Vermont Yankee Nuclear Power Station

Radiological Historical Site Assessment

Entergy Nuclear Operations, Inc.
Vermont Yankee Nuclear Power Station
320 Governor Hunt Road
Vernon, Vermont 05354

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RSCS
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Glossary of Terms, Acronyms and Abbreviations

ANR – Agency of Natural Resources
AOG – Augmented Off Gas
bgs – below ground surface
BWR – Boiling Water Reactor
CAB- Containment Access Building
Co – Cobalt
COB – Construction Office Building
CSM – Conceptual Site Model
CST – Condensate Storage Tank
Cs - Cesium
DCGL - Derived Concentration Guideline Level
DP - Decommissioning Plan
DPR – Decommissioning Planning Rule
DQOs – Data Quality Objectives
DSAR - Defueled Safety Analysis Report
ENVY- Entergy Nuclear Vermont Yankee
Fe - Iron
FSAR - Final Safety Analysis Report
FSS – Final Status Survey
GPI – Groundwater Protection Initiative
H – Hydrogen or Tritium
HSA - Historical Site Assessment
HVAC-Heating, Ventilation, Air Conditioning
ISFSI - Independent Spent Fuel Storage Installation
LLD – Lower Limit of Detection
MARSSIM - Multi-Agency Radiation Survey and Site Investigation Manual
MDA – Minimum Detectable Activity
Mn – Manganese
MW – Mega Watt
NEI - Nuclear Energy Institute
Ni - Nickel
NRC - Nuclear Regulatory Commission
ODCM - Offsite Dose Calculation Manual
PSB – Plant Support Building
Pu – Plutonium
RB – Reactor Building
RCA - Radiologically Controlled Area
REMP – Radiological Environmental Monitoring Program
RHSA – Radiological Historical Site Assessment
RRCs – Recognized Radiological Conditions
RW – Radioactive Waste
RWB – Radioactive Waste Building
SAFSTOR - Safe Storage
Sr – Strontium

SSCs – Systems, Structures and Components
TB – Turbine Building
V&V – Verification and Validation
VYNPS – Vermont Yankee Nuclear Power Station
Zn – Zinc

Executive Summary

The radiological historical site assessment was completed in accordance with the guidance provided in NUREG-1575 (MARSSIM). As expected, operational activities at VYNPS have resulted in areas that have been impacted with radiological contaminants. Events and conditions that resulted in radioactive contaminants being deposited in locations outside of buildings and structures are attributed to spills, leaks, effluent releases and build up over time of residual contamination that could not be detected by monitoring methods in use at the time. No impacted areas were identified that were not previously known or documented.

Events and conditions were investigated upon discovery and appropriate actions taken to terminate/secure the leaks or stabilize and/or eliminate the condition. Remediation was initiated if required to prevent migration of contamination and minimize impact to the environment. No identified areas of radiological contamination are a current or expected threat to human health, the environment, or appear to present a significant challenge for decommissioning.

The dominant plant-related radioactive contaminants identified in the Protected and Owner-Controlled areas are cobalt-60 (Co-60), cesium-137 (Cs-137) and tritium (H-3). Additional radionuclides such as manganese-54 (Mn-54), zinc-65 (Zn-65), iron-55 (Fe-55), cesium-134 (Cs-134) and strontium-90 (Sr-90) were identified in samples collected at the Northeast side of the Radwaste Building and from soil borings beneath the chemistry lab sinks.

Areas designated as non-impacted include the Plant Support Building (PSB), the power up-rate building (PUB), several smaller ancillary buildings within the Owner Controlled Area and the Entergy-owned property outside the Owner Controlled Area.

Impacted areas include buildings and structures, soil and groundwater. The locations of the impacted areas are confined to the Protected and Owner Controlled Areas. All areas and structures have been given a preliminary classification based on available radiological characterization data, knowledge of historical site operations and results of personnel interviews.

Buildings, structures, systems and components associated with nuclear power operations and handling of related radioactive material that are located within the Radiologically Controlled Area (RCA) are designated as Class 1 areas. This includes buildings such as Reactor, Turbine, Radwaste, Condensate Storage Tank and associated structure, parts of the Service Building, Containment Access and Augmented Off-Gas Buildings.

In Class 2 buildings and structures, the potential for residual contamination exists. Buildings and structures designated as Class 2 include the North Warehouse, Plant Stack and Maintenance Machine Shop. The potential for low levels of residual contamination may exist in Class 3 areas. The classification of Class 3 buildings and

structures include the Control Building, South Warehouse, Construction Office Building, Cooling Towers and the Intake and Discharge Structures.

As a result of plant operations, soil has been impacted by spills, leaks and plant activities. Categories of impacted soil areas include:

- Storm drain system
- Septic system
- Underground pipes
- Surface soil areas

Impacted soil (environmental) areas that are outside of buildings and structures and are designated as Class 1 include:

- Underground pipe leak at AOG Building
- Buildup of contamination on the Northeast side of the Radwaste Building (contaminated soil near cask room doors)
- Chemistry lab drain line leak (10 CFR 20.2002 NRC approved disposal in place)
- Condensate Storage Tank spill and tank bottom leak
- North and South Storm Drain Systems, Outfall and River Sediments accumulation of building roof and site runoff

Areas that have been known to contain residual radioactivity are designated as Class 2; examples of Class 2 soil areas include:

- Concentration of low levels of contamination in septic system sludge (10 CFR 20.2002 NRC approved disposal in South Field Application Area)
- Sand blast media from maintenance work near the south side of the North Warehouse
- Cask loading activities impacting soil adjacent to the Radwaste Building
- Storage and handling of radioactive materials impacting surface soil adjacent to the North Warehouse

Areas of potential residual radioactivity are designated as Class 3; examples of Class 3 soil areas include:

- Septic leach fields and tanks
- Cooling tower silt and temporary storage areas (10 CFR 20.2002 NRC approved disposal of cooling tower silt in South Field Application Area)
- Former burn area for wood scraps
- Former storage area for asbestos and plowed snow

Groundwater monitoring programs in place to meet regulatory guidance and permit requirements has detected tritium resulting from the underground leaking pipe in the pipe trench located near the AOG building. No plant generated radionuclides have ever been detected in groundwater samples from the South Field Application Area (10 CFR 20.2002 licensed disposal area for septic sludge and soil) or within the septic leach field areas.

1.0 Purpose

The purpose of this report is to summarize the radiological historical site assessment of the VYNPS, the "subject property", located at 320 Governor Hunt Road in Vernon, Vermont. The objective is to assess the potential for the presence of recognized radiological conditions of concern at this location. This report assesses whether current or past activities at the subject property have created such conditions and the potential impact of these conditions on the decommissioning process. This document focuses on potential radiological contamination of the VYNPS. A separate document has been prepared to identify and evaluate potential non-radiological contamination of the site.

The VYNPS Training Center and Emergency Response Center are located at 185 Old Ferry Road in Brattleboro, Vermont. These properties plus the company-owned properties adjacent to VYNPS along Governor Hunt Road are not included in this assessment.

2.0 Property Identification

The subject property, commonly known as Vermont Yankee Nuclear Power Station (VYNPS), is a 125-acre parcel located on Governor Hunt Road in the town of Vernon, Windham County, Vermont.

Construction of the single 540 megawatt (MW) Boiling Water Reactor (BWR) plant began in 1967. Commercial operation began on November 30, 1972. The station power output was increased to 650 MW in 2006.

The following information further identifies the subject property:

Address:	320 Governor Hunt Road, Vernon, Vermont	
County:	Windham	
Property owners:	Entergy Nuclear Vermont Yankee, LLC (ENVY)	
USGS Quadrangle:	Brattleboro, Vermont	
Latitude, Longitude:	42º46'43.97" North, 72º30'50.36" West	
Zoning:	Industrial	
Lister's Map:	Map No. 36 Lot No. 21	
Year Built:	1967–1972	Main Power Station Buildings
	1985	Construction Office Building
	1985	Containment Access Building
	1981	New Warehouse Building
	1998	Plant Support Building

2.1 Physical Characteristics

The property is divided into the Protected Area and the Owner Controlled Area. The Protected Area is completely enclosed by a high security double chain-link fence system that is subject to electronic surveillance and monitored by security personnel 24-hours per day. Buildings located within the Protected Area of the property include the Reactor Building (RB), the Turbine Building (TB), the North and South Warehouses, the Containment Access Building (CAB), Advanced Off-Gas Building (AOG), the Radwaste Building (RWB), the Maintenance Building, the Control Room Building, the Administration Building, the Construction Office Building (COB), the New Warehouse, and various small storage sheds and outbuildings.

The Owner Controlled Area comprises all the property outside the Protected Area, and is completely enclosed by a chain-link perimeter fence. Access by vehicular traffic is gained through Gate 1 off of Governor Hunt Road. Buildings located within the Owner Controlled Area of the property include the Plant Support Building (PSB), the Shipping and Receiving Building, the Power Up-rate Building (PUB), four temporary buildings storing turbine rotors and casings, the 115kV and 345kV switchyards and VELCO substation and small storage sheds and outbuildings.

The area adjacent to the power station buildings and the parking lots are paved with asphalt and the surrounding land is covered with grass, shrubs and trees. In addition to the fences around the Protected Area and the Owner Controlled Area, a fence has been erected on the west side of the property owned by VYNPS, on the line parallel to the rear (east) plot lines of the properties on Governor Hunt Rd. This land is farmed on a regular basis.

VYNPS and properties in the power station's vicinity are served by privately-owned water and sewer systems. Figure 1 is a site plan showing the layout of the power station and its buildings.

2.2 Environmental Setting

The subject property is located on the west shore of the Connecticut River, immediately upstream of the Vernon Hydroelectric Station. The property is bounded on the north, west, and southwest by privately-owned land and on the east and south by the Connecticut River.

2.2.1 Geological Setting

The geology of the subject property has been described during previous investigations completed at the site. The first investigation was completed in 1966 by Goldberg-Zoino and Associates, Inc. (GZA) for siting of the power station (Reference 1). A second study was a detailed hydrogeological investigation completed in 1988 by Wagner, Heindel & Noyes (WHN), for the siting of a proposed low-level radioactive waste

repository (Reference 2). A third investigation was completed in 1991 by Battelle, in conjunction with Hanson, Shannon & Wilson and WHN, and was a comprehensive site characterization to determine the feasibility of land application of low-level radioactive waste in the North Field portions of the subject property (Reference 3). A fourth investigation was completed in 2001 by Environmental Compliance Services, Inc., immediately prior to purchase of the subject property by Entergy, to identify areas of the property where petroleum and /or hazardous materials may have been released to the soil or groundwater (Reference 4). A fifth investigation was completed in 2011 by GZA GeoEnvironmental, Inc., to investigate the occurrence of tritium in groundwater at the subject property (Reference 5). The following discussion of geology and hydrology is reproduced from Reference 5.

2.2.1.1 Surficial Geology

VYNPS (the "Site") is located in an area of lowlands and river terraces that span approximately one mile in width and border the Connecticut River. These lowlands are situated between bedrock-controlled upland areas to the east and west of the river. The average local relief is up to several hundred feet. The overburden geology is typical of glacial river valleys. The Site is underlain by soils typical of glaciolacustrine deposits, ice-contact stratified drift or outwash, scattered till deposits, and floodplain deposits (i.e. sand, silt and gravel, with some clayey zones) over bedrock consisting of hard biotite gneiss.

The region of the Site is located within the footprint of the Laurentide ice sheet, which at its maximum reached south of the current shoreline of the states of Connecticut and Rhode Island. As the climate warmed and the ice sheet retreated northward, large volumes of sand and gravel were deposited into the Connecticut River Valley. In the area of Rocky Hill, Connecticut these deposits, referred to as the Rocky Hill dam, blocked the flow of surface water in the Connecticut River Valley, and as water became impounded between this sediment and the retreating ice margin, Glacial Lake Hitchcock was formed. The lake grew slowly as the ice sheet continued to melt and retreat, with the lake's maximum extent reaching as far north as St. Johnsbury, Vermont. Eventually the Rocky Hill dam was breached and Glacial Lake Hitchcock drained, leaving behind extensive glaciolacustrine sediments in the Connecticut River Valley.

The Site is situated within the historic extent of Glacial Lake Hitchcock. Mapped surficial geology for the area indicates lacustrine and littoral sediments, described as predominantly well-sorted sand and pebbly sand. This material is typical of that deposited along the shoreline of the lake as fast-flowing water from tributaries flowing off the valley margins or along the retreating and melting glacial front entered the calm lake region.

The geology within the Site vicinity includes approximately 10 to 70 feet of glacially deposited soils overlying bedrock. The overburden geology is typical of glacial river valleys, with the soils consisting of sand, silt and gravel. Occasional pockets of clay

have been encountered in depressions in the bedrock surface. Individual strata within the sand deposit are generally relatively uniform in nature, as is common for glacial stream deposits, and range from loose fine sand to dense coarse sand with a trace of silt. In general, the sand increases in density with depth. Some potentially discontinuous fine-grained deposits (silt layers) also appear to be present in areas of the Site.

A number of gravel pits are found on terraces along the eastern side of the hills west of the Site, which form the western boundary of the river valley. These areas are mapped as being underlain by gravel lake shore deposits on upland terraces that run roughly north-south. Higher up on the hills exposed and minimally covered bedrock is common. East of the ridges, wooded sloped areas transition into a valley of more level farm land where the Site is located.

2.2.1.2 Bedrock Geology

The Site is located within the Brattleboro syncline, part of the Connecticut Valley-Gaspe Synclinorium. This region is underlain by Paleozoic age metamorphic rocks. The area contains a band of Triassic age sedimentary rock to the south of the Site in Massachusetts. Foliated igneous rocks of middle and late Devonian age underlie a large portion of the region. The Site is located over a fairly large pluton of the Oliverian Magma Series known as the Vernon Dome, which is comprised generally of gneiss grading from a light gray to pinkish-gray, slightly to moderately foliated, medium-grained granodiorite (quartz-diorite) to granite. This pluton extends over an area approximately 8 miles long and 2 miles wide, striking approximately 10 degrees to the northwest and dipping steeply to the east.

2.2.2 Hydrology

The Site is located on the west bank at approximately mile 138 upstream from the mouth of the Connecticut River. At this location, the river is formed into a reservoir (often referred to as Vernon Pond) above the TransCanada Corporation's Vernon Station Hydroelectric Dam. As a result, the surface elevation of the Connecticut River is well regulated adjacent to the Site.

The Connecticut River flows generally from north to south. It is the most significant drainage feature in the region, and local streams ultimately discharge to the river. In addition to variations in rainfall and snow melt, the flow of river water is largely determined by the operation of dams and hydroelectric stations, including the Vernon Dam and several upstream and downstream facilities. River stage data indicate that the surface water elevation in the river adjacent to the Site typically ranges from approximately 217 to 220 feet above the North American Vertical Datum of 1988 (NAVD 88).

2.2.2.1 Groundwater Levels and Flow Directions

The local water table fluctuates depending on the amount of precipitation and level

changes in the Connecticut River. River flooding may cause a temporary, localized reversal in the normal groundwater flow direction toward the river, resulting in river water flowing into river bank soils.

At the Site, groundwater is present within the glacial deposits overlying the bedrock (also known as the overburden) at depths ranging from approximately 5 to 30 feet below ground surface (bgs). Groundwater generally flows from the west to the east toward the Connecticut River. In 1988 and 1989, and again in 2007 and 2010, groundwater monitoring well networks were installed across the Site to monitor groundwater quality and elevations. Groundwater levels in the northern portion of the Site (where the surface elevation is approximately 260 feet NAVD 88) vary between approximately 5 and 18 feet bgs. In the vicinity of the major VYNPS plant structures (the "power block"), where the surface elevation is approximately 252 feet NAVD 88, groundwater has been observed to be about 20 to 30 feet bgs. Along the southern portion of the Site, where the surface elevation is approximately 260 feet NAVD 88, depth to groundwater is approximately 30 feet bgs.

The area in the vicinity of the VYNPS plant is primarily farm and pasture land with much of the surrounding region undeveloped and wooded. Residences, the Vernon Town Office Building and the Vernon Elementary School are located along Governor Hunt Road to the west of the Site. The school, the town offices, most residences and the VYNPS plant are served by private water-supply wells drilled into the bedrock beneath the overburden. Some residences located along Governor Hunt Road have shallow water supply wells for domestic use.

2.2.2.2 Groundwater Recharge and Discharge

Groundwater recharge is comprised of the net precipitation (minus runoff and evapotranspiration) that infiltrates the ground and contributes to groundwater flow within a watershed. Areas of recharge exist in the upland portion of the watershed west of the Site and on unpaved portions of the river terrace deposits within the valley in which the Site is located. Due to the relatively steep grades and low permeability of the subsurface materials in the upland areas to the west of the Site (primarily bedrock and glacial till), a relatively high amount of the precipitation that falls on this area runs off, resulting in a relatively low amount of infiltration to the water table there (groundwater recharge). Water that does infiltrate in upland areas primarily will recharge the underlying fractured bedrock. On unpaved portions of the river terrace deposits in the lower portions of the river valley, where slopes are flatter and permeabilities are greater, a relatively greater amount of infiltration and lesser amount of surface runoff results in relatively more groundwater recharge.

3.0 Historical Site Assessment Methodology

The Historical Site Assessment (HSA) is the first step in a process described in NUREG -1575, “Multi-Agency Radiation Survey and Site Investigation Manual” (MARSSIM) (Reference 6). The purpose of MARSSIM is to provide a standardized approach to demonstrating compliance with a dose or risk-based regulation. MARSSIM provides guidance to prepare and implement a statistically valid survey and site investigation plan that will support termination of the NRC operating license for a licensed facility.

3.1 Approach and Rationale

The primary tasks in the MARSSIM survey and site investigation process are:

- Historical Site Assessment
- Scoping Survey
- Characterization Survey
- Remedial Action Support Survey
- Final Status Survey
- Regulatory Agency Confirmation and Verification

This document is focused on the initial steps in what is an iterative process in which knowledge about the site is continuously gained by reviewing past events and conditions and conduct of scoping and characterization surveys.

Historical Site Assessment

The intent of an HSA is to document a comprehensive investigation that identifies and evaluates historical information pertaining to events and conditions that may have resulted in contamination during the operating history of the subject site. Contaminants of interest include both radiological and non-radiological, and may have impacted systems, structures or components (SSCs) of the plant or environmental media within the owner-controlled property. The information developed by the HSA is evaluated to differentiate impacted from non-impacted areas of the site. Areas determined to be impacted are further classified (based on preliminary information) as Class 1, Class 2 or Class 3, depending upon the apparent severity of their impact.

As defined in NUREG-1575, Class 1 areas are those that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiation surveys) at concentrations greater than the release criteria. 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 and high specific activity.

Class 2 areas are those that have, or had prior to remediation, a potential for radioactive contamination or known contamination, but not at concentrations expected to exceed the release criteria. 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 release criteria. Examples of areas that might be classified as Class 2 include: 1) locations where radioactive materials were present in an unsealed form, 2) potentially contaminated transport routes, 3) areas downwind from stack release points, 4) upper walls and ceilings of buildings or rooms subjected to airborne radioactivity, 5) areas handling low concentrations of radioactive materials, and 6) areas on the perimeter of former contamination control areas.

Class 3 areas are 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 release criteria, based on site operating history and previous radiation 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.

Class 1 areas have the greatest potential for contamination and, therefore, receive the highest degree of survey effort using a graded approach, followed by Class 2, and then by Class 3. Non-impacted areas do not receive any level of survey coverage because they have no potential for residual contamination.

3.2 Documents Reviewed

Historical information was reviewed and compiled into the HSA to identify areas where contamination existed, remains or has the potential to exist. This information included interviews of long-tenured employees, spill reports, radiological incident files, special survey and operational survey records, the VYNPS file maintained in compliance with10 CFR 50.75(g), VYNPS Radioactive Effluent Release Reports, VYNPS Annual Radiological Environmental Monitoring Reports, and a Phase I and II Environmental Site Assessment report of the VYNPS (Reference 4). Each identified radiological area of interest is listed in Table 1.

3.3 Property Inspections

Aerial photographs, station walk downs and information gathered from personnel interviews were used to establish the current condition of systems, structures and components as well as environmental areas at VYNPS.

In general, there has been a progressive increase in the number of structures and switchyards within the Protected Area and the Owner Controlled Area since operation of the station began in 1972. The outlying properties beyond the Owner Controlled Area

are relatively unaffected by site operations and have remained open farm land with unrestricted use since construction of the facility began.

3.4 Personnel Interviews

Interviews of current or former long-time employees of VYNPS were conducted during April and May 2014. The intent of the interviews was to provide a means of identifying areas where either radiological or non-radiological contamination may have occurred but that may not have been documented in plant records. Employees who were at VYNPS for many years, particularly during plant construction and early operation, were sought because spill reporting and documentation of contamination incidents then may not have been as complete as they have become more recently. For example, federal regulation 10 CFR 50.75(g), which requires compilation of records of contamination incidents that may have significance during decommissioning, did not exist prior to 1988. Therefore, incidents that occurred prior to approximately 1988 may have been documented but those records may not appear in the 10 CFR 50.75(g) file and may not be easily found.

Nine (9) individuals with an average length of employment at the plant of 36 years were interviewed; most began employment at VYNPS during the years 1967 to 1972 and had first-hand experience during plant construction.

In general, results of the interviews corroborated information developed by record searches and plant tours, and did not identify any Class 1 areas that had not been identified by other lines of investigation. A common comment was that interviewees were not aware of incidents that were not reported and recorded. It was their experience that their co-workers generally followed procedures and performed their duties to the best of their ability. Several of the interviewees also stressed that employees at the plant were very conscientious of their responsibility to identify significant issues and ensure that they were properly addressed and reported to management.

4.0 Historical and Current Use

Consistent with the guidance of NUREG-1575 (MARSSIM) (Reference 6), and Regulatory Guide 4.22 “Decommissioning Planning During Operations” (Reference 7), the HSA evaluated information regarding historical facility operation, regulatory involvement, permits and licenses, and waste handling procedures.

4.1 History

Central Vermont Public Service (CVPS) purchased the initial parcel of farm land for the VYNPS site. CVPS and several other New England utilities contracted with Yankee Atomic Electric Company (YAEC) to build the 540 Megawatt (MW), General Electric, boiling water reactor.

Construction was started in 1967 and the plant became fully operational in 1972 under the management of YAEC and CVPS. In the late 1970's Vermont Yankee Nuclear Power Corporation (VYNPC) was established and successfully operated and managed the facility until 2002 when the facility was sold to Entergy Nuclear Vermont Yankee, LLC.

In 2006 the permitted power output was increased to 650 MW. In 2011 the U.S. NRC granted the plant a 20-year license extension (from 2012 until 2032). In 2013 Entergy announced that the plant would be closing at the end of 2014.

4.2 Description of Circumstances Impacting Site Radiological Status

Normal plant operations are expected to result in contamination of certain areas of the site (mainly buildings and structures); these areas were designed to contain such material. During operations, certain events and conditions have resulted in radioactive material being deposited in other locations. As a result, the plant design and operational procedures evolved to accommodate or eliminate these circumstances.

The following events and circumstances generally contributed to the various aspects of residual contamination found in areas outside of the buildings and structures.

- Leaks from tanks, chemistry lab drains and underground piping to the environment
- Build up over time of low levels of contamination in soil adjacent to buildings
- Surface water runoff from building roofs and paved areas to adjacent soil and storm drain systems
- Build up over time from activities associated with packaging and transport of radwaste
- Concentration of low levels of contamination in septic system tank bottoms
- Build up over time of fallout/washout of routine plant effluents
- Build up over time from storage and handling of radioactive materials

From the research described in Subsections 3.2, 3.3 and 3.4 above, areas of interest were identified as potentially impacted by radioactive contamination that may have significance during decommissioning. None of the areas identified are considered to be an imminent threat to human health or the environment, or appear to present a significant challenge to the decommissioning process. Table 1 lists the areas of interest; the map locations listed in Table 1 refer to the areas shown on Figure 1, Figure 2 ("Map A") and Figure 3 ("Map B").

Each radiological condition of interest listed in Table 1 has been assigned a preliminary classification, as described in MARSSIM. Site-specific derived concentration guideline levels (DCGLs) for VYNPS have not been determined; therefore, the preliminary classifications in Table 1 are only an estimate of the relative magnitude of radiological contamination that may now exist in an area of interest. In some areas, (for example

the station gatehouses) the classification is based solely on knowledge of plant operations rather than radiological sampling and analysis. In other areas (for example the soil beneath the Chemistry Lab floor) the classification is based on previous radiological characterization surveys that may have been completed many years in the past.

Events and conditions were investigated upon discovery and appropriate actions taken to terminate/secure the leaks or alleviate the condition. Remediation was initiated if required to prevent migration and minimize impact to the environment. Some incidents of contamination were not completely remediated at the time of discovery because 1) the source of contamination was removed and residual contaminant concentrations were very low, 2) screening data indicated that the contaminant levels detected did not present a risk to human health or the environment, 3) the contamination was contained and managed within a structure, 4) the contamination was inaccessible, and/ or 5) the contaminants are not mobile in soil.

5.0 Assessment Findings

Most issues identified were the result of spills, leaks, or accumulated concentration over time of contaminating material that was released from the facility at levels less than those that could be detected by real-time monitoring methods employed at the facility. Those monitoring methods at the time were state-of-the-art and comparable to methods used throughout the nuclear industry.

5.1 Contaminants

The dominant plant-related radioactive contaminants identified in the Protected and Owner-Controlled areas are cobalt-60 (Co-60), cesium-137 (Cs-137) and tritium (H-3). Additional radionuclides such as manganese-54 (Mn-54), zinc-65 (Zn-65), iron-55 (Fe-55), cesium-134 (Cs-134) and strontium-90 (Sr-90) were identified in samples collected at the Northeast side of the Radwaste Building and from soil borings beneath the chemistry lab sinks.

5.2 Environmental Radioactivity

Radionuclides present in the environmental background are both naturally occurring and man-made. Carbon-14 is introduced cosmogenically and by the atmospheric testing of nuclear weapons. Tritium is also introduced cosmogenically and through atmospheric detonation of nuclear weapons. Cesium-137 and strontium-90 are fission products that occur in the environment as a result of atmospheric nuclear weapon detonations and international nuclear accidents (Chernobyl and Fukushima- Daiichi). A study completed in 1999 by Duke Engineering and Services (Reference 8) quantified the background concentrations of Cs-137 in surface soils and sediments in the Brattleboro, VT region.

5.3 Contaminated Media

Contaminated media include primarily soil, groundwater, concrete and steel. Relatively small volumes of other construction materials such as paint, insulation, rubber, glass, asphalt, etc., may be found to be contaminated during detailed radiological surveys of various areas of the plant. Septage from the sewage systems within the Protected Area of the station may be slightly contaminated. Additionally, some components such as Interim Off-Gas system (IOG) filters, pipes conveying radioactive liquids or gases and the leach field laterals potentially may be contaminated.

5.4 Non-Impacted Areas

The non-impacted areas include the Plant Support Building (PSB), the power up-rate building (PUB), several smaller ancillary buildings within the Owner Controlled Area and the Entergy-owned property outside the Owner Controlled Area. A more complete list of non-impacted areas is provided in Table 2.

5.5 Impacted Areas

The impacted areas include buildings, structures, soil and groundwater. The locations of the impacted areas are confined to the Protected and Owner Controlled Areas. Table 1 contains a list of potential areas of interest.

6.0 Impacted Buildings and Structures

All areas and structures have been given a preliminary classification based on available radiological characterization data, knowledge of historical site operations, and results of personnel interviews. The classification of an area or subsection of an area may be revised when new radiological sample data become available. Tables 1 and 2 contain a summary of all buildings and structures on site at the time this HSA was developed and their preliminary classifications.

6.1 Class 1 Buildings and Structures

All buildings, structures, systems, and components associated with the VYNPS nuclear power reactor or associated with handling of related radioactive material are Class 1 areas as they are defined in MARSSIM (Reference 6). The areas listed below are located within the RCA. These areas have been designated as Class 1 because they are very likely to contain radioactive contamination at concentrations greater than the license termination criteria. Remediation of this contamination will require removal and disposal of radioactive waste at an NRC-licensed disposal facility if the VYNPS site is to be released for unrestricted use from its operating license issued by the U.S. NRC.

Reactor Building

The Reactor Building encloses the primary reactor system, primary containment, reactor primary and auxiliary cooling systems, reactor refueling pool, dryer and separator pool, and spent fuel storage pool. The building provides secondary containment for the reactor and primary containment for auxiliary systems. Primary containment for the reactor consists of the drywell and the pressure suppression chamber (Torus).

Turbine Building

The Turbine Building houses the turbine generator and associated auxiliaries, including the condensers, feedwater system, and condensate water treatment system. Other auxiliary equipment is also located in this building, such as emergency diesel generators, house heating boilers, the water pre-treatment room and the machine shop.

Radwaste Building

The Radwaste Building contains systems designed to treat radioactive water for recycling back to the plant and the equipment to process solid waste for shipment and disposal off site. The building also houses the Fuel Pool demineralizers for maintaining the Fuel Pool chemistry. The area east of the Radwaste Cask room was discovered to be contaminated in 1987. This contamination was caused by leakage from the Cask room during the cask wash-down process. The area was cleaned sufficiently to insure the safety of the station personnel and procedures and processes were modified such that the potential for future contamination was greatly reduced.

Condensate Storage Tank and Associated Structure

The Condensate Storage Tank building is adjacent to the condensate storage tank and is part of the moat that surrounds the tank. The building contains valves, piping and instrumentation associated with the operation of the tank. Approximately 83,000 gallons of water from this tank leaked to the Connecticut River through electrical penetrations in the moat and the South Storm Drain System 1976. Also, in 1986 a leak developed in the bottom of the tank. Corrective actions involved replacing the bottom of the tank, upgrading the moat and routing the discharge from the sump in the moat to the Radwaste Building to prevent future unmonitored release to the river by this pathway.

Service Building

The Service Building contains the access to the RCA, and includes the Chemistry Lab, count rooms, decontamination showers, and the Health Physics Check Point. The remainder of the building primarily consists of office space. A leak from a drain line from the chemistry laboratory sinks to the Radwaste Building was discovered to have released radionuclides to the soil beneath the lab floor in 1991. VYNPS submitted a 10 CFR 20.2002 application to the NRC to allow the contamination to remain in place. The application was approved on July 10, 1992.

Containment Access Building

The Containment Access Building is primarily a very large empty building. The main function of the building is to provide shelter for moving equipment and material, including new fuel assemblies and radioactive waste casks, in and out of the Reactor Building. Radioactive material stored in the building is sealed such as to prevent the spread of contamination. Occasionally, large quantities of radioactive material, including new and spent fuel assemblies, are moved through this building

Advanced Off-Gas Building

The Advanced Off-Gas building houses the hydrogen recombiners, two charcoal guard beds, dryers, flame arrestor, the main hold up charcoal filters and associated piping systems. The general purpose of the AOG system is to reduce the release of short half-life radioactive gasses to the environment. This is accomplished by recombining the combustible gasses and passing the remaining non-combustible radioactive gasses through a series of pipes and charcoal beds. The process “holds up” or “delays” these gasses, allowing most of the radioactive material to decay before discharging it to the environment. When the plant is shut down, there will be very little residual radioactive material left in the system. The exception will be the charcoal beds, including the guard bed and the main bed. These filters will have measurable amounts of Cs-137 trapped in the charcoal. Once the charcoal is removed, there should be only trace amounts of radioactive material remaining.

6.2 Class 2 Buildings and Structures

Class 2 areas are likely to contain measurable concentrations of radioactive contamination, but not at levels expected to be greater than the DCGLs. Major buildings presumed to be Class 2 are listed below.

North Warehouse

The North Warehouse is located inside the Protected Area and is used to store waste oil awaiting shipment off site for disposal, various pieces of radiologically contaminated equipment and other waste items including spent lead-acid batteries, used ethylene glycol and small PCB-containing components. The radioactive waste packages are stored in the east end of the building when they are ready to ship. This building also housed a waste oil furnace that was formerly used to burn slightly radioactive contaminated oil for several years.

Plant Stack

All of the air from the HVAC systems in the main buildings is discharged from the station through the plant stack. Additionally, the Standby Gas Treatment System, the Gland Seal Exhaust and the Advanced Off-Gas System exhaust through the Plant Stack. The associated piping for these systems runs underground from the plant to the stack. Low point drains from these pipes also run underground to the Radwaste Building.

Maintenance Machine Shop

The maintenance machine shop is where components from within the RCA are serviced and repaired. The shop is located in the south end of the Turbine Building and contains equipment normally associated with a well-equipped machine shop. The shop is part of the RCA and contains the radioactive materials tool crib. When radioactive components are worked on in the shop, a "containment" is established around the work area and is decontaminated after the job is completed.

6.3 Class 3 Buildings and Structures

Class 3 areas may have measurable concentrations of radioactive contamination, but if present, it is presumed to be at levels that are a small fraction of the DCGLs. The major buildings and structures presumed to be Class 3 are listed below. Additional smaller buildings presumed to be Class 3 are listed in Table 2.

Control Building

The Control Building contains the control room from which the turbine, reactor and associated ancillary systems are operated. The building also houses the cable vault and the two switch gear rooms.

South Warehouse

The South Warehouse is located inside the Protected Area and is used to store drums of virgin lubricants and motor oils. Radioactive material was never used or stored in the facility.

Construction Office Building

The Construction Office Building is located inside the Protected Area and contains offices and a cafeteria for plant workers. Radioactive material was never used or stored in this facility.

Cooling Towers

The Cooling Towers (2) are located outside of the Protected Area. They include the pipes, fans, baffles and collection pools that comprise a system for cooling the circulating water from the plant main condenser. Trace amounts of radioactive material

generated by the plant have been measured in the silt collected from the deep basin of the west cooling tower. Therefore, there is the potential that areas of the system where silt may collect may also contain trace amounts of radioactive material.

Intake Structure

The Intake Structure is located at the northeast corner of the Protected Area and draws cooling water from the Connecticut River through the Circulation Water Bay for use in the Circulation Water System that cools the plant main condenser. The structure also houses the Service Water pumps, the Fire pumps and the Radioactive Waste dilution pumps. These pumps draw water from the Service Water Bay to supply their associated systems. The Radioactive Waste dilution pumps were used infrequently early in the life of the station and then not used after 1981. Trace amounts of radioactive material generated by the plant have been measured in silt in the river bed upstream of the intake structure near the North Storm Drain outfall. Therefore, there is the potential that the Circulation Water Bay and the Service Water Bay may accumulate silt that contains trace amounts of this same activity.

Discharge Structure

The Discharge Structure is located immediately outside of the southeast corner of the Protected Area and discharges cooling water that has passed through the plant main condenser or the cooling towers. The structure houses the pumps that send water to the cooling towers when operation of the towers is required. Trace amounts of radioactivity that may have collected in these systems have been detected in the river silt near the Discharge Structure.

7.0 Soil and Groundwater Impacts

As a result of site operations, soil and groundwater have been impacted by spills, leaks and plant activities. In accordance with the requirements of the NRC Decommissioning Planning Rule (DPR), licensees of operating facilities are required to minimize contamination and generation of radioactive waste, conduct appropriate radiological surveys including of the subsurface, maintain records of residual radioactivity, and provide adequate funding to complete decommissioning. Specific guidance is contained in Regulatory Guide 4.22, “Decommissioning Planning During Operations” (Reference 7). VYNPS has been satisfying the intent of the requirements including implementation of the Groundwater Protection Initiative (GPI) for subsurface monitoring.

7.1 Impacted Site Soil

Impacted soil areas are have been categorized as:

- Storm Drain Systems
- Septic Systems
- Underground Pipes

- Surface soil areas

The following sections have summarized some of the information gathered from the review of plant records. Table 1 contains a summary of impacted soil areas on site at the time this HSA was developed and their preliminary classifications.

7.1.1 Class 1 Areas- Areas of Potentially Elevated Residual Radioactivity

- Soil outside of a pipe trench in the vicinity of the Augmented Off-Gas (AOG) Building became contaminated due to a pipe leak identified in January 2010. The area between the Maintenance Shop and the AOG Building was excavated and the leak was stopped. Approximately 85 cubic yards of soil was removed as part of the remediation. The two drains lines that were leaking were isolated and abandoned following the installation of new lines. The excavated area was backfilled with flowable concrete material and clean soil from an off-site source. The groundwater was also impacted and is discussed in section 7.2. Additional information on this event can be found in Item # 7, Table 1.
- In 1991, a leak was discovered in the drain line from the chemistry lab sinks to the chemical drain tank in the Radwaste Building. This leak contaminated the soil under the concrete floor of the lab. Soil borings were analyzed and results indicated the presence of radiological contamination. This area has been designated as an approved on-site waste disposal area under the the requirements of NRC regulation 10 CFR 20.2002. The groundwater surface in this area of the station is below the bedrock surface and the soil between the lab floor and the underlying bedrock is not saturated, as evidenced by the fact that no groundwater entered a monitoring well installed at the location of the leak. Additional information on this event can be found in Item# 8 of Table 1.
- Soil adjacent to the Northeast side of the Radwaste Building was contaminated by build-up of low level radioactivity associated with activities to package expended resin for transport to a disposal facility. The contaminated soil nearest the cask room doors was analyzed for levels of radioactivity and subsequently excavated, backfilled, and sealed with asphalt in August 1987. Further sampling of this area to better characterize the extent of soil contamination performed in May of 1988, indicated the presence of contamination at levels lower than those found in 1987. Therefore, no additional soil was removed. A pathway dose assessment of this area was completed. The contaminated soil is not a concern for on-site or off-site doses. Additional sampling was performed at the boundaries of this area in 1999 and results indicate the contamination has not spread beyond the original identified boundary. Additional information on this event can be found in Item# 14 of Table 1.
- In 1976, 83,000 gallons of CST water was released to the Connecticut River from an overflow pipe over a 2-day period via electrical conduit from the Condensate Storage Tank Moat, which eventually flowed to the South Storm Drain System. This was documented in NRC Report No: RO-76-22/1T. In addition, in 1986 a leak was discovered in the bottom of the tank that had saturated the sand layer

between the tank bottom and the underlying concrete support structure. Additional information on this event can be found in Item# 35 of Table 1.

- North and South Storm Drain Systems, Outfall and River Sediments- During the early years of operation, the Turbine and Admin Building Heating, Ventilation and Air Conditioning (HVAC) exhausts went to the roof vents. Contamination accumulated over time on the roofs and in other areas of the site and through weathering, migrated via runoff to the storm drain systems. Tritium was detected intermittently in manholes and a discrete particle of Co-60 was detected in the silt in the river near the area of the North Storm Drain outfall. The Turbine Building and Admin exhausts were redirected to the plant stack in 1993. River sediment sampling is conducted two times a year in accordance with the ODCM and the ongoing Radiological Environmental Monitoring Program (REMP) to ensure the safety of the public and to protect the environment. Information on the storm drain system contamination is included in the Annual Radiological Environmental Operating Report. Additional information on this condition can be found in Items #1, 2, 3 and 4 of Table 1.

7.1.2 Class 2 Areas- Areas that Have Been Known to Contain Residual Radioactivity

- In 1983, a pile of contaminated sand-blasting media was discovered near the south side of the North Warehouse. This material had been generated during maintenance work associated with a previous refueling outage. The material was discovered on an unpaved portion of the Protected Area. The media was packaged and disposed of as radioactive waste. The affected area was excavated and all contaminated soil was disposed of as radioactive waste. Subsequent samples collected in this area have shown only trace amounts of radioactivity. Additional information on this event can be found in Item# 16 of Table 1.
- The cask loading activities impacting the soil adjacent to the Radwaste Building described in Section 7.1.1 have resulted in low level contamination migrating to an area adjacent to the Intake structure. Additional information on this event can be found in Item# 15 of Table 1.
- Storage and handling of radioactive materials in the North Warehouse resulted in low level contamination of the surface soil adjacent to the North Warehouse. Additional information on this event can be found in Items# 17 and 18 of Table 1.
- In June 1988, plant septage was found to contain low levels of Co-60 and Cs-137. All off-site septage shipments were halted immediately. The issue of residual contamination in septic tanks and leach fields is not unique to VYPNS; this is a recognized industry-wide concern prompting issue of NRC Bulletin 80-10 (contamination of a nonradioactive system). VYNPS submitted a 10 CFR 20.302 application (now 10 CFR 20.2002) to the NRC which was approved on 8/30/89. These regulations pertain to a method for obtaining NRC approval for a proposed disposal method. The application and approval to spread the septage on the North and South Application Fields are in Appendix B of the ODCM; to date only

the South Application Field has been used. When the septic tanks are pumped the sludge is sampled, analyzed and spread in the South Field Application Area. Additional information on this event can be found in Item# 5 of Table 1.

7.1.3 Class 3 Areas- Areas of Potential Residual Radioactivity

- The area between the Cooling Towers has been used for temporary storage of silt removed from the Deep Basin of the West Cooling Tower and soil excavated during modification of the Protected Area. This material was spread in the South Field Application Area in accordance with an NRC approved 10 CFR 20.2002 application. Additional information on this condition can be found in Item# 60 of Table 1.
- The soil area north of the main parking lot was previously used to store contaminated asbestos and snow was routinely piled in this area from plowing the Protected and Owner Controlled Area parking lots. Low levels of contamination may have accumulated in this area. Additional information on this condition can be found in Item # 63 of Table 1.
- Wood scraps were burned on-site during the late 1970s in the North parking lot. The material was surveyed and released from the plant using monitoring techniques that were in accordance with industry standards at the time. These monitoring techniques may have resulted in release of trace amounts of radioactive material which was concentrated in the burn process resulting in measurable low levels of contamination in the burn area. Sampling was completed in this area in 2001 and a monitoring well was installed. The area was also sampled and remediated during construction of the new VELCO substation and adjacent parking lot. Additional information on this condition can be found in Item # 64 of Table 1.
- The Spray Pond is located south of the Protected Area, north of the Cooling Towers. Since December 2004, silt removed from the West Cooling Tower Deep Basin that contains trace amounts of radioactivity is temporarily stored in the spray pond before being spread in the South Field Application Area. Additional information on this condition can be found in Item # 61 of Table 1.
- In 1993, low levels of contamination were found in the silt removed from the deep basin under the West Cooling Tower. The source of the silt is cooling water withdrawn from the Connecticut River. Every 18 months, the Deep Basin is inspected and if necessary, additional silt is removed. VYNPS submitted an amendment to the 10 CFR 20.2002 application for spreading of septic sludge, to also allow spreading of the cooling tower silt on the same 2-acre South Field Application Area where the septic sludge is spread. That amended application was approved by the NRC on 6/18/97. Additional information on this event can be found in Item# 58 of Table 1.
- Currently there are a number of septic systems serving the various buildings in the Protected and Owner Controlled Areas that collect waste from the lavatories, showers, kitchens and janitorial facilities. The associated leach fields receive the liquid portions from the septic tanks. Groundwater from monitoring wells in each

leach field and effluent are sampled and analyzed for tritium and gamma-emitting radionuclides semiannually. No radioactivity has been detected in these samples. However, when the septic tanks are pumped, the sludge is sampled, analyzed and spread in the South Field Application Area in accordance with the NRC approved 10 CFR 20.2002 application as discussed in Item #5 of Table 1. Additional information on septic leach fields can be found in Item #6 of Table 1.

7.2 Groundwater Monitoring (Radiological and Non-radiological)

7.2.1 Groundwater Monitoring Programs

Groundwater monitoring programs have been developed to meet various regulatory guidance and permit requirements. The key programs include:

- Groundwater Protection Initiative in accordance with Nuclear Energy Institute's (NEI 07-07) (Reference 9); the program is currently designed for operating plants.
- The Radiological Environmental Monitoring Program (REMP) monitors groundwater used for drinking water.
- Groundwater monitoring to meet permit requirements for the septic tank sludge and septic leach field permits.

After VYNPS ceases operation, the technical bases of the groundwater monitoring programs will continue to be evaluated throughout the phases of decommissioning to ensure groundwater monitoring is commensurate with the activities and conditions of the station.

VYNPS implemented NEI 07-07 as part of a fleet-wide effort to comply with the Groundwater Protection Initiative (GPI). This program was first implemented in November 2007 when three monitoring wells were drilled at locations along the eastern boundary of the site to screen for the presence of radionuclides in groundwater down gradient from the plant. Tritium was detected in a groundwater sample collected in November 2009 from one of these wells. A comprehensive hydrogeological investigation was commenced in January 2010 to determine the source, fate and transport of the tritium. Twenty nine (29) additional groundwater monitoring wells were drilled at the site during that investigation to characterize the hydrogeological flow domain and allow collection of groundwater samples.

In addition to groundwater from the 31 monitoring wells routinely sampled as part of the Groundwater Protection Initiative (NEI 07-07), groundwater from other wells is sampled as part of the VYNPS Radiological Environmental Monitoring Program (REMP). These wells include two on-site potable water wells producing drinking water from the bedrock aquifer west of the protected area. A third well, the Southwest Well, also taps into the bedrock aquifer but is no longer used as a potable water well. Water from the Southwest Well is also sampled quarterly in compliance with the Vermont Yankee Offsite Dose Calculation Manual (ODCM).

Septic tank sludge (septage) is periodically land spread in the South Field Application Area in accordance with a Vermont Agency of Natural Resources (VANR) permit for residuals management and an NRC septage spreading permit under federal regulation 10 CFR 20.2002, as outlined in Appendix B of the VY Off-Site Dose Calculation Manual (ODCM). Four shallow wells, located adjacent to the South Field Application Area are sampled quarterly for gross beta activity, gamma-emitting radionuclides and tritium. No plant-generated radionuclides have ever been found in the samples from these wells.

Groundwater from approximately 21 shallow monitoring wells distributed within six septic leach field areas located in various parts of the plant and septic system effluent from the three systems within the Protected Area are sampled semi-annually. The samples are analysed by a contract laboratory for indicators of biological impacts, including E. coli, chloride, nitrate, sulfate, phosphorus and pH, in accordance with the VYNPS Indirect Discharge Permit issued by the Vermont Agency of Natural Resources. The sample results from each location are in compliance with the permit requirements. Although not required by the permit, groundwater and effluent samples are analyzed for radioactivity by the VYNPS on-site Chemistry Laboratory before shipment off-site for analysis by the contract lab. No plant-generated radionuclides have ever been found in the samples from these wells.

7.2.2 Summary of Groundwater Impacts

The known impacts to groundwater at VYNPS can be summarized as follows:

- Tritium is the only plant-generated radionuclide detected in groundwater at the site. In 2010, a comprehensive hydro-geologic investigation of the site was completed and found tritium in shallow groundwater extending approximately 400 feet down-gradient from the source at the AOG Building pipe chase to the Connecticut River. The width of the tritium plume increases from approximately 100 feet at the source area to approximately 300 feet along the bank of the river. Tritium concentrations in the shallow sand aquifer have rapidly decreased at the source area from approximately 2,500,000 pCi/L in February 2010 when the leak was terminated to less than 2,000 pCi/L in April 2010. Similar attenuation has also occurred within the shallow plume down-gradient of the source, as the center of the residual contaminant mass migrates to the east. Attenuation is occurring at a slower rate in a deeper silt sand aquifer and an intervening silt aquifer where the hydraulic conductivities and related seepage rates are lower.
- No tritium, gamma-emitting or hard-to-detect radionuclides have been identified in groundwater from any wells in other areas of the plant, including the drinking water wells located west of the Turbine Building, the REMP wells and the wells in the six septic system leach field areas. The one exception

is the Construction Office Building (COB) well located at the northeast corner of the COB and within the area of the tritium plume. The COB well was one of four drinking water supply wells for the plant that produce water from the bedrock aquifer. Low levels (approximately 2,000 picocuries/liter) of tritium were detected in the COB well during the investigation of the leak from the AOG Building pipe chase however; this test was deemed invalid due to the test conditions resulting in shallow groundwater being pulled down into the COB bedrock well. The COB well has since been permanently abandoned and filled with a cement grout to reduce the potential for drawing tritium into the bedrock aquifer.

- No non-radiological impacts to groundwater related to the permitted disposal of sanitary wastewater in on-site septic system leach fields or spreading of septic system sludge in the South Land Application Area have been detected by groundwater monitoring in these areas. No data points are available to evaluate the impact to groundwater (if any) that may have resulted from the leak in the chemistry laboratory sink drain discovered in 1991, or from fires at the Main Transformer (in 2004) and the Auxiliary Transformer (in 1973) that released transformer oil on the ground beyond their containment structures.

- Non-radioactive contamination of groundwater was identified in 1994 when the 5,000-gallon underground storage tank containing fuel oil for the house heating boiler was found to be leaking and was removed. Free-phase fuel oil was detected in 2 of 9 monitoring wells installed during the investigation and remediation of the leak. A buried fill pipe for the 5,000-gallon tank that runs more than 200 feet from the fuel oil pump room near the 75,000-gallon main fuel oil storage tank failed a tightness test after the tank was removed. The fill pipe was blanked off but not removed because overlying buildings made it inaccessible. In 2008 the Vermont Department of Environmental Conservation issued a finding of “site management activities complete” regarding the tank leak, although low levels of fuel oil constituents and solvents were still detectable in nearby monitoring wells. The source of the solvents was likely a dry cleaning operation formerly located in the nearby Turbine Building truck bay during the mid-1980s. Impacts to soil beneath the Turbine Building truck bay or along the buried fuel oil fill pipe that were not investigated because these areas are effectively inaccessible.

- It should be noted that the four underground storage tanks containing fuel oil or diesel fuel that are currently on site are double-walled, with electronic interstitial leak monitoring. The above-ground tanks storing petroleum products are either double-walled or within concrete containment

structures. Similarly, transformers with large oil capacities are located within concrete containment structures or are on concrete pads with a perimeter concrete berm. These design features reduce the likelihood of groundwater contamination caused by a release from these transformers.

8.0 Summary and Conclusions

The radiological historical site assessment was completed in accordance with the guidance provided in NUREG-1575 (MARSSIM). As expected, operational activities at VYNPS have resulted in areas that have been impacted with radiological contaminants. Events and conditions that resulted in radioactive contaminants being deposited in locations outside of buildings and structures are attributed to spills, leaks, effluent releases and build up over time of residual contamination that could not be detected by monitoring methods in use at the time. No impacted areas were identified that were not previously known or documented.

Events and conditions were investigated upon discovery and appropriate actions taken to terminate/secure the leaks or stabilize and/or eliminate the condition. Remediation was initiated if required to prevent migration of contamination and minimize impact to the environment. No identified areas of radiological contamination are a current or expected threat to human health, the environment, or appear to present a significant challenge for decommissioning.

The dominant plant-related radioactive contaminants identified in the Protected and Owner-Controlled areas are cobalt-60 (Co-60), cesium-137 (Cs-137) and tritium (H-3). Additional radionuclides such as manganese-54 (Mn-54), zinc-65 (Zn-65), iron-55 (Fe-55), cesium-134 (Cs-134) and strontium-90 (Sr-90) were identified in samples collected at the Northeast side of the Radwaste Building and from soil borings beneath the chemistry lab sinks.

Areas designated as non-impacted include the Plant Support Building (PSB), the power up-rate building (PUB), several smaller ancillary buildings within the Owner Controlled Area and the Entergy-owned property outside the Owner Controlled Area.

Impacted areas include buildings and structures, soil and groundwater. The locations of the impacted areas are confined to the Protected and Owner Controlled Areas. All areas and structures have been given a preliminary classification based on available radiological characterization data, knowledge of historical site operations and results of personnel interviews.

Buildings, structures, systems and components associated with nuclear power operations and handling of related radioactive material that are located within the Radiologically Controlled Area (RCA) are designated as Class 1 areas. This includes buildings such as Reactor, Turbine, Radwaste, Condensate Storage Tank and

associated structure, parts of the Service Building, Containment Access and Augmented Off-Gas Buildings.

In Class 2 buildings and structures, the potential for residual contamination exists. Buildings and structures designated as Class 2 include the North Warehouse, Plant Stack and Maintenance Machine Shop. The potential for low levels of residual contamination may exist in Class 3 areas. The classification of Class 3 buildings and structures include the Control Building, South Warehouse, Construction Office Building, Cooling Towers and the Intake and Discharge Structures.

As a result of plant operations, soil has been impacted by spills, leaks and plant activities. Categories of impacted soil areas include:

- Storm drain system
- Septic system
- Underground pipes
- Surface soil areas

Impacted soil (environmental) areas that are outside of buildings and structures and are designated as Class 1 include:

- Underground pipe leak at AOG Building
- Buildup of contamination on the Northeast side of the Radwaste Building (contaminated soil near cask room doors)
- Chemistry lab drain line leak (10 CFR 20.2002 NRC approved disposal in place)
- Condensate Storage Tank spill and tank bottom leak
- North and South Storm Drain Systems, Outfall and River Sediments accumulation of building roof and site runoff

Areas that have been known to contain residual radioactivity are designated as Class 2; examples of Class 2 soil areas include:

- Concentration of low levels of contamination in septic system sludge (10 CFR 20.2002 NRC approved disposal in South Field Application Area)
- Sand blast media from maintenance work near the south side of the North Warehouse
- Cask loading activities impacting soil adjacent to the Radwaste Building
- Storage and handling of radioactive materials impacting surface soil adjacent to the North Warehouse

Areas of potential residual radioactivity are designated as Class 3; examples of Class 3 soil areas include:

- Septic leach fields and tanks
- Cooling tower silt and temporary storage areas (10 CFR 20.2003 NRC approved disposal of cooling tower silt in South Field Application Area)
- Former burn area for wood scraps
- Former storage area for asbestos and plowed snow

Groundwater monitoring programs in place to meet regulatory guidance and permit requirements has detected tritium resulting from the underground leaking pipe in the pipe trench located near the AOG building. No plant generated radionuclides have ever been detected in groundwater samples from the South Field Application Area (10 CFR 20.2002 licensed disposal area for septic sludge and soil) or within the septic leach field areas.

9.0 References

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3. Site Characterization Data Report for the Vernon/Vermont Yankee Site, Battelle; Hanson, Shannon and Wilson, Inc.; and Wagner, Heindel and Noyes, Inc., November 1991
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5. Hydrogeologic Investigation of Tritium in Groundwater, Vermont Yankee Nuclear Power Station, GZA GeoEnvironmental, Inc., May 2011
6. NUREG – 1575, Rev 1, “Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)”, U.S. Nuclear Regulatory Commission, U.S. Environmental Protection Agency, U.S. Department of Energy, and U.S. Department of Defense, August, 2000
7. Regulatory Guide 4.22, “Decommissioning Planning During Operation”, U.S. Nuclear Regulatory Commission, December 2012
8. Determination and Application of Background Cesium-137 Concentrations to Various VYNPS Soils and Sediments, Duke Engineering & Services, March 31, 1999
9. NEI 07-07, Industry Groundwater Protection Initiative-Final Guidance Document, Nuclear Energy Institute, August, 2007
10. BVY 97-101, Report to the NRC and the Vermont Department of Health of detection of a Co-60 hot particle at the North Storm Drain Outfall
11. BVY 10-039, Report to the NRC and the Vermont Department of Health of the tritium leak at the AOG pipe chase

Table 1 Summary of Radiological Conditions of Interest

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
Storm Drain Systems					
1	North Storm Drain System	2 / A-1	The system was sampled extensively in 1993. Two manholes, 11E and 11F, were sampled monthly for sediment analyses. Tritium was detected intermittently. The tritium was condensed from the air in the Turbine and Administration Buildings. HVAC exhaust from these buildings was redirected to the plant stack in late 1993. Manholes MH-12A (North Storm Drain) and 14 (South Storm Drain) are sampled monthly for tritium but none has been detected since redirection of the HVAC exhaust. Starting in September 2001 most manholes are inaccessible because they have been welded shut due to security concerns. Extensive sampling of the storm drain systems was done in the summer of 1999. VYNPS has completed an evaluation pursuant to 10 CFR 50.59 (a regulation controlling changes, tests and experiments by nuclear plant licensees) on both the North and South Storm Drain Systems. Information on the storm drain system contamination is included in the Annual Radiological Environmental Operating Report.	1	Detection of a discrete particle of Co-60 in the silt in the river near the area of the North Storm Drain outfall.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
2	North Storm Drain Outfall and River Sediments	2 / A-2 and A-3	A sample in 1997 contained a discrete particle of Co-60 of 3,820 pCi. This detection was reported to the NRC in BVY 97-101(Reference 10). The source of the particle was likely washout of the Turbine Building HVAC exhaust that formerly discharged to the Turbine Building roof but was redirected to the Plant Stack in late 1993. The roof was replaced in the early 2006. Samples of river sediment are collected from an area along the shoreline 80 ft by 160 ft. This sampling is done two times per year as required by the VYNPS ODCM. Recent sampling results are only showing trace levels of Cs-137 and sporadic low level detections of Co-60. A dose assessment of the Co-60 particle concluded that this area poses no risk to human health, as reported in BVY 97-101. The ongoing radiological environmental monitoring program (REMP) is designed to detect and monitor any buildup of radioactivity in the environment from plant activities.	2	Detection of a discrete particle of Co-60 in the silt in the river near the area of the North Storm Drain outfall.
3	South Storm Drain System	2 / A-4	The system was sampled extensively in 1993. Tritium is detected sporadically in the South Storm Drain System. MH-14 is currently sampled weekly for tritium. There was one positive tritium value in 1998 (900 pCi/l) in MH-14. All other samples were <700 pCi/l. This is a recognized NRC Bulletin 80-10 issue (contamination of a nonradioactive system). Extensive sampling of the storm drain systems was done during the summer of 1999. VYNPS has completed an evaluation pursuant to 10 CFR 50.59 (a regulation controlling changes, tests and experiments by nuclear plant licensees) on both the North and South Storm Drain Systems. Information on the storm drain system contamination is included in the Annual Radiological Environmental Operating Report.	1	This system receives much of the storm water from the station power block and MH-12 receives storm water from the Radwaste Cask Loading Area.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
4	Manhole 12	2 / A-4	Manhole 12 is in the South Storm Drain System and is close to the Radwaste Cask Loading Area (A-5 on Figure 2). The sediment is sampled monthly. Typically, there is very little sediment available for sampling. Monitoring of this manhole began in February 1988.	1	Proximity to the Radwaste Cask Loading Area.
Septic Systems					
5	Septic System Sludge	3 / B-1	In June 1988, VY determined that the plant septage contained Co-60 and Cs-137. All off-site septage shipments were halted immediately. This is a recognized NRC Bulletin 80-10 issue (contamination of a nonradioactive system). VYNPS submitted a 10 CFR 20.302 application (now 10 CFR 20.2002) to the NRC which was approved on 8/30/89. 10 CFR 20.302 has been superseded by 10 CFR 20.2002. Both regulations pertain to a method for obtaining NRC approval for a proposed disposal method. The application and approval to spread the septage on the North and South Application Fields are in Appendix B of the ODCM. The material is spread only on the 2-acre South Field Application Area. Sampling data demonstrate that the concentrations of radioactive material spread are well below the criteria specified in the permit for the activity. No septage or other contaminated material has ever been spread on the North Field Application Area. Most of the North Field is now within the perimeter of the new VELCO substation.	2	Sampling data demonstrate only low levels of radioactive material but the sludge application area warrants further characterization.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
6	Septic Leach Fields and Tanks	3 / B-3	Groundwater from monitoring wells in each leach field and liquid effluent from septic tanks are sampled and analyzed for tritium and gamma-emitting radionuclides semiannually in accordance with the indirect discharge permit. No radioactivity above background has been detected in the effluent or groundwater samples. The leach fields and septic tanks will be evaluated for potential contamination at the time of decommissioning. This is a recognized NRC Bulletin 80-10 issue (contamination of a nonradioactive system). The septic systems will continue to be operated according to plant procedures through the decommissioning process.	3	Low potential for residual contamination exists.
Underground Pipes					
7	Underground pipe chase (trench) located between AOG Building and Turbine Building	1 / B5	Tritium was detected in a groundwater sample collected in November 2009. An investigation was initiated to determine the source of the tritium. A leak was determined to be coming from pipes within an underground pipe chase (pipe trench) located between the Turbine Building and the AOG Building. The area of the leak was excavated and the leak was stopped. The two drain lines that were leaking were isolated and new accessible lines were installed during refueling outage RFO-28. A groundwater extraction well was installed and pumped for several months to remove tritium from the aquifer. Natural attenuation of the tritium is continuing as of July 2014 and concentrations in groundwater continue to decrease. As of July 2014, no groundwater samples contain tritium at concentrations greater than the drinking water standard of 20,000 pCi/l. No tritium above background has been detected in the river. A dose assessment for tritium has been performed and it has	1	Potential residual contamination in inaccessible areas.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
			been concluded that these levels of tritium pose no risk to human health or the environment. The incident has been reported to the NRC and state of Vermont (BVY 10-039)(Reference 11). Residual contamination may exist in inaccessible areas and will be characterized and remediated to the extent necessary during decommissioning.		
8	Chemistry Lab Drain Line and RCA portion of Service Building	2 / A-6	In 1991, a leak was discovered in the subfloor drain line from the chemistry lab sinks to the chemical drain tank in the Radwaste Building. This leak was to the soil under the concrete floor of the lab. The groundwater surface in this area of the station is below the bedrock surface and the soil between the lab floor and the underlying bedrock is not saturated, as evidenced by the fact that no groundwater entered a monitoring well installed at the location of the leak. This finding suggests that any residual contamination that may remain in the soil in the vicinity of the leak is not mobile. VYNPS submitted a 10 CFR 20.2002 application (a method for obtaining NRC approval for a proposed disposal method) to the NRC to allow the contamination to remain in place. The application was approved on 7/10/92. The application and approval are in Appendix E of the ODCM. The area of the leak will be further characterized and remediated if required when it becomes accessible during decommissioning.	1	Potential residual contamination in inaccessible areas.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
9	House Heating Boiler Room Drain Line to and including Oil Separator Pit 'B'	2 / C-101	Contamination of Oil Separator Pit 'B', which formerly drained to the South Storm Drain System, was discovered in 1993. Corrective actions at that time were to secure the discharge flow path from Oil Separator Pit 'B'. The volume of oil is drummed and transported to Radwaste when necessary.	2	Only low levels of radioactive material detected but potential for residual contamination exists.
10	HVAC duct from Plant buildings to the Plant Stack	1 / A5 to B3	All interior air from the primary plant buildings is discharged through the plant stack via this underground 78-inch diameter concrete duct.	2	No indication of contamination but the potential exists for radioactive material to have plated out on the duct.
11	Interim Off Gas (IOG) filters west of the plant stack	3 / B-4	These filters were taken out of service and left in place after less than a year of operation immediately after the plant began operation in 1972. This system was used before the AOG (Augmented Off Gas) system became operational in 1973. There is a potential for residual contamination of the filters because of the possible presence of decay products of the noble gases that the filters were designed to collect. The filters are sealed, underground and have not been sampled. They will be characterized during decommissioning.	2	The potential for residual contamination exists.
12	Underground gaseous effluent lines from the plant to the Stack.	1 / A5 to B3	Gas lines such as the Standby Gas System discharge line, Off Gas hold up line and Gland Seal exhaust line travel underground from the plant to the Stack. Two twenty-foot sections of these lines were excavated and inspected in 2011 and showed no signs of deterioration. These lines have 2-inch drain lines in low points to drain condensation back to the Radwaste Building.	3	Low potential for residual contamination exists.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
13	Plant Stack Sump discharge line from the Stack to the Radwaste Building	1 / B3 to A4	The Stack Sump underground gaseous effluent discharge line from the Stack to the Radwaste Building was identified as a potential source of radioactive material leaking to the environment. The line was capped and abandoned in place. There is no indication of leakage and soil samples in the area between the Stack and the Radwaste Building have been negative for plant generated radioactive isotopes. Condensate that accumulates in the discharge line is collected in a portable tank and taken to the Radwaste Building for treatment.	3	Low potential for residual contamination exists.
Soil					
14	Northeast side of the Radwaste Building	2 / A-5	Contaminated soil nearest the cask room doors was analyzed for levels of activity. The area was subsequently excavated, backfilled and sealed with asphalt in August of 1987. Further sampling of this area to better characterize the extent of soil contamination performed in May of 1988, indicated the presence of contamination at levels lower than those found in 1987. Therefore, no additional soil was removed. A pathway assessment of this area has been completed. The assessment concluded that the contaminated soil is not a risk to human health. Additional sampling was performed at the boundaries of this area in 1999. The sample results indicate that the contamination has not spread significantly. NRC follow item 87-15-02 was closed on 2/26/88 based on the corrective actions taken and a determination that the low levels of activity that were found had no impact on the health and safety of the public or VYNPS personnel. The area will be further characterized during decommissioning.	1	Past history of the area indicates that contamination likely remains.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
15	East of Cask Loading Bay (grassy area by stairs down to the Intake Structure)	2 / C-87	Soils were core-sampled down to 10 inches in 2-inch segments in the end of 1993. The top 2-inch layer of each core was analyzed by gamma spectrometry. In addition, a complete analysis was performed on each of the five layers for each core sample showing greater than the ODCM LLD for sediments for either Co-60 or Cs-137 in the top 2 inch layer. Analysis data is on file. Decision was made to leave in place. The area will be further characterized during decommissioning.	2	The potential for residual contamination exists.
16	Sandblast grit south of the east entrance to the North Warehouse, near manhole MH-11E	2 / A-1	VY personnel discovered a sand blast grit spill in the vicinity of manhole MH-11E on the gravel area between the North Warehouse and the black top roadway (closer to the roadway). The area was excavated and contaminated soil was disposed of as radioactive waste. Subsequent samples in this area have shown only trace amounts of activity. The area will be further characterized when appropriate.	2	The potential for residual contamination exists.
17	East Entrance to the North Warehouse	2 / C-102	Samples were collected on 2/10/99 to characterize the Protected Area. Most of this area was excavated during installation of the ISFSI pad.	2	The potential for residual contamination exists.
18	West Entrance to the North Warehouse	2 / C-103	Samples were collected on 2/10/99 to characterize the Protected Area.	2	The potential for residual contamination exists.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
19	Outside ground surfaces in the Protected Area	2 / A-7, also C 83 - C 91	Surface soils in areas of the Protected Area contain low levels of Co-60 and Cs-137. No levels of contamination higher than those found during the 1999 sampling campaign have been found in recent years. Controls exist to evaluate "dry flowable" material such as soil in the Protected Area to environmental LLD levels to allow for free release. The areas of surface soil contamination are high foot traffic areas and low levels of contamination that are not detectable by portal monitors at the radiologically controlled area (RCA) exits may have been tracked from the RCA to these areas and accumulated over time. These areas are near the power block buildings and may become further contaminated during decommissioning of the power block. The areas of soil contamination will be further characterized after decommissioning of the power block.	3	Potential low levels of residual contamination may exist.
20	West Lawn near sidewalk	2 / C-83	Soils were core-sampled down to 10 inches in 2-inch segments in the end of 1993. The top 2-inch layer of each core was analyzed by gamma spectrometry. In addition, a complete analysis was performed on each of the five layers for each core sample showing greater than the ODCM LLD for sediments for either Co-60 or Cs-137 in the top 2 inch layer. Analysis data is on file. Decision was made to leave in place. The area will be further characterized during decommissioning.	3	Potential low levels of residual contamination may exist. See Item No. (19)
21	West Lawn around former Light Pole	2 / C-84	Soils were core-sampled down to 10 inches in 2-inch segments in the end of 1993. The top 2-inch layer of each core was analyzed by gamma spectrometry. In addition, a complete analysis was performed on each of the five layers for each core sample showing greater than the ODCM LLD for sediments for either Co-60 or Cs-137 in the top 2 inch layer. Analysis data is on file. Decision was made to leave	3	Potential low levels of residual contamination may exist. See Item No. (19)

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
			in place. The area will be further characterized during decommissioning.		
22	Northeast corner of the Clean Workshop	2 / C-85	Soils were core-sampled down to 10 inches in 2-inch segments in the end of 1993. The top 2-inch layer of each core was analyzed by gamma spectrometry. In addition, a complete analysis was performed on each of the five layers for each core sample showing greater than the ODCM LLD for sediments for either Co-60 or Cs-137 in the top 2 inch layer. Analysis data is on file. Decision was made to leave in place. The area will be further characterized during decommissioning.	3	Potential low levels of residual contamination may exist. See Item No. (19)
23	East of RCA (Strip of lawn between the road to the Intake Structure and the Reactor Building)	2 / C-86	Soils were core-sampled down to 10 inches in 2-inch segments in the end of 1993. The top 2-inch layer of each core was analyzed by gamma spectrometry. In addition, a complete analysis was performed on each of the five layers for each core sample showing greater than the ODCM LLD for sediments for either Co-60 or Cs-137 in the top 2 inch layer. Analysis data is on file. Decision was made to leave in place. The area will be further characterized during decommissioning.	3	Potential low levels of residual contamination may exist. See Item No. (19)

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
24	East of the North Warehouse and ISFSI pad area	2 / C-88 2/C-102, 103	Soils were core-sampled down to 10 inches in 2-inch segments in the end of 1993. The top 2-inch layer of each core was analyzed by gamma spectrometry. In addition, a complete analysis was performed on each of the five layers for each core sample showing greater than the ODCM LLD for sediments for either Co-60 or Cs-137 in the top 2 inch layer. Analysis data is on file. Decision was made to leave in place. The area will be further characterized during decommissioning.	3	Potential low levels of residual contamination may exist. See Item No. (19)
24 A	Perimeter around North Warehouse and particularly the north side	2/24A	Waste oil with low levels of radiological contaminants was burned for space heating in the North Warehouse during the period from approximately 1995 to 2011. Unburned particulates may have accumulated on the roof (particularly the north side) and on the ground below the roof drip line. This operation was controlled in accordance with ODCM requirements and was discontinued after 2011	3	Potential low levels of residual contamination may exist.
25	Front of the Admin Building (near the Start-up Transformers)	2 / C-89	Soils were core-sampled down to 10 inches in 2-inch segments in the end of 1993. The top 2-inch layer of each core was analyzed by gamma spectrometry. In addition, a complete analysis was performed on each of the five layers for each core sample showing greater than the ODCM LLD for sediments for either Co-60 or Cs-137 in the top 2 inch layer. Analysis data is on file. Decision was made to leave in place. The area will be further characterized during decommissioning.	3	Potential low levels of residual contamination may exist. See Item No. (19)

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
26	Front of the Administration Building (along the sidewalk)	2 / C-91	Soils were core-sampled down to 10 inches in 2-inch segments in the end of 1993. The top 2-inch layer of each core was analyzed by gamma spectrometry. In addition, a complete analysis was performed on each of the five layers for each core sample showing greater than the ODCM LLD for sediments for either Co-60 or Cs-137 in the top 2 inch layer. Analysis data is on file. Decision was made to leave in place. The area will be further characterized during decommissioning.	3	Potential low levels of residual contamination may exist. See Item No. (19)
27	Northwest Corner of the Protected Area	2 / C-90	Soils were core-sampled down to 10 inches in 2-inch segments in the end of 1993. The top 2-inch layer of each core was analyzed by gamma spectrometry. In addition, a complete analysis was performed on each of the five layers for each core sample showing greater than the ODCM LLD for sediments for either Co-60 or Cs-137 in the top 2 inch layer. Analysis data is on file. Decision was made to leave in place. The area will be further characterized during decommissioning.	3	Potential low levels of residual contamination may exist. See Item No. (19)
Buildings and Structures Inside the Protected Area					
28	Reactor Building and Drywell	1 / A4 and A5, & B4 and B5	The Reactor Building and Drywell house the reactor and all of the supporting pumps, pipes and demineralizers associated with the operation of a nuclear reactor. The Spent Fuel Pool is also located in the Reactor Building. The piping, coolers and pumps required to support the Spent Fuel Pool are also located in the Reactor building. Most of the radioactive material at the station is located in the Drywell and Reactor Building.	1	Potential for significant levels of contamination.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
29	Radioactive Waste Building	1 / A4 and B4	The Radioactive Waste Building houses the tanks, piping and filters required for processing radioactive water at the facility. It also houses the filters for maintaining the Spent Fuel Pool water chemistry. The amount of radioactive material in the building is significant.	1	Potential for significant levels of contamination.
30	Radwaste tanks, Moat, trench, sump and associated piping	1 / A4	These tanks are used on a regular basis to process contaminated water that is returned to the facility during plant operation. Rain water that collects in the moat and sump is pumped to the Radioactive Waste building to be processed with contaminated plant water. The moat area is routinely surveyed for contamination by the plant staff and no contamination has been detected.	1	Potential for contamination in the tanks to exceed DCGLs.
31	Turbine Building (TB)	1 / B4 and B5	The Turbine Building is the largest building on site and extends from the Service Building at the north end to the back of the Maintenance Shop at the south end. The building contains the main turbine and the pumps, demineralizers and associated piping required to operate the turbine. The liquids and gases moving through these systems will leave the systems moderately contaminated after the plant is shut down.	1	Potential for contamination to exceed DCGLs.
32	Turbine Building (TB) Basement	1 / B4 and B5	The Turbine Building Basement is the area in the TB that receives all drainage from the steam, feed and condensate systems. These systems are only slightly contaminated. The TB clean sump identified in Item No. 37 is in the southern end of this basement.	1	Potential for contamination to exceed DCGLs.
33	Containment Access Building (CAB)	1 / A5	The Containment Access Building is a very large building which is used to provide shelter for moving equipment and material in and out of the Reactor Building. Radioactive material stored in the building is sealed so as to prevent the spread of contamination. Occasionally, large quantities of radioactive material, including new and spent fuel assemblies, are moved through this building.	1	Potential for contamination to exceed DCGLs.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
34	Advanced Off-Gas (AOG) Building	1 / A5 and B5	The Advanced Off-Gas Building contains the recombiners, a dryer skid, two guard bed charcoal filters, the main hold-up charcoal filters and all of the associated piping. When the plant is shut down, there will be very little residual radioactive material left in the system, except for the charcoal beds. Once the charcoal is removed, there should be only trace amounts of radioactive material remaining.	1	Potential for contamination to exceed DCGLs.
35	Condensate Storage Tank (CST)	2 / C-104	In 1976, 83,000 gallons of CST water was released to the Connecticut River from an overflow pipe over a 2-day period via electrical conduit from the Condensate Storage Tank Moat, which eventually flowed to the South Storm Drain System. This was documented in NRC Report No: RO-76-22/1T. In addition, in 1986 a leak was discovered in the bottom of the tank that had saturated the sand layer between the tank bottom and the underlying concrete support structure. Telltale drains are embedded within the sand layer. The leak was evidenced by water from the telltale drains in the CST ante-room. The bottom of the tank was replaced with new aluminum plates and the leak was curtailed. All of the leakage from the tank was returned to the Radwaste Building via the floor drains in the CST Moat area.	1	Potential for contamination to exceed DCGLs.
36	CST Building	1 / B5	The CST Building is a portion of the CST Moat that is enclosed and has a roof to shelter some of the instrumentation and electrical equipment associated with the operation of the CST. See Item No. 35 for additional information relating to the tank overflow that occurred in 1976 and the tank leak in 1986.	1	Potential for contamination to exceed DCGLs.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
37	Turbine Building Clean Sump	2 / C-100	The sump was contaminated by the overflow of the Condensate Demineralizer Backwash Receiving Tank on 8/14/92. The overflow resulted in release of a small amount of radioactive contamination to the Service Water System and thence to the Connecticut River. This sump has been protected with a berm so that this incident cannot be repeated. Operation procedures were enhanced to reduce the possibility of an overflow of the Condensate Demineralizer Backwash Receiving Tank. Very small amounts of Co-60 were identified in the sump water in March of 1999. As a result, the procedure for monitoring this water has been enhanced to include a more frequent isotopic analysis. Results are reported in the Annual Environmental Radiological Operating Report. The releases were assessed for dose consequence. Reports were made to the State of Vermont and the NRC.	2	The potential for residual contamination exists.
38	Maintenance Machine Shop	1 / B5	Tools and small items with limited fixed radioactive material are stored here. On occasion a temporary RCA / containment area was set up in the shop to work on contaminated components. When these jobs were completed, the containment area was decontaminated. There is the potential that trace levels of contamination may have accumulated in this shop.	2	The potential for residual contamination exists.
39	North Warehouse	1 / B4	This building is a RCRA hazardous waste storage area and has been used to store containers of radioactive waste awaiting shipment. The building has a concrete slab floor with an approximately six-inch high berm around the perimeter of the building. Current plans call for this building to be removed to allow construction of an addition to the ISFSI pad. In 1995 a drum of mixed waste in the building was found to be leaking. The drum was overpacked, and the area of the spill was cleaned up. Floor drains that used	2	The potential for residual contamination exists.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
			to go to Radwaste are now plugged with concrete.		
40	Service Building and offices (Not including the HP check point and Chemistry lab; see Item No. 8 above)	1 / B4	This building is on the north end of the Turbine Building and contains the Chemistry Laboratory, Decontamination Showers and the Health Physics (HP) check point. The lab drain identified in Item No. 8 above is located in the lower level of this building. The remainder of the building contains primarily offices. The check point is the entry way into the RCA. The lab and decontamination showers are inside the RCA.	2	There is the potential that very low levels of contamination below what can be detected in the portal monitors at the RCA exits may have been tracked into the building by workers leaving the RCA and accumulated over time.
41	Control Building	1 / B4	This building contains the Control Room, the Cable Vault and the Switchgear rooms. Radioactive material was not used or stored in this building, but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building.	3	The potential for accumulation of low levels of contamination exists.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
42	Admin Building	1 / B4	The Administration Building is on the north end of the Turbine Building and consists primarily of offices. Radioactive material was not used or stored in this building, but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
43	John Deere Diesel Building	1 / B4	This building is on the north end of the Protected Area. Radioactive material was not used or stored in this building, but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in it. Currently this building is scheduled to be removed to allow expansion of the ISFSI dry fuel storage area.	3	Potential low levels of residual contamination may exist.
44	Construction Office Building (COB)	1 / A5	The Construction Office Building is on the east side of the Turbine Building and consists primarily of offices. Radioactive material was not used or stored in this building, but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
45	Clean Work Shop / Construction Storage Building	1 / A5	The Clean Work Shop is on the southeast corner of the Protected Area and consists primarily of a storage area and locker room. Radioactive material was not used or stored in this building, but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
46	South Warehouse	1 / B5	The South Warehouse is on the south end of the Protected Area and consists primarily of a storage area for virgin and used oils and office space. Radioactive material was not used or stored in this building, but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
47	Tan Building	1 / B5	The Tan Building is a temporary building on the southwest corner of the Protected Area and consists primarily of a storage area and office space. Radioactive material was not used or stored in this building, but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
48	Hydrogen / CO_2 Purge Building	1 / B5	The Hydrogen / CO_2 Purge Building is located on the west side of the Turbine Building and just south of the roll up door. Radioactive material was not used or stored in this facility, but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
49	Intake Structure	1 / A4	The Intake Structure is located in the northeast corner of the Protected Area. Radioactive material was not used or stored in this structure but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building. Trace amounts of radioactivity have been detected in the river silt that may be found in the underwater portions of this structure.	3	Potential low levels of residual contamination may exist.
50	Chemical Addition Building	1 / A4	The Chemical Addition Building is located at the south end of the Intake Structure, near the Connecticut River. Radioactive material was not used or stored in this building but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
51	Nitrogen Storage Facility	1 / A4	The Nitrogen Storage Facility is a tank complex located on the east side of the Reactor Building, between the building and the Connecticut River. Radioactive material was not used or stored in this facility and the potential for any contamination is very low.	3	Potential low levels of residual contamination may exist.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
52	Bottle Storage Shed - North of Control Building	1 / B4	The Bottle Shed is used to store gas bottles. Radioactive material was not used or stored in this shed but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
53	Large Mixed Gases Shed east of South Warehouse	1 / A5	This shed is used to store gas bottles. Radioactive material was not used or stored in this shed but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
54	Propane Storage Shed	1 / B5	This shed was used to store propane gas bottles for forklifts. Radioactive material was not used or stored in this shed but because of its proximity to the power block there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
55	New Warehouse	1 / B5	For many years this facility performed the function of a Shipping and Receiving facility. During these times, some radioactive material was shipped and received in this area. There is a small storage area for Special Nuclear Material in the New Warehouse. There is the potential that trace levels of contamination may have accumulated in this area.	3	Potential low levels of residual contamination may exist.
56	Sumps (all except Item #s: 13, 30 and 37)	1 / A4 to A5 and B4 to B5	Sumps in the plant will be characterized and remediated, if necessary, at the time of decommissioning.	**	**To be determined.
Buildings and Structures Outside the Protected Area					

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
57	Plant Stack	1 / B3	Heating and ventilating exhaust from the major plant buildings is discharged through the Plant Stack. In addition, the Off Gas system, the Standby Gas Treatment System and the Gland Seal Exhauster discharge through the Plant Stack. The Plant Stack sump was addressed in Item No. 13 above. There is the potential that contamination from the air discharged through the stack may have plated out and could result in measurable activity.	2	The potential for accumulation of low levels of contamination exists.
58	West Cooling Tower	3 / B-1	In 1993, low levels of contamination were found in the silt removed from the deep basin under the West Cooling Tower. The source of the silt is cooling water withdrawn from the Connecticut River. The first silt volume removed was 14,000 cu. ft. Every 18 months, the Deep Basin is inspected and if necessary, additional silt is removed. It is estimated that each time the volume removed will be an additional 4,000 cu. ft. VYNPS submitted an amendment to the 10 CFR 20.2002 application for spreading of septic sludge, to also allow spreading of the cooling tower silt on the same 2-acre South Field Application Area where the septic sludge is spread. That amended application was approved by the NRC on 6/18/97. The application and approval are in Appendix F of the ODCM. The silt is sampled, analyzed, spread and monitored in accordance with VYNPS approved procedures, and is spread in the South Field Application Area only if the measured activity is greater than background level. The silt collected as of June 1997 was spread in the fall of 1998, and was last spread on October 19, 2009.	3	Potential low levels of residual contamination may exist in the silt.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
59	East Cooling Tower	1 / B6 and B7	Because river water passes through both the East and West Cooling Towers, there is the potential that low levels of contamination that has been found in silt accumulated in the Deep Basin of the West Cooling Tower also may be found in the shallow basin beneath the East Cooling Tower and the systems associated with this tower. See Item No. (58).	3	Potential low levels of residual contamination may exist in the silt.
60	Area Between Cooling Towers	3 / B-2	This area had been used for temporarily storing silt removed from the Deep Basin of the West Cooling Tower and soil excavated during modification of the Protected Area until it was spread in the South Field Application Area under an amendment to the 10 CFR 20.2002 Exemption Request, which was approved in 1997. A pathway assessment for the temporary placement of the material was completed. The temporarily stored material was removed in December 2004. The area has been sampled and characterized and found to contain no plant related radionuclides.	3	Potential low levels of residual contamination may exist in the silt.
61	Spray Pond	1 / B6	The Spray Pond is located south of the Protected Area, north of the Cooling Towers. Since December 2004, silt removed from the West Cooling Tower Deep Basin that contains trace amounts of radioactivity is temporarily stored in the spray pond before being spread in the South Field Application Area.	3	Potential low levels of residual contamination may exist in the silt.
62	Discharge Structure	1 / A6	The Discharge Structure is located immediately south of the Protected Area adjacent to the Connecticut River. Radioactive material was not used or stored in the structure, but has been measured in the South Storm Drain System that empties into the Discharge Structure and in the river silt collected from the cooling towers.	3	Potential low levels of residual contamination may exist.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
63	Area in northern portion of Owner Controlled Area	3 / B-5	Sampling was conducted in 1999/2001 with one sample indicating low levels of Co-60. Containers of contaminated asbestos were identified in this area in 1984 and was likely removed during the asbestos control program conducted during the mid-1980s. This area was also a former snow lay down area. Much of the area was used for construction of the new VELCO substation in 2009. Soil samples of the area collected for construction of the VELCO substation were all non-detectable for plant-related radionuclides.	3	Potential low levels of residual contamination may exist.
64	Former Burn Area	3 / B-6	VY burned waste wood scraps in this area during the late 1970s. Sampling was completed in 2001 and a monitoring well was installed. The area was also sampled during construction of the new VELCO substation and adjacent parking lot. Sample results from 2009 were non-detectable.	3	Potential low levels of residual contamination may exist.
65	Low-Level radioactive waste storage pad north of the North Warehouse	1 / B3 to A4	This pad was used to store containers with radioactive material awaiting shipment and Sealand containers containing equipment.	2	The potential for residual contamination exists.
66	Turbine Rotor Buildings	1 / C3	The Turbine Rotor Buildings are 4 large temporary buildings on the west border of the Protected Area. These buildings house the original turbine rotors and casings that were replaced in 1995. There should be only trace amounts of radioactive material on this equipment.	3	Potential low levels of residual contamination may exist.

No.	Area	Figure No. / Map Location	Current Condition	Prelim Class (1, 2 or 3)	Justification for Preliminary Classification
67	Haz Mat Storage Building (next to Maintenance Storage Building)	1 / B4	This building is used to store Hazardous Waste and may have stored Mixed Hazardous Waste (waste that is both hazardous and radioactive). Radioactive material was not normally stored or used in this building but there is the potential that trace levels of radioactive contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
68	Shipping and Receiving Building	1 / C7	This building is used for shipping and receiving material from VYNPS. At times, radioactive material has been shipped from or received at this facility. Radioactive material was not normally stored or used in this building but there is the potential that trace levels of radioactive contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
69	Gate House 1	1 / C7	This is the main entrance and security checkpoint for VYNPS. Radioactive material was not used or stored in this building but there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
70	Gate House 2	1 / B4	Radioactive material was not used or stored in this building but there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
71	Gate House 3	1 / A5 and A6 & B5 and B6	Radioactive material was not used or stored in this building but there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.
72	Empty Drum Storage Building	1 / B2	Radioactive material was not used or stored in this building but there is the potential that trace levels of contamination may have accumulated in this building.	3	Potential low levels of residual contamination may exist.

Table 2 Preliminary Classification of the Radiological Status of Plant Buildings, Structures and Site Soil

Impacted						Non-Impacted	
Figure/ Location	Class 1	Figure/ Location	Class 2	Figure/ Location	Class 3	Figure/ Location	
Fig 1 / A4, A5 & B4, B5	Reactor Building (RB)	Fig 1 / B5	Maintenance Machine Shop	Fig 1 / B4	Control Building	Fig 1 / B2	Dog House Building
Fig 1 / B4	Service Building (RCA)	Fig 1 / B4	North Warehouse	Fig 1 / A4	Nitrogen Storage Facility	Fig 1 / B7, B8	Hydrogen Storage Facility
Fig 1 / B4, B5	Turbine Building (TB) Including the basement	Fig 1 / B3	Plant Stack	Fig 1 / B5	South Warehouse	Fig 1 / C2	Met Tower - North
Fig 1 / A4, B4	Radioactive Waste Building (RWB)	Fig 1 A5 to B3	HVAC duct from Plant buildings to the Plant Stack	Fig 1 / B5	New Warehouse	Fig 1 / C5	Met Tower - South
Fig 1 / B5	Condensate Storage Tank and associated structure (CST)	Fig 2 / C-102, C-103	Soil adjacent to the North Warehouse (east and west)	Fig 1 / A5	Construction Office Building (COB)	Fig 1 / C3	Salt Storage Shed
Fig 1 / A5	Containment Access Building (CAB)	Fig 2 / C-87	Surface soil East of Cask Loading Bay	Fig 1 / B4	Bottle Storage Shed - North of Control Building	Fig 1 / B3	SOCA Building - North
Fig 1 / A5, B5	Advanced Off-Gas Building (AOG)	Fig 2 / C-102 and C-103	Surface soil in the vicinity of manhole MH-11E on the gravel area between the North Warehouse and the black top roadway (closer to the roadway	Fig 1 / B6, B7	Cooling Tower 1	Fig 1 / C4	SOCA Building - West
Fig 1 / B5	Soil near underground pipe chase located west of AOG Drain Pit	Fig 3 / B-1	Surface soil in the 2-acre South Field Application Area.	Fig 1 / B6, B7	Cooling Tower 2	Fig 1 / B3	Sally Port - North
Fig 2 / A-6	Soil underneath Chemistry Lab	Fig 1 / B3, B4	Low-Level Radwaste Storage Pad	Fig 1 / A6	Discharge Structure	Fig 1 / C6	Sally Port - South

Impacted						Non-Impacted	
Figure/ Location	Class 1	Figure/ Location	Class 2	Figure/ Location	Class 3	Figure/ Location	
Fig 2 / A-5	Surface soil nearest the cask room doors on the northeast side of the Radwaste Building	Fig 3 / B-1	Septic System Sludge	Fig 1 / A4	Intake Structure	Fig 1 / B3	Domed Building (Maine Yankee Bldg.)
Fig 2 / C-104	Soil under Condensate Storage Tank and associated structure (CST)	Fig 2 / C-101	HHB Room Main Line	Fig 1 / B5	Propane Storage Shed (for forklifts)	Fig 1 / C4	Power Uprate Building (PUB)
Fig 2 / A-1	North Storm Drain System	Fig 2 / A-2 / A-3	North Storm Drain Outfall & River Sediment	Fig 1 / B5	Tan Building (office space)	Fig 1 / B5	Station Black-Out Diesel Building
Fig 2 / A-4	South Storm Drain System	Fig 2 /C-102	Sandblast Grit Area	Fig 1 / B5	Hydrogen / CO2 Purge Building	Fig 1 / C4	Plant Support Building (PSB)
Fig 2 / A-4	Manhole 12	Fig 1 / B4	Service Building Offices	Fig 1 / B2	Empty Drum Storage Building		
Fig 2 / A-5	Northeast Side of Radwaste Building	Fig 2 / C-100	Turbine Building Clean Sump	Fig 1 / C7	Gate House 1		
Fig 1 / A-4	Radwaste Tanks, Moat, etc.	Fig 2/24A	North Warehouse waste oil burn fallout	Fig 1 / B4	Gate House 2		
				Fig 1 / A5, A6 & B5, B6	Gate House 3		
				Fig 1 / A5	Clean Work Shop		
				Fig 1 / B6	Spray Pond		
				Fig 1 / A5	Large mixed gases Shed - (east of South Warehouse)		
				Fig 1 / A4	Chemical Addition Building		

Impacted						Non-Impacted	
Figure/ Location	Class 1	Figure/ Location	Class 2	Figure/ Location	Class 3	Figure/ Location	
				Fig 1 / B4	Admin Building - (North of Turbine Building)		
				Fig 1 / B3 to A4	Stack Sump discharge line from Stack to the Radwaste Building		
				Fig 1 / A5 to B3	Underground gaseous effluent lines from the plant to the Stack		
				Fig 1 / C3	Turbine Rotor Storage Buildings (4)		
				Fig 1 / B3	Haz Mat Storage Building		
				Fig 1 / B4	John Deere Diesel Building		
				Fig 1 / C7	Shipping and Receiving		
				Fig 3 / B-2	Surface soil in the area between the Cooling Towers		
				Fig 3 / B-6	Surface soil in the former wood burning area in the north parking lot		
				Fig 1 / B6	Surface soil in the Spray Pond area		
				Fig 3 / B-1	Silt removed from the deep basin under the West Cooling Tower		
				Fig 3 / B-3	Septic Leach Fields & Tanks		

Impacted						Non-Impacted	
Figure/ Location	Class 1	Figure/ Location	Class 2	Figure/ Location	Class 3	Figure/ Location	
				Fig 3 / B-4	Interior Off-Gas Filters		
				9 Areas	Outside Ground Surfaces in Protected Area		

Figure 1 Preliminary Classification of the Radiological Status of Plant Buildings and Structures

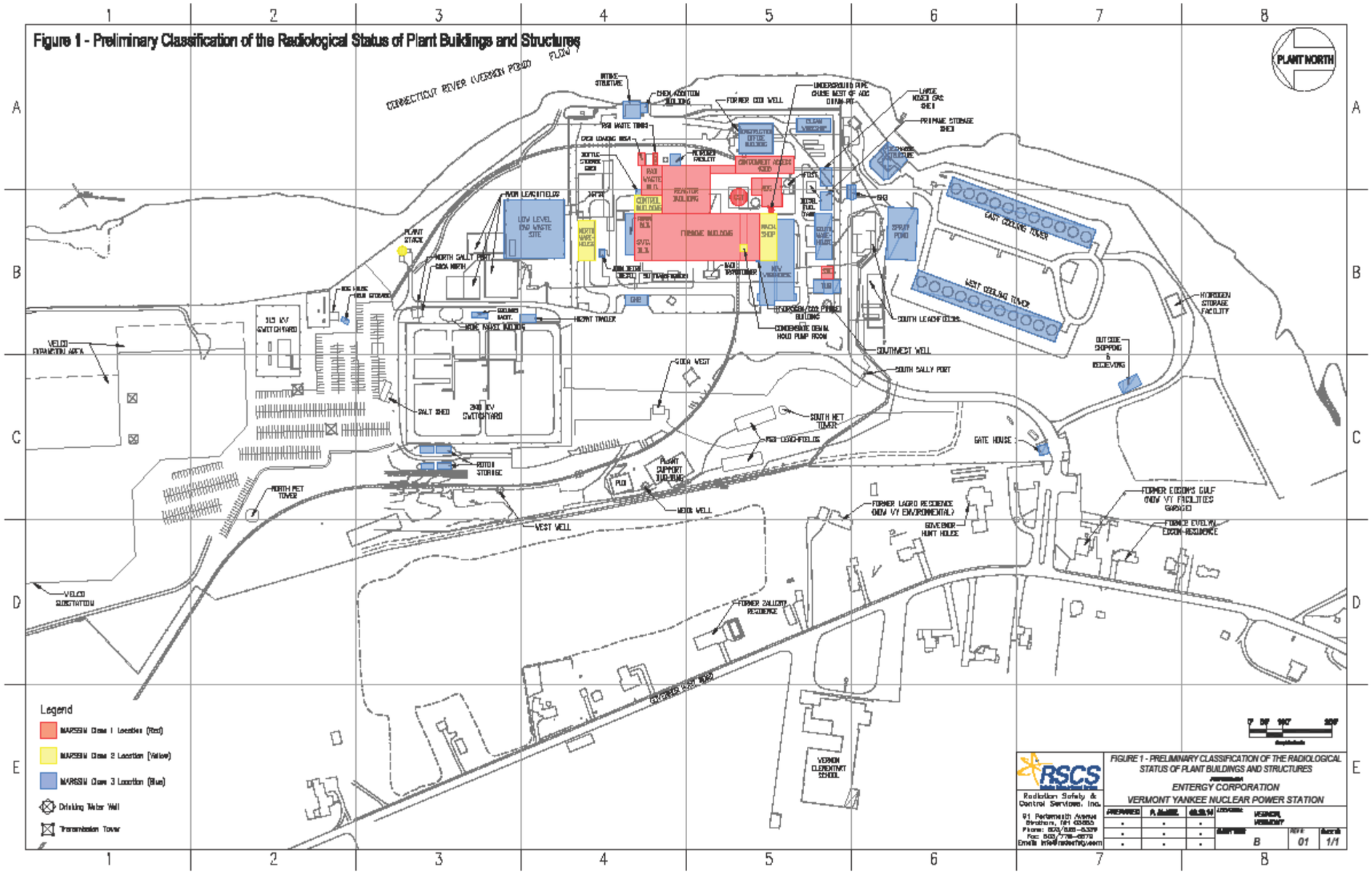

Figure 2 Map "A" Showing Areas of Radiological Conditions of Interest

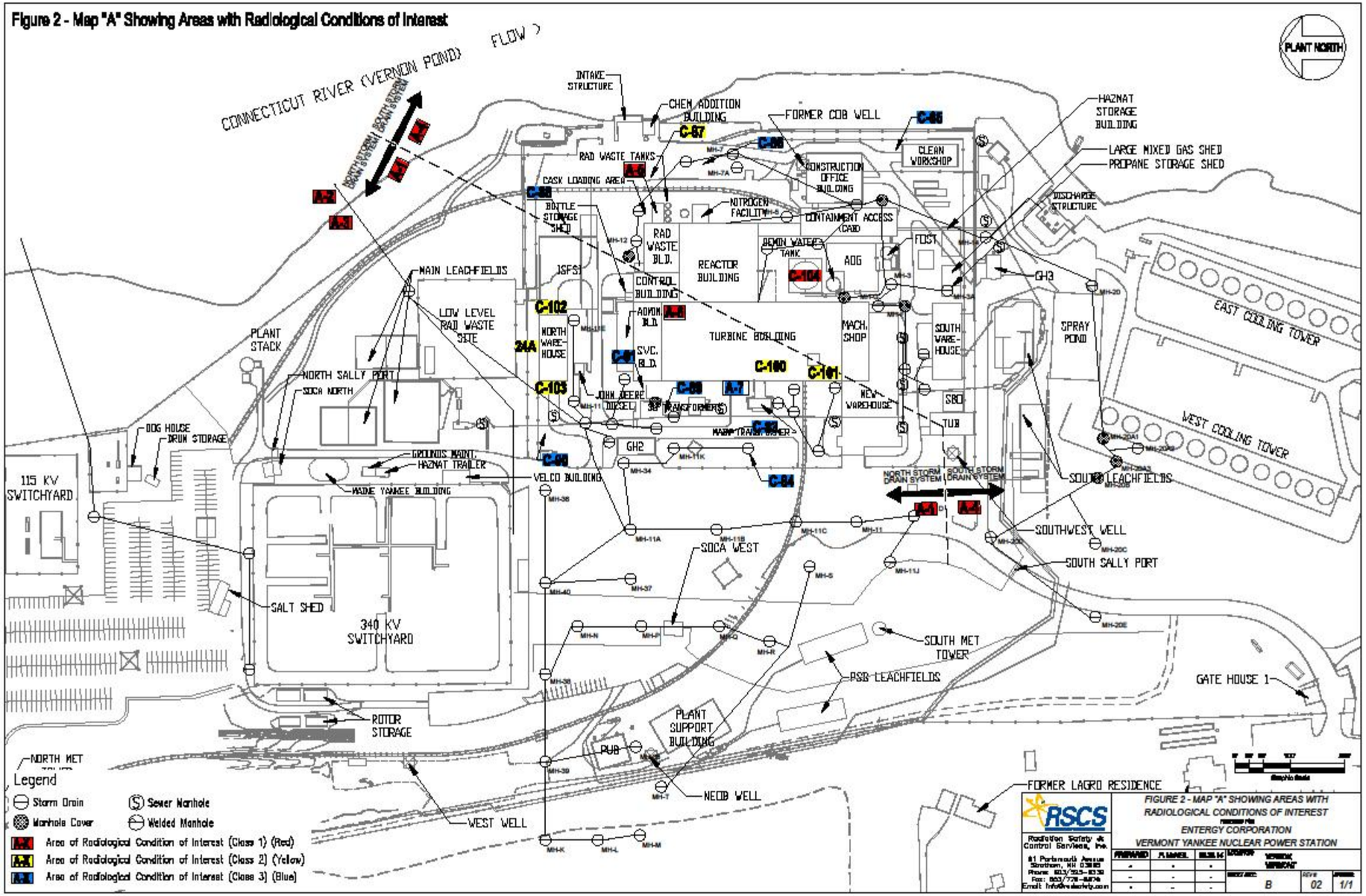

Figure 3 Map "B" Showing Areas of Radiological Conditions of Interest