containing low levels of residual plant related radioactivity:

- The modification of parking lot, (to current configuration) 1989 and 1990, Area 9514.

  Constituents: Soils and gravel mixed with broken asphalt, concrete in the form of light pole base, foundation pieces, floor slabs, sidewalk and curbs.

  Likelihood of Plant Related Radioactivity: Unlikely to contain plant related radioactivity. A review of plant history indicates that this area was surveyed in 1980 following remediation of radioactivity released in December of 1979. Additional surveys were performed annually through 1984.

- The construction of the Emergency Operations Facility, 1979, Area 9402.

  Constituents: Soils, gravel and blasted rock.

  Likelihood of Plant Related Radioactivity: Unlikely to contain plant related radioactivity. The location of the Emergency Operations Facility is approximately 1400 feet from the RCA, is not in the flow path of the run-off from the RCA and was constructed prior to the radioactive released identified and cleaned up in 1980.

- Construction of the Building #140 and parking lot modification, 1989, Area 9418, 9514.

  Constituents: Soils and gravel mixed with broken asphalt, Asphalt in concentrated masses, Concrete in the form of light pole base, sidewalk and curbs.

Likelihood of Plant Related Radioactivity: Unlikely to contain plant related radioactivity. A review of plant history indicates that this area was surveyed in 1980 following clean up of a release of radioactivity. Additional surveys performed annually through 1984 also identified no contamination in this area.

- Construction of Warehouse #1, 1976, Area 9414.

  Constituents: Soils and gravel mixed with broken asphalt, assorted size blasted rock, concrete in the form of sidewalk, curbs and the concrete slab foundation of a pre-existing structure.

  Likelihood of Plant Related Radioactivity: Unlikely to contain plant related radioactivity. The location of the warehouse #1 at the time of construction was not in the flow path of the run-off from the RCA and was constructed prior to the radioactive release identified and cleaned up in 1980.

- Construction of Steam Generator Mock-Up Building, 1982, Area 9410.

  Constituents: Soils and gravel mixed with broken asphalt resulting from demolition of a temporary parking area established over existing soils.

  Likelihood of Plant Related Radioactivity: Likely to contain low levels of residual plant related radioactivity. There is evidence in the plant history that indicates distribution of plant related radioactivity associated with surface water run-off containing plant related radioactivity from within the RCA to non-RCA areas. The location of the Steam Generator Mock-Up Building was in the flow path of the run-off from the RCA.

- Warehouse "A", Constructed in the early in 1982, Area 9410.

  Constituents: Soils and gravel mixed with broken asphalt resulting from demolition of a temporary parking lot.

  Likelihood of Plant Related Radioactivity: Likely to contain low levels of plant related radioactivity. The location of Warehouse #A was in the flow path of the run-off from the RCA.

- Warehouse "B", Constructed in the later part of 1982, Area 9416.

  Constituents: Soils and gravel mixed with broken asphalt.

Likelihood of Plant Related Radioactivity: Unlikely to contain plant related radioactivity based upon review of plant history, which indicates that this area was surveyed in 1980 following clean-up of a release of radioactivity and this area is not adjacent to the RCA

.

- Construction of New Gatehouses, 1979, 1983, 1986, Area 9420.

  Constituents: Soils and gravel mixed with broken asphalt.

  Likelihood of Plant Related Radioactivity: Unlikely to contain plant related radioactivity. A review of plant history indicates that this area was surveyed in 1980 following clean up of a release of radioactivity.

- Security System Modifications (security fence relocation, security fence E-field installation.) Guard Towers Construction and Demolition, 1979, 1982.

  Constituents: Soils, gravel and pea stone mixed with broken asphalt, Concrete in the form of security fence posts base and as protective encapsulation of security system conduit.

  Likelihood of Plant Related Radioactivity: Generally the sections of security fence at both the north and south ends of the site run adjacent to the RCA and are likely to contain plant related radioactivity. Those sections of the security fence not adjacent to the RCA are unlikely to contain plant related radioactivity. A review of plant history indicates that the latter area was surveyed in 1980 following clean up of a release of radioactivity.

- Demolition and Construction for the Training Building, 1989, Area 9412.

  Constituents: Soils, gravel mixed with broken asphalt and concrete in the form of sidewalk, curbs and orb shaped monoliths used as footing or anchors under temporary buildings.

  Likelihood of Plant Related Radioactivity: Likely to contain low levels of plant related radioactivity. There is evidence in the plant history that indicates routine distribution of plant related radioactivity associated with surface water run-off containing plant related radioactivity from within the RCA to non-RCA areas. The location of the Training Building was in the flow path of the run-off from the RCA.

- Demolition and Construction for the Gatehouse and Medical Facility, 1990, Area 9514.

  Constituents: Soils and gravel mixed with broken asphalt, concrete in the form of sidewalk, curbs and orb shaped monoliths used as footing or anchors under temporary buildings.

  Likelihood of Plant Related Radioactivity: Unlikely based upon review of plant history, which indicates that this area was surveyed in 1980 following clean up of a release of radioactivity.

- Installation of utilities for temporary trailers and buildings 1976 to Present.

  Constituents: Soils and gravel mixed with broken asphalt.

  Likelihood of Plant Related Radioactivity: Likely to contain plant related radioactivity. The site history suggests that most of this type of site modification occurred within the protected area and often was performed within or adjacent to the RCA.

- Fire Protection System upgrades and maintenance, 1979-1980.

  Constituents: Soils and gravel mixed with broken asphalt.

  Likelihood of Plant Related Radioactivity: Likely to contain plant related radioactivity. The site history suggests that most of this type of site modification occurred within the protected area and often was performed within or adjacent to the RCA.

- Septic System upgrades and maintenance, 1982, Area 9520.

