2 SITE CLASSIFICATION

2.1 Historical Site Assessment and Survey Area Delineation

2.1.1 Approach and Rationale

The Historical Site Assessment (HSA) (Reference 2-1) for the Yankee Nuclear Power Station (YNPS) documents those events and circumstances occurring during the entire operating history of the facility that contributed to the contamination of the site environs above background levels. Information relevant to changes in the radiological status of the site following publication of the HSA will be considered a part of the continuing characterization evaluations (see section 2.6). The continuing evaluations include ongoing decommissioning activities, the expansion of the site groundwater investigation and evaluations of subsurface contamination. The results of the ongoing investigations into the extent of subsurface contamination will drive continuing remediation and/or mitigation efforts as appropriate.

The HSA development approach was to collect, organize and evaluate information that described the YNPS site in terms of physical configuration and the extent to which the site was radioactively contaminated as a result of plant operations and decommissioning activities. The HSA information was used to bound and classify survey areas. The boundaries of the identified survey areas as depicted in Figures 2-1a, 2-1b and 2-2 were selected based on operational history including recorded significant events, common radiological profiles and where appropriate, parcel ownership boundaries. The preliminary survey area classifications and sizes are shown in Table 2-1 for structures and Table 2-2 for open land areas. Survey areas for structures will be broken into multiple survey units where appropriate in order to meet the survey unit size limitations recommended by NUREG-1575 (Reference 2-2). All open land survey area boundaries have been sized to meet the NUREG-1575 size limitation constraints.

The general criteria used to classify the identified survey areas was drawn from the regulatory guidance of NUREG-1575 (MARSSIM) as follows:

Non-impacted Area: Areas where there is no reasonable possibility (extremely low probability) of residual contamination. Non-impacted areas are typically off-site and may be used as background reference areas.

Impacted Area*:* Any area that is not classified as non-impacted. Areas with a possibility of containing residual radioactivity in excess of natural background or fallout levels. All impacted areas must be classified as class 1, 2 or 3 as described in NUREG-1575.

Class 1 Area: An area that is projected to require a Class 1 final status survey. Impacted areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiological surveys) above the DCGL. Size limitations are ≤100 sq. m. for structures and ≤2000 sq. m. open land areas.

Class 2 Area: Impacted areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGL. Size limitations are >100 sq. m. and ≤1000 sq. m. for structures and > 2000 sq. m. and ≤ 10,000 sq. m. for open land areas.

Class 3 Area: 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 DCGL, based on site operating history and previous radiological surveys. There are no size limitations for Class 3 areas.

The collection and evaluation of site radiological information is conducted under approved site procedures. The output of this process is in the form of information generated for each survey area that are used in the preparation of survey plans. Information generated for each survey area contains a detailed operational history, the current radiological status, an evaluation of radionuclide past and current translocation pathways that have been or continue to be operable and a description and status of decommissioning work performed. The decommissioning work description includes the results or status of any subsurface characterization or remediation efforts.

The general process for integration of the HSA with continuing characterization and Final Status Survey is shown in the following flowchart.

Process for Integrating HSA with Characterization and FSS

Review YNPS operational history and identify significant events contributing to contamination of the site.

↓

Establish Survey Area boundaries based on common history.

↓

Assemble available historical reference documentation into Survey Area packages.

↓

Assign Survey Area Classification.

↓

Publish Historical Site Assessment Document.

↓

Obtain Site-Specific DCGL's.

↓

Update Survey Area packages as decommissioning activities progress. Include results of continuing characterization activities and document progress of remediation/ mitigation of sub-surface survey areas.

↓

End-state of decommissioning attained. All areas below appropriate DCGL's.

↓

Evaluate Data Quality in survey area packages using DQO/DQA process and prepare characterization survey plans.

↓

Obtain additional characterization data if necessary and document turn-over surveys.

↓

Begin Final Status Survey process.

Over the operational history of the YNPS site, the term "remediation" was often used to refer to any process involving the removal of radioactive media. For the purpose of license termination activities, "remediation" is narrowly defined as efforts specifically conducted to reduce the quantity or concentration of radioactivity to a level below the appropriate Derived Concentration Guideline Level (DCGL). Other processes may be referred to as “mitigation” or routine decommissioning activities.

2.1.2 Boundaries of the Site

The YNPS site consists of about 2,200 acres on both sides of the Deerfield River in the towns of Rowe and Monroe, in Franklin County, Commonwealth of Massachusetts. Figure 1-1 shows the boundary of the site and plant exclusion area.

The “YAEC Deed Study Project Rowe and Monroe, Massachusetts,” dated December 18,1998, (Reference 2-3) provides information concerning properties that make up the YAEC site and current abutments.

YAEC or USGen New England, Inc. (USGen) own all of the land located within the licensed site property boundary, and all of the property within the exclusion boundary is under the control of YAEC. The USGen property is generally located along the riverbank and Sherman Reservoir. The portions of the YAEC industrial area located on USGen property are the circulating water discharge seal pit, the Screenwell Pump House, and the meteorological tower located on peninsula at the northeast corner of the site. USGen also owns that portion of the northeast yard area that fronts Sherman Reservoir and the property outside of the industrial area fence located between Yankee Road and the Deerfield River. A portion of the USGen property is considered impacted by licensed activities and is included in licensed termination activities. Two public secondary roads traverse the exclusion area. The first, Tunnel Road, is across the river from the plant, approximately 1,500 feet away at its closest point, and runs north and south along the river connecting the towns of Monroe, Massachusetts and Readsboro, Vermont. The second, Monroe Hill Road, is approximately 2500 feet away from the plant at its nearest point and is located southwest of the plant and runs between the towns of Rowe and Monroe, Massachusetts. During the early site history, a public rail line ran through the industrial area. This rail line and the associated spur facilitated early construction and spent fuel shipments. Currently, there are no rail lines that traverse or are adjacent to the YNPS site.

Most of the site area is wooded with very steep grades on both sides of the Deerfield River. Features of the site include the Yankee Nuclear Power Station, the YNPS Independent Spent Fuel Storage Installation (ISFSI), the USGen Sherman Station hydroelectric plant, Sherman Reservoir and Dam, the transmission lines running through the site, the Yankee Administration Building and the Yankee Visitor Center (Furlon House).

2.1.3 Documents Reviewed

In performing the YNPS Historical Site Assessment (HSA) the following documents were reviewed:

- License and Technical Specifications
  - Technical Specification Changes
  - License amendments
- Original Plant Design
  - Function and purpose of systems and structures
  - Plant operating parameters
  - Plant operating procedures
- Original Plant Construction Drawings and Photographs
  - Specifications for systems and structures
  - Field Changes/as built drawings
  - Site Conditions
- Plant Operating History
  - Abnormal Operating Reports (AOR)
  - Licensee Event Reports (LER)
  - Plant Information Reports (PIR)
  - Radiological Occurrence Reports (ROR)
  - Radiological Incident Reports (RIR)
  - Condition Reports (CR)
  - Plant Operating Procedures Regarding Spills and Unplanned Releases
  - Plant Operations Logbooks
  - Radiological Environmental Monitoring Program and Radiological Environmental Technical Specification Reports (REMP & RETS)
  - Monthly Plant Operations Reports
  - Semi-Annual Plant Operations Reports

- Work Control Documents and Site Modifications
  - Job Orders
  - Plant Alterations
  - Engineering Design Change Requests (EDCR)
  - Plant Modifications
  - Maintenance Requests

- Radiological Surveys and Assessments
  - Radiological surveys performed in support of normal plant operations and maintenance
  - Radiological surveys performed in support of special plant operations and maintenance

  - Radiological assessments performed in response to radioactive spills or events
  - Scoping and characterization surveys performed as part of Decommissioning Plan development
  - Remediation support surveys conducted during decommissioning activities
  - Surveys conducted under the guidance of NUREG/CR-5849 (Reference 2-4)
- The historical evaluations performed for the previously submitted LTP.
- The YAEC Decommissioning Plan
  - Decommissioning Work Plans
  - Secondary Side Work Plans
  - Engineering Change Notifications
  - Field Change Notifications
  - Temporary Change Requests

- The documented radiological end point of decommissioning activities
- Documentation of remediation area stabilization and restoration activities.

2.1.4 Property Inspections

The YNPS site is at an advanced stage of decommissioning with only those plant systems necessary to support the ISFSI and portions of the site remaining in service (e.g., potable water, sanitary sewers, construction electrical power, fire protection and storm sewers). Plant operations, maintenance and security personnel continue to occupy portions of the site in support of the YNPS site operations and maintenance. Due to the advanced state of decommissioning, these activities have a minimal risk of spreading radioactive contamination. The demolition operations contractor occupies a portion of the site with temporary office spaces from which to conduct the decommissioning/demolition activities scheduled for completion during the current phase of decommissioning. These temporary office spaces will be removed from the site at the completion of this phase of decommissioning. The portion of the site historically identified as the Radiation Control Area (RCA) is posted and restricted for personnel access and radioactive material control. RCA access control is maintained through the Radiation Protection (RP) control point.

Decontamination processes have been performed on certain site structures and systems as part of site decommissioning activities under the site Decommissioning Plan. These processes include application of chemical paint strippers, dry ice (carbon dioxide) blasting, steel shot blasting and mechanical removal techniques (including rota-peen tools, needle guns, reciprocating chipping hammers and jackhammers). In addition, both the east and west storm drain system catch basins have routinely been cleaned of accumulated sediment. Sediment socks are now been installed at each catch basin to curtail the build up of sediment in the storm drain system.

Surveys were performed in those areas where decommissioning activities had been completed in accordance with the protocols established under the previously submitted and withdrawn License Termination Plan (Reference 2-5). Controls were instituted and maintained to preserve the

radiological condition of most of these areas, and routine surveys are performed in all of these areas to verify that the radiological condition of these areas was not adversely impacted by ongoing plant operation, maintenance, or fuel transfer activities.

Decommissioning activities have resulted in the disturbance and/or excavation of soils in certain survey areas. Extensive soil evaluations have been performed in support of soil excavation. The soil excavations were associated with removal of sub-grade components/systems and site modifications necessary for the construction of the ISFSI and the upgrade of security measures around the spent fuel pool. Piles of excavated soil are located in several areas of the site.

Controls are in place to track the location of these soils from the point of origin (excavation) through temporary onsite storage to final disposition. Disturbed/excavated soils, evaluated and verified by sampling and analysis protocols to be non-detectable for radiological constituents (below environmental Lower Limit of Detection LLD level for soils) were used as backfill in some excavated areas. Excavated soils contaminated above a Guide Line Value (GLV) protocol were packaged and disposed of as radioactive waste. This protocol allowed some soils contaminated above background to be used as backfill in some locations. Retrospectively, the criteria is lower than the proposed DCGL. As these areas are evaluated for survey planning, the backfilled soil results will be evaluated against the soil DCGL for mitigation action.

During the evaluation of survey areas , walk-downs of each area were performed to document the types of survey media remaining or expected to remain at end-state. The walk-downs also documented the current decommissioning status of the area and identify any potential radionuclide translocation pathways that impacted the area or any contiguous survey areas. Such pathways include ongoing decommissioning activities or environmental transport pathways, such as sub-surface migration of radioactivity by surface water infiltration, wind, surface water run-off or wildlife.

2.1.5 Personnel Interviews

At the time of plant shutdown in 1992, personnel interviews were conducted as a part of an exit interview process. Since that time personnel have provided additional information on plant operations and practices when additional data was needed or desired relative to condition of the plant or activities performed.

2.2 History and Current Status

2.2.1 Licensing History

Yankee Atomic Electric Company is the holder of Yankee Nuclear Power Station Facility Operating License DPR-3 issued under the authority of the Atomic Energy Commission (AEC). Yankee Nuclear Power Station achieved initial criticality in 1960 and began commercial operations in 1961. The original thermal power design limit of 485Mwt was upgraded to 600Mwt in 1963.

On February 26, 1992, the YAEC Board of Directors decided to cease power operations permanently at YNPS. On August 5, 1992 the NRC amended the YNPS Facility Operating License to a possession only status.

The YNPS Decommissioning Plan (Reference 2-6) was submitted March 29, 1994 and received final approval in October 28, 1996. In May 1997, Yankee submitted to the NRC for approval a License Termination Plan (LTP) for YNPS, pursuant to 10CFR50.82(a)(9). The initial YNPS LTP employed a survey methodology based upon NUREG/CR-5849. Subsequently the NRC, jointly with the DOD, DOE, and EPA, approved an alternate survey methodology documented in NUREG-1575 (Reference 2-2). In May 1999, Yankee advised the NRC that it intended to shift from the survey methodology in NUREG/CR-5849 to the NUREG-1575 methodology, and withdrew its previously submitted LTP application.

In 2000, Yankee created a Post-Shutdown Decommissioning Activities Report (PSDAR) within the Final Safety Analysis Report (FSAR). NRC Draft Regulatory Guide DG-1071 recommends that licensees with approved Decommissioning Plans (D Plans) "extract pertinent detail from the decommissioning plan and submit a PSDAR update in the format and content specified by [DG-1071]." Based on the NRC draft guidance, Yankee segregated, updated and condensed certain information concerning post-shutdown decommissioning activities in a manner that conforms to the standard format and content of a PSDAR. The current LTP is written to reflect the NUREG-1575 (MARSSIM) methodology, as well as regulatory guidance made available since the previous LTP submittal.

Decommissioning activities completed as of May 1997 had removed the majority of systems and components not required to support the storage of spent fuel in the spent fuel pool. Detailed planning for the transfer of spent fuel from the Spent Fuel Pit began in February of 2000. In June of 2003 the transfer of all fuel and Greater Than Class "C" waste from the Spent Fuel Pit to the ISFSI was completed.

2.2.2 Regulatory Involvement

The NRC monitors YNPS site activities using inspectors from Region I offices to perform onsite inspections. Periodic calls are also held with NRC headquarters and Region I staff to monitor plant status and decommissioning progress. The NRC is notified of any incidents on site per the existing protocol established with NRC Region I and NRC reporting regulations.

The decommissioning of the YNPS site is also being performed under various Federal, State and local requirements in addition to the NRC regulations. For example, YNPS is subject to 29 CFR 1910 and 1926 (Reference 2-7) for worker health and safety protection under OSHA regulations. Asbestos and lead-based paint handling and removal are subject to OSHA regulations cited above, and EPA regulations 40 CFR Part 61, Subpart M (Reference 2-8). State and EPA requirements will be met for PCB paint removal activities. YNPS will also be required to meet the state standards for surface water and groundwater.

The Commonwealth of Massachusetts Department of Public Health also has state radiological remediation standards. Compliance with the state standards is not addressed in this document. This issue will be addressed in separate correspondence with the Commonwealth.

Permits and approvals from, or notifications to, several State (Commonwealth) and local agencies are required for safety and environmental protection purposes. Some of these are for specific decommissioning activities, and others are for existing YNPS site facilities and ongoing activities that are necessary to support decommissioning. The following is a partial listing of permits and approvals for decommissioning activities.

- Air emissions from the burning of diesel fuel are regulated by the Commonwealth of Massachusetts Department of Environmental Protection, Air Quality Control Division.
- Non-radioactive liquid effluents are administered by the Commonwealth of Massachusetts Department of Environmental Protection, Division of Water Pollution Control.
- Liquid effluents are controlled under the National Pollutant Discharge Elimination System (NPDES permit) under the EPA and State (Commonwealth) approvals.
- Building permits may be required by the Town of Rowe, Massachusetts, for temporary field office facilities constructed on the plant site to support decommissioning activities. The Town of Rowe uses the Uniform Building Code for evaluating building permit applications.
- The site make-up water wells are operated under permits from the Commonwealth of Massachusetts Department of Environmental Protection, Division of Water Supply.
- Hazardous waste generation is regulated by the Commonwealth of Massachusetts Department of Environmental Protection, Division of Hazardous Waste. Notification of the generator status and annual reporting are conducted in accordance with Massachusetts regulations.
- The Commonwealth of Massachusetts, Department of Labor and Industries, Division of Industrial Safety, regulates the installation, removal and encapsulation of friable asbestos-containing materials and lead-based paint. All non-radiological solid waste will be handled and disposed of in accordance with State and local rules and regulations.
- The Commonwealth of Massachusetts, Department of Public Health, Radiological Control Program, and the Vermont State Health Department, Division of Occupational and Radiological Health, are notified in advance of all placarded shipments of radioactive waste. In addition, the Governors of all affected States receive advance notifications in accordance with 10 CFR 71.97, " Advance notification of shipment of nuclear waste."

- Licenses are required for radio communications by the Federal Communications Commission.

- PCB paints will be removed from all exposed concrete surfaces as required by the Alternate Method of Disposal Authorization (AMDA) requirements prior to demolition of the structures as authorized by the EPA on October 8, 2002 and subsequent changes thereto.

2.2.3 Description of Operations Impacting Site Radiological Status

Normal plant operations were expected to result in contamination of certain areas of the site and these areas were designed to contain such material; however, early in the plant life, certain events and conditions 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. Review of the early operational history of the site drew heavily on the Plant Superintendent's "Monthly Operating Reports".
The following principal events and circumstances listed in chronological order generally contributed to the various aspects of residual contamination found on the site to be dispositioned at decommissioning.

- Release of elemental silver and nickel into the reactor coolant due to mechanical wear and corrosion from the initial set of control rods resulted in distribution of radioactive silver in plant systems and on equipment used during the first refueling. [circa 1960's]

- Storage of the refueling equipment and prepared radioactive waste outdoors resulted in distribution of contamination, including radioactive silver, within the RCA yard area.

- Snow removal activities performed in the RCA caused a redistribution of accumulated surface contamination to the areas outside the RCA where snow was relocated.
- Rain falling on the surface of yard areas in the RCA caused redistribution of the contamination into low areas in the RCA and into the storm drain system.

- Leaks in the radioactive systems in the Ion Exchange (IX) Pit resulted in contamination of the water in the IX Pit. A defect in the construction of the IX Pit concrete allowed the contaminated water to leak, resulting in contamination of the subsurface soils, asphalt and concrete around the IX Pit and adjoining structures.

- Wear on internal valve components made of stellite resulted in the introduction of wear particles into the reactor primary system. These particles were activated to gamma emitting Co-60 during plant power operations. Some particles associated with fuel fragments were also generated during plant operations. Maintenance on primary system components resulted in the distribution of these activated particles onto tools and equipment. Although not a frequent occurrence, Co-60 particles have been identified and removed during surveys of the yard area. The particles associated with fuel fragments have not been identified in open yard areas but were mostly confined to controlled contamination areas.
- A failure of a check valve allowed a backflow of shutdown cooling water to enter the seal water system resulting in contamination of the normally clean seal water system up to and including the vent port on the PAB roof.

- Out of doors decontamination facilities (North and South decontamination pads) resulted in contamination of the soils around the pads.

- The repair of a damaged reactor cooling pump motor on the normally clean turbine deck resulted in contamination of the turbine building generally and on the turbine deck and control room specifically.

- In the mid 1970s YNPS converted to zirconium clad fuel pins from stainless steel. Some of