  Constituents: Gravel, pea stone and soils, with a gray tint and the odor of a sewer.

  Likelihood of Plant Related Radioactivity: Likely to contain plant related radioactivity. The site history contains documentation of plant related radioactivity being present in the septic system.

- Construction of the "B" Switchgear Building, 1989, Area 9202.

  Constituents: Soils and gravel mixed with broken asphalt and processed rock.

Likelihood of Plant Related Radioactivity: Unlikely to contain plant related radioactivity. The location of the "B" Switchgear Building is not in the flow path of run-off from the RCA.

- Construction of the Diesel Generator Building, 1969, Area 9302.

  Constituents: Soils and gravel mixed with broken asphalt.

  Likelihood of Plant Related Radioactivity: Unlikely to contain plant related radioactivity based upon no indication of site contaminating events in the short duration of plant operation prior to this modification.

- Spent Resin Transfer and Storage, 1978-1980, Area 9116.

  Constituents: Soils and gravel mixed with broken asphalt and concrete in the form of slab foundation or pads.

  Likelihood of Plant Related Radioactivity: Likely to contain plant related radioactivity. Modifications to the Spent Resin Transfer and Storage System were made to simplify system operation and eliminate system malfunctions that resulted in contamination of the original system and structure.

- RCA Modifications: Radwaste Reduction Facility, New Waste Disposal Building, RP Count Room, North Tank Farm, Containment Access Buildings, Re-cycled Primary Water Storage Tank, Unconditional Release Facility, Tool Issue Building, Fabrication Shop, hydrogen Storage Tanks, Cable Vault Modification, Service Building Modification Chemistry Laboratory Drain Line Repair.

  Constituents: Soils and gravel mixed with broken asphalt and concrete in the form of slab foundation or pads.

  Likelihood of Plant Related Radioactivity: Likely to contain plant related radioactivity. The structures, components and system present in the RCA were impacted by plant operation and generally thought of as containing plant related radioactivity. Spoils generated by modifications performed in the RCA would require specified sampling and analysis prior to their release.

- Parking Lot Modification, Area 9514, (Temporary parking lots created to support refueling outages): Typically these site modification activities involved initial paving of areas without generation of spoils; subsequent demolition of the temporary parking areas generated spoils that were stockpiled in the overflow parking area while awaiting disposition. See also construction of Warehouse "A" and "B".

Constituents: Soils and gravel mixed with broken asphalt.

Likelihood of Plant Related Radioactivity: Unlikely to contain plant related radioactivity. A review of plant history indicates that the areas identified as temporary parking areas were surveyed in 1980 following clean up of a release of radioactivity.
(Reference 7-3)

Figure 7-1 provides a summary of the surface and subsurface areas, excluding the landfill Area 9535, potentially impacted by operations and radiological events. Figure 7-2 provides a summary of the soil sampling conducted within and adjacent to the industrial area.

Ground Water

As part of the site characterization efforts and to address issues related to leakage of radioactive liquids from the Refueling Water Storage Tank (RWST), a ground water monitoring sampling and analysis plan was developed in March of 1998. An investigation was conducted through May of 1999, with the primary purpose of radiological characterization of ground water in four geographically separate areas of interest. The areas of interest are the power plant area, the peninsula water supply area, the Emergency Operations Facility area, and the landfill area.

As called for in the sampling and analysis plan, monitoring wells were installed to characterize the water table and shallow bedrock aquifers near potential contaminant source areas. Two rounds of sampling, March and April of 1999, were analyzed for dissolved boron, tritium, gross alpha, gross beta and gamma spectroscopy. Tritium was quantified above detection limits (Minimum Detectable Activities of 700 to 1000 pCi/l) at 11 of 40 monitoring well locations and in the reactor building mat drain sump. The elevated tritium concentrations, detected only in those wells in the plant area, ranged from 1,180 pCi/l (located between the Spent Fuel Pool and the Containment Building), to 138,700 pCi/l (located between the Containment Building and the Primary Auxiliary Building). Cs-137 was detected in 1 of 40 monitoring well locations, again in the power plant area. No other gamma emitting radionuclides were above the minimum detectable levels. Sr-90, a pure beta emitting radionuclide, is not expected to be detectable in the ground water. The chemical behavior of strontium is similar to that of cesium, and the activity ratio of Cs-137 to Sr-90 in the plant is greater than 100 to 1. Boron, a naturally present chemical element as well as a power plant chemical additive, was found at concentrations above background at the same locations where elevated tritium was found (maximum of 9,590 µg/l) and the values roughly correlated.

Complete sampling results, along with results of geologic and hydrogeologic characterization activities, are documented in the Malcolm Pirnie Ground Water Monitoring Report. This report has been submitted to the CTDEP and was provided to the Nuclear Regulatory Commission and the Environmental Protection Agency. The primary conclusions of that report are as follows.

- The general flow of ground water is from north to south, or from hillside to river across the plant site, primarily within the fractured bedrock.
- The ground water migrates down under and around the deep foundations of the plant structures in complex patterns and then moves upward again to the river.
- Areas such as the Emergency Operations Facility, water supply well and landfill areas show no tritium above minimum detectable activity and no boron above background levels. No contamination in any of the drinking water wells has been detected.
- Ground water beneath and immediately around the power plant buildings has been affected by boron and tritium.
- The likely source of tritium and boron in the ground water is the RWST. This source was eliminated when the RWST was drained.
- More ground water data and monitoring wells are needed to identify the bottom and core of the plume.

Concentration Trends

Additional sampling and analysis of monitoring wells in the power plant area were performed in September 1999. Table 7-4 summarizes these results along with data from the two previous sampling rounds for key monitoring locations. As the data indicate, both tritium and Cs-137 concentrations are generally declining with time. This trend is consistent with the removal of the source of contamination (i.e., draining of the RWST). Ground water monitoring will continue on a periodic basis during the decommissioning process to confirm this trend. (Reference 7-4)

7.4 Related Environmental Evaluations

The following paragraphs describe environmental issues involving hazardous (non-radiological) substances and potential liquid pathways for transfer of contaminates beyond the presently recognized areas.

Discharge Canal Area 9106

Three sediment samples taken during 1997 in the Discharge Canal, area 9106, indicate the presence of barium, chromium, and lead. The following table provides a summary of the analysis.

Table 7-5 Area 9106 Sediment Samples from 9/12/97

Cy Sample Number	Sample Number	Barium mg/kg	Chromium mg/kg	Lead mg/kg
DC-32-S1	97-0040217	46	20	16
DC-33-S2	97-0040220	34	14	13
DC-34-S3	97-0040222	15	6.4	4.8

(Reference 7-5)

Further evaluation of the Discharge Canal sediments for RCRA metals is recommended.

Bus 10 Pad Soils Area 9227

Bus 10 Pad was originally an outdoor staging area designed to function as a decontamination facility. The concrete pad was equipped with a drain that emptied into the plant radwaste system to accommodate generated liquid wastes. Within a few years after plant start-up, the pad became a convenient storage area for containers of radioactive spent primary resins and other contaminated items.

Around 1975, the pad was designated for decontamination and reutilization. Attempts to radiologically decontaminate the pad were unsuccessful.

Remediation consisted of placing a lead sheet on top of the pad and pouring a layer of concrete over this to provide shielding. The area was backfilled to grade and later became the foundation for the waste compactor building. In the late 1990s, the area soils and pad was remediated for the radiological contamination found in surrounding soils and in the pad itself. Although radiological sampling was adequate, the soils in the area were not systematically evaluated for lead contamination.

Waste analyses reports indicate that one soil sample was analyzed for lead in May of 1999. This sample was positive for lead- 4.6 milligrams per liter and barium-1.4 milligrams per liter. Further evaluation of Bus 10 soils for lead contamination should be considered.
(Reference 7-6)

South East Landfill/"Shooting Range" Area 9535

Although an analysis of soil samples, taken in 1999, does not indicate lead contamination, visually observable shell casings, wadding, slugs and shot are readily found in the sandy soil of this area. Make shift targets on the range, riddled and fragmented with bullet holes, are rotting or rusting away. As these materials erode, lead contaminates which may be present in the targets will be released into the soil. Several bullet fragments and shot found on the surface display the typical patina of lead oxide. Further investigation of this area for lead contamination should be conducted. (Reference 7-7)

Septic System- Area 9520

The potable water system at HNP is a typical copper pipe plumbing system installed when the plant was built during the 1960s. As required by code, at that time, the copper plumbing was assembled with lead solder. The wastewater from sinks, fountains and toilets in this system drain to the septic sewer system located in Area 9520, Southwest Site Storage Area.

Recent testing of the potable water system, at HNP, indicates lead contamination above the EPA standard for drinking water. Over the years, lead contaminates in this system may have accumulated and concentrated in the septic tank sludge. Testing of this sludge for lead has not been performed. Sludge and soils associated with the site septic system should be evaluated for lead contamination. (Reference 7-8)

Waste Oil Management

In February 1977, CYAPCO issued memo EN-MO-592, stating that the disposal of waste oil on the property does not create any problems with the Oil Spill Prevention Control and Countermeasures Plan as long as it does not get into navigable waterways.

Available records do not indicate if this became common practice at the site or if any disposal of waste oil ever took place in the "back yard". The description "back yard" does not conform to plant nomenclature and may be any place on site. Soils at HNP should be investigated for petroleum contamination.
(Reference 7-9)

Site Filling Station-Gasoline

A gasoline fill station for plant equipment existed, until the mid-1980s, in Area 9118, Fuel Oil Tank, TK-33. The storage tank for this dispenser was an underground tank located adjacent to TK-33. No information is available on the removal of this tank. Information about this tank came from interviews of plant personnel. The soil in this area should be investigated for pollutants associated with gasoline. (Reference 7-10)

In 1998, an underground gasoline storage tank was removed from Area 9514, north of Warehouse #2. Although samples were taken,

eight in total, analysis for lead and MTBE were not performed. The sample analysis did indicate the presence of gasoline contamination below state action limits; however, independent verification was not performed. As a concern, this area should be investigated for pollutants associated with gasoline.
(Reference 7-11)

Fill Line for Emergency Diesel Generator Fuel Tanks
The Emergency Diesel Generator fuel tanks are located underground near Area 9502. The tanks were filled via a carbon steel connector pipe from Fuel Oil Storage Tk-33, Area 9118. Sections of this pipe are buried underground and not accessible for routine inspection. The condition of this line is not known. An inspection of this pipe and surrounding soils is recommended to determine if leakage of fuel oil occurred.

Storm Water Run-off
A concern exists that pollutants and contaminates present in site soils or surfaces may have been in storm water run-off. Site construction activities disturbed soils and may have changed run-off gradients. Erosion controls were not in place to prevent further erosion and limit sediment transport.

Available information suggests that the control of contaminants and pollutants in storm water did not receive an appropriate amount of attention at HNP. (Reference 7-12)

As of March 2000, a storm water management plan was implemented by CYAPCO and Bechtel. This plan, issued in March of 2000, recommended that the following items be repaired and/or rectified as soon as practicable after they are discovered:

- Erosion channels formed on slopes, in swales, or around structures;
- Hay/straw bale dikes with broken strings or with less than two stakes per bale;
- Deteriorated silt fences;
- Fallen or damaged orange construction fencing surrounding the on-site wetlands and watercourse;
- Inlet structures requiring cleaning;
- All conveyances or inlet structures not operating as in their design conditions; and
- All storm water detention/retention structures, and settling basins containing sediment, vegetation, and foreign debris.

Installed or Process Hazardous Substances

PCBs and Lead

In 1998, the Results of Scoping Surveys report made recommendations for improvement to the PCB and lead management program. These recommendations for PCB management are as follows:

- Conduct a more detailed sampling program particularly inside the reactor containment building. This includes wipe samples and concrete chip samples as well as more paint chip samples. Coordinate the PCB and radiological characterization inside containment. A more detailed sampling program will enable CY to properly quantify the amount of material contaminated with PCB and/or PCB/radioactivity.
- Develop and implement a non-liquid PCB control program that specifies the requirements for working safely with non-liquid PCBs. This procedure should be directed toward decommissioning activities.
- Develop communication with EPA-New England (Region 1) TSCA branch and State DEP to obtain approval for small-scale paint removal from piping and equipment.
- Develop an Alternate Method of Disposal Approval for allowance to remove PCB coatings from various surfaces. This process can take as long as one year for EPA-New England to grant approval for request to perform large scale PCB paint removal.
- Develop the air monitoring procedure for PCBs to characterize works areas and activities having the potential to expose workers to PCB aerosols and vapors and insure compliance with OSHA standards.
- Develop a PCB Awareness Training program to supplement the Hazard Communication Program and improve worker PCB awareness on-site.
- Evaluate off-site disposal options for PCB/RCRA/radioactive waste.
- Evaluate potential storage areas on-site for PCB/RCRA/radioactive waste.

The recommendations for lead management are:

- Conduct a more detailed lead sampling program using a direct reading XRF instrument (lead in paint detector). This will enable CY to properly assess the need for lead work permits and practices during decommissioning.
- Develop and implement a lead control program that includes a lead work permit procedure and steps to facilitate lead work during decommissioning.
- Develop the air monitoring procedure for use during various lead work activities.
- Review Lead Awareness training modules and revise as necessary to reflect new policy and procedures.

As of June 2000, CYAPCO and Bechtel have initiated activities to address the PCB and lead concerns.

During the scoping surveys, non-radiological analyses for Poly-Chlorinated Biphenyls and RCRA metals were performed on paint samples from various surfaces and equipment. The results and locations are summarized in Table 7-6 and Table 7-7. (Reference 7-16)

Asbestos
The abatement of asbestos at HNP is well managed through the use of utility competent persons, procedures and licensed abatement contractors. This practice has been in place since the early 1990s.

Table 7.1
Potential Chemical Contaminates

Chemical	**Process**
Lead	Shielding, Bus 10 burial[1], paint, lamps, circuit boards
Chrome	Electropolisher waste[2], Component Cooling, decon solutions
Cadmium	Electropolisher waste, lamps, batteries, decon solutions, lead acid batteries, Ni-cad batteries
Mercury	Switches and manometers, lab use, lighting
Chlorofluorocarbons (Freon, CFC)	Dye penetrant testing, parts washer, lab use, Freon dry cleaning for Anti-c clothing,
Chlorinated Solvents	Dye penetrant testing, parts cleaning, strippers
PCB	Paint, capacitors, transformers
Asbestos	Insulation, gaskets, surfacing
Petroleum	Emergency Diesel Generators, Aux Boilers, various plant trucks, Past Policy of oil disposal on ground[3]
Hydraulic Fluids	Plant equipment, trucks, cranes
Gasoline (MTBE, lead, benzene, toluene, ethyl-benzene, xylene)	Plant equipment, trucks, site filling station
Xylene	Lab use, liquid scintillation, paint solvent
MEK	Painting
Lithium	Batteries, chemical control
Toluene	Lab use, paint solvent
Hexane	PCB sampling, lab use

(Reference 7-1)

Table References

1. See Reference 7-13
2. See Reference 7-14.
3. See Reference 7-9.

Table 7.2
Potential Radionuclide Contaminates

Radionuclide	Half-life (years)
H-3	12.33
C-14	5,730
Mn-54	0.8561
Fe-55	2.685
Co-60	5.271
Ni-59	75,000
Ni-63	100
Sr-90	28.8
Nb-94	20,000
Tc-99	214,000
Cs-134	2.062
Cs-137	30.17
Eu-152	13.3
Eu-154	8.5
Eu-155	4.96
Pu-238	87.74
Pu-239	24,100
Pu-241	14.4
Am-241	432.2
Cm-243	28.5

(Reference 7-2)

Table 7-3
Radiological Status of HNP Systems

System Name	Survey Area #	Contamination Potential	Comments
Auxiliary Boiler	0001	A	Identified radioactivity through sampling, 9/9/97
Auxiliary Feedwater	0002	B	
Blowdown	0003	B	
Boric Acid	0004	B	
Boron Recovery	0005	A	
Charging	0006	A	
Chemical Addition	0007	B	System consists entirely of addition tank.
Circulating Water	0008	C	
Closed Cooling Water	0009	A	Identified radioactivity through sampling, 9/3/97
Component Cooling Water	0010	A	Identified radioactivity through sampling, 9/3/97
Condensate	0011	B	
Containment Air Recirculation	0012	A	
Containment Heating	0013	A	
Containment Iodine Removal	0014	A	
Containment Leak Monitoring	0015	A	
Containment Purge	0016	A	
Containment Rod Drive Mechanism Cooling	0017	A	
Control Air	0018	B	
Demineralized Water	0019	B	Grouped system with Water Treatment for survey purposes as systems are closely aligned.
Diesel Generator	0020	C	
Domestic Water	0021	C	

(Reference 7-2)

A – System contains radioactive materials, known to be contaminated.

B – Radioactivity detected in portions of the system, surveys required to determine full scope of contamination

C – System has no history of radioactive contamination, no samples that have indicated detectable contamination.

Table 7-3 Radiological Status of HNP Systems

System Name	Survey Area #	Contamination Potential	Comments
Feedwater	0022	**B**	
Feedwater Heater, Extraction Steam, Drains, Vents	0023	**B**	
Fire Protection	0024	**C**	
Floor/Equipment Drains	0025	**A**	
High Pressure Safety Injection	0026	**A**	
High Pressure Steam Dump	0027	**B**	
Isolated Phase Bus Duct Cooling	0028	**C**	
Letdown	0029	**A**	
Low Pressure Safety Injection	0030	**A**	
Low Pressure Steam Dump	0031	**B**	
Main Generator Seal Oil	0032	**C**	
Main Steam	0033	**B**	
Main Turbine & Auxiliaries	0034	**A**	Survey data indicates areas of radioactivity
Misc. Ventilation Systems	0035	**B**	Includes Turbine Bldg, Cable Vault, New Diesel Gen Bldg, Aux Feed Pump Enclosure, Office Bldg and Service Bldg.
Nitrogen/Hydrogen/ Carbon Dioxide	0036	**B**	
PAB Ventilation	0037	**A**	
Post Accident Sampling	0038	**A**	
Primary Grade Water	0039	**B**	
Purification	0040	**A**	
Radiation Monitoring	0041	**A**	
RCP Seal Water Injection	0042	**A**	
Reactor Coolant	0043	**A**	
Residual Heat Removal	0044	**A**	
Roof Drains	0045	**B**	

(Reference 7-2)

A – System contains radioactive materials, known to be contaminated.

B – Radioactivity detected in portions of the system, surveys required to determine full scope of contamination

C – System has no history of radioactive contamination, no samples that have indicated detectable contamination.

Table 7-3
Radiological Status of HNP Systems

System Name	Survey Area #	Contamination Potential	Comments
Sampling	0046	A	
Septic	0047	B	
Service Air	0048	B	
Service Water	0049	B	
Spent Fuel Building Exhaust	0050	A	
Spent Fuel Pool Cooling	0051	A	
Storm Drains	0052	B	
Turbine Lube/Control Oil	0053	C	
Vacuum Priming	0054	C	
Waste Disposal	0055	A	
Waste Gas	0056	A	
Waste Water Treatment	0057	B	
Water Treatment	0058	C	

(Reference 7-2)
A – System contains radioactive materials, known to be contaminated.
B – Radioactivity detected in portions of the system, surveys required to determine full scope of contamination
C – System has no history of radioactive contamination, no samples that have indicated detectable contamination.

Table 7-4
Temporal Trends in TRITIUM and Cs-137 Ground Water Concentrations

Date	TRITIUM (pCi/l)				Cs-137 (pCi/l)
	MW-103S	MW-103D	MW-105S	MW-105D	MW-103S
Mar 1999	2,580	22,180	138,700	4,590	75.9
Apr 1999	9,260	17,550	67,400	2,450	32.7
Sep 1999	2,980	19,660	23,480	3,030	28.7

(Reference 7-4)

Table 7-6
Scoping Survey Examples of Highest Results Found of Non-Radiological Analysis

Sample Location	PCB (ppm)	Arsenic (ppm)	Barium (ppm)	Cadmium (ppm)	Chrome (ppm)	Lead (ppm)	Selenium (ppm)	Silver (ppm)
RC-54-P	61000	<1	8900	240	3600	77	<5	<0.5
WG-37-P	<1	5.7	7900	8.1	94	180	<5	<0.5
TB-03-P	4.9	<1	29000	20	31	2600	<5	<0.5
RC-54-P	61000	<1	8900	240	3600	77	<5	<0.5
RC-55-P	12000	<1	11000	160	11000	110	<5	<0.5
MS-18-P	4.5	<1	3200	6.2	3000	220000	<5	<0.5
PAB-27-P	42	<1	10000	<1	1200	7800	<5	<0.5
TB-04-P	42	<1	2000	42	19	470	<5	6

(Reference 7-16)

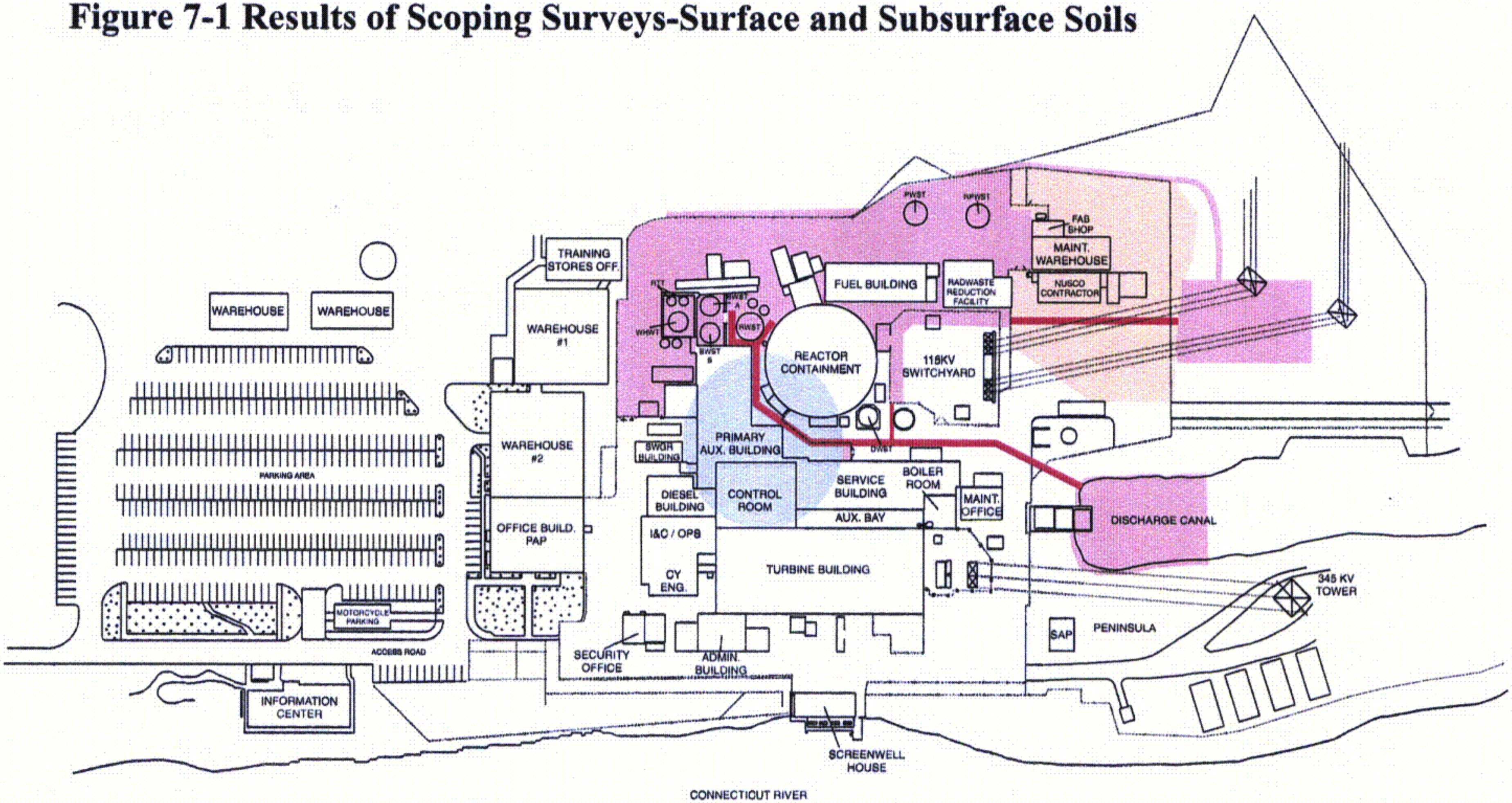
RC-Reactor Building
WG- Waste Gas
TB-Turbine Building
MS-Machine Shop
PAB-Primary Auxiliary Building

Table 7-7
Scoping Survey Summaries of Non-Radiological Analyses

Sample Location	Number of Samples	Highest reading for each substance analyzed							
		PCB (ppm)	Arsenic (ppm)	Barium (ppm)	Cadmium (ppm)	Chrome (ppm)	Lead (ppm)	Selenium (ppm)	Silver (ppm)
Turbine Building	15	410	1.4	29000	54	6200	140000	<5	6
Engineering Building	2	<2	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Control Room	1	19	<1	43	<1	530	56	<5	3.4
Machine Shop	2	4.5	<1	5100	<1	370	220000	<5	<0.5
Service Building	4	6.1	<1	3400	<1	1000	35000	<5	<0.5
Primary Aux. Building	9	50	<1	10000	44	6100	100000	<5	<0.5
Discharge Canal	3	<0.2	<1	46	<1	20	16	<5	<0.5
Waste Gas Decay	2	<1	5.7	9200	18	110	180	<5	<0.5
Yard Crane	2	<1	<1	11000	4.3	1400	87000	<5	<0.5
Rad Waste Reduction Facility	3	<1	<1	7700	1.6	55	70	<5	<0.5
Butler Building	1	<1	<1	170	<1	210	960	<5	<0.5
Spent Fuel Pool	4	33	<1	3700	5.5	3400	52000	<5	<0.5
Reactor Containment	14	61000	<1	13000	240	11000	15000	<5	<0.5

(Reference 7-16)

Figure 7-1 Results of Scoping Surveys-Surface and Subsurface Soils



General area of site affected by radiological events

Yard drains affected by documented radiological events

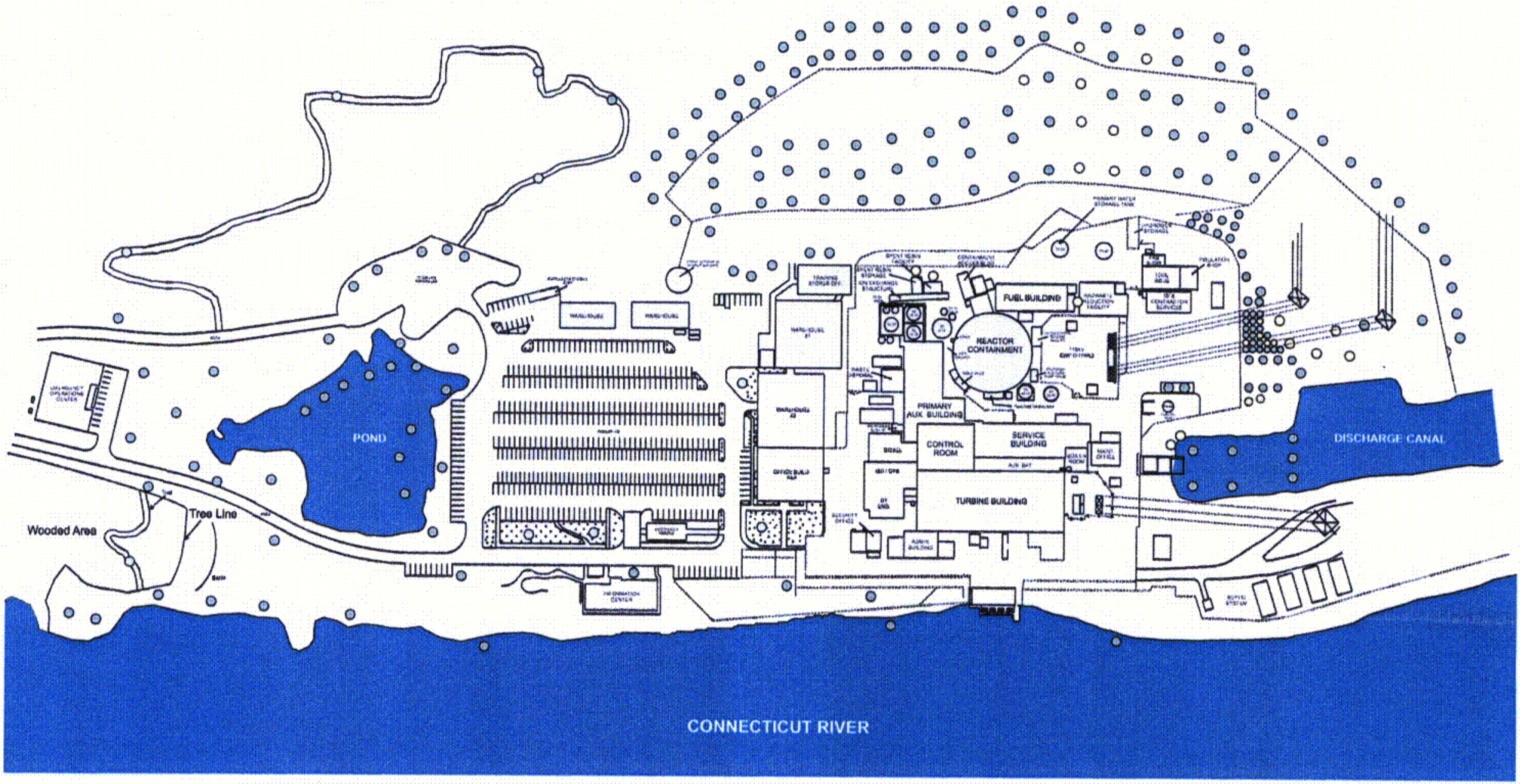
Area of potential migration of residual radioactivity

Potential residual radioactivity in the expanded protected area. (orig grade)

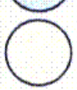
Area of potential residual radioactivity from operations

C04

Figure 7-2 Soil Sampling Summary (Reference 7-2)




INDICATES AREAS OF THE SITE THAT SOIL HAS BEEN SURVEYED / SAMPLED FOR RADIOACTIVE MATERIALS - NO DETECTABLE ACTIVITY


INDICATES AREAS OF THE SITE THAT SOIL HAS BEEN SURVEYED / SAMPLED FOR RADIOACTIVE MATERIALS - DETECTABLE ACTIVITY

C05

8.0 Conclusions

As a result from site characterizations and investigations, approximately 93 acres (Area 9532) of the plant site have been initially identified as "non impacted" as defined in MARSSIM. For those portions of the site that have been identified to be impacted, approximately 50% of the survey areas have been initially identified as Class 1, 30% of the survey areas have been initially identified as Class 2, and 20% of the survey areas have been initially identified as Class 3.

Structures
The primary structures on site are designed to house systems containing radioactive material and to function as an environmental barrier against releases. These buildings have been identified as impacted areas with the majority of areas expected to be classified as Class 1 areas. Only those areas with adequate characterization data to support a lesser classification will be classified as Class 2. There are no Class 3 areas within the primary buildings, including the reactor containment, primary auxiliary building, spent fuel building, and waste processing building. All survey areas within the turbine building are identified as Class 2 impacted areas due to historical steam generator tube leaks and the proximity to the Class 1 areas. All other structures within the industrial area have been identified as impacted areas with the specific classification based on the function of the area, historical events and radiological survey results. Structures outside the industrial area are identified as Class 3 impacted areas unless specific events or radiological data has determined that a high (Class 2) classification is required.

Soils
Soils in the RCA and several areas outside the RCA are contaminated with radioactive materials originating from HNP. These areas are designated Class 1. Investigations of the site soils are continuing to aid in the development of final status survey plans.
(See Section 7.3)

Soils in Areas 9106, 9118, 9227, 9520, 9514, and 9535 may be contaminated with lead or other pollutants of concern. Further investigation is required to more fully characterize these areas for remediation, if needed.

Ground Water
The subsurface ground water under the RCA is contaminated with tritium that originated at HNP. An initial estimate by CYAPCO is that approximately one Curie of tritium is in the ground water.

The drilling and installation of site monitoring wells in 1998 could allow the local mixing of aquifers to occur.

Ground water contaminates may spread into the shallow and deep aquifer. This event and situation will be investigated further.

Storm Water Run-off

A concern exists that pollutants and radioactive contaminates present in site soils or surfaces may have been in storm water run-off. Site construction activities disturbed soils and may have changed run-off gradients. Erosion controls were not in place to prevent further erosion and limit sediment transport. Available information suggests that the control of contaminants and pollutants in storm water did not receive an appropriate amount of attention at HNP.

As of March 2000, a storm water management plan is being implemented by CYAPCO and Bechtel.

Bonemill Brook Fault

This fault, which passes under the site grounds (Area 9520, 9521), may allow the transportation of site ground water below the Connecticut River under certain circumstances, the existence of which has not been established. Investigations into the potential for this fault to act at a transport mechanism for site ground water should be conducted. (Note: CYAPCO management is implementing a ground water assessment program to address this and other issues related to groundwater flow.)

Hazardous Substances

Further sampling for hazardous substances, specifically lead contamination and PCBs in surface coatings, should be performed to provide information for an accurate site characterization.

9.0 References

Section 2.0

2-1 Connecticut Yankee Haddam Neck Plan Characterization Report, January 6, 2000, Millennium Services Inc.

Section 4.0

4-1. "Connecticut Yankee Atomic Power Company Decomissioning Environmental Review," dated August 1997

4-2 Groundwater Monitoring Report, Connecticut Yankee Atomic Power Station Haddam Neck, Connecticut, dated July 1999, revised September 1999, Malcolm Pirnie, Inc.

4-3 Letter CY-99-077, CYAPCO November 17,1999

4-4 "Transmittal of Groundwater Characterization Report," dated November 14, 2000 Bechtel LTR No. 24265-000-TOC-GAM-00282-00

4-5 "Connecticut River Flooding," Connecticut Yankee Atomic Power Company Plant Information Report –PIR# 84-80

4-6 Bedrock Geological Map of Connecticut, John Rodgers 1985, Connecticut Geological and Natural History Survey, Department of Environmental Protection.

4-7 Water Quality Violation of the Bacterial Standard (Total Coliform), State of Connecticut Department of Public Health

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5-1 "Construction Spoils-Draft Copy " Connecticut Yankee Atomic Power Station Haddam Neck, (no date-1999) Shippee/Derrig

Section 6.0

6-1 "A History of Haddam Neck," L. Kruger Brooks 1972

6-2 "Final Environmental Statement," United States Atomic Energy Commission 1973

6-3 "Connecticut Yankee Atomic Power Company Decomissioning Environmental Review," dated August 1997

6-4 Haddam Neck Plant, "Decommissioning Updated Final Safety Analysis Report," January 1998.

6-5 CYAPCO to AEC, CYA-342, May 28, 1969

6-6 Report of Inspection CO Report No. 213/70-5, AEC October 14-16, 1970

6-7 AEC Management Audit Inspection, September 26-28, 1972

6-8 United States Nuclear Regulatory Commission Systematic Assessment of Liscensee Performance (all)

6-9 CYAPCO Regulatory Affairs Records

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6-11 United States Nuclear Regulatory Commission Historical Review Team Report, March 1998

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6-17 "Evaluation of the Decontamination of the Reactor Coolant Systems at Maine Yankee and Connecticut Yankee," EPRI TR-112092 Final Report, January 1999.

6-18 CYAPCO procedure- RPM 2.2-22 Vehicle and Material Release from Radiologically Controlled Areas and Restricted Areas

6-19 Connecticut Annual Low-Level Radioactive Waste Report, 1999, 2000, 2001.

6-20 CYAPCO Waste Management Plan- Attachment 1, Revision 0, November 12, 1999

6-21 Item #0001 Inventory of Sources, and interview with CYAPCO Nuclear Licensing

6-22 Procedure "SUR 5.6-16, Receipt, Inventory, Leak Test and Disposal of Non-Exempt Radioactive Sources"

6-23 Maintenance Department Post- Maintenance Testing, MA 1.5-2 Revision 8, CYAPCO, February 10, 1993

6-24 Connecticut Yankee Atomic Power Station Environmental Indicators Report Completed March, 1998, Connecticut Department of Environmental Protection

6-25 "Response to EPA's RCRA CAP Questionnaire" CY-99-064, Connecticut Yankee Atomic Power company, September 27, 1999

6-26 10CFR50.75 (g) database CYAPCO/BECHTEL

6-27 Origin of Fill Material Identified at Offsite Locations CYAPCO HP 01-022, May 30, 2001

6-28 CYAPCO Offsite Materials Recovery Program

6-29 USNRC Confirmatory Action Letter – CAL No. 1-97-007, March 4, 1997

6-30 NRC Inspection No. 50-213/98-02 (Closure of Confirmatory Action Letter 1-97-007) May 5, 1998

6-31 http://www.opm.state.ct.us/pdpd3/data/estimate.htm

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Section 7.0

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7-2 Connecticut Yankee Haddam Neck Plant Characterization Reports, Millennium Services Inc, January 6, 2000

7-3 CYAPCO Offsite Materials Recovery Program

7-4 Groundwater Monitoring Report, Connecticut Yankee Atomic Power Station Haddam Neck, Connecticut, dated July 1999, revised September 1999, Malcolm Pirnie, Inc.

7-5 Northeast Laboratory project # 9709290 10/07/97

7-6 Barringer Laboratories Inc. Job 992166E May 21,1999

7-7 Shooting Range Landfill Characterization Survey Report for Connecticut Yankee Atomic Power Plant, Revision 0, GTS DURATEK, Inc., December, 1999

7-8 Environmental Science Corporation esc#2012000358 12/26/00

7-9 "Dumping Waste Oil Tank in Back Yard" CYAPCO EN-MO-592 February 28, 1977

7-10 Interview with maintenance supervisor 7/17/2001 sr/cd

7-11 CYAPCO UST Removal Final Report CY-98-189, December 2, 1998

7-12 Storm Water Pollution Control/Erosion and Sediment Control Plan, TRC Environmental Corporation Windsor, Connecticut, March 2000

7-13 Attachment A Survey/Sampling Work Package Survey Areas 9227 (Bus 10) Addendum 1 "Sandwiched between the bottom and middle layers is approximately 0.5" thick layer of lead." Dated January 6, 1999

7-14 CYAPCO Routine Surveys from 1983, Surveys of Bartlett Decon Facilities.

7-15 Yankee Atomic Electric Company Environmental Laboratory Analysis Report, November 9-21, 1997

7-16 Results of Scoping Surveys, Connecticut Yankee Atomic Power Company, Haddam Neck Plant, September 1998

10.0 <u>Appendices</u>

A. Conceptual Model and Site Diagram

The model in Section A-1 consists of a narrative describing the Survey Area(s), an illustration of the area(s) with contamination and dose rates, a table of contamination levels, samples (if taken) and classification.

The illustrations are from the area maps enclosed in Section A-2. Contamination levels are from Table A-1. Samples are referenced.

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A copy of the Index is enclosed in Section A-3 for reference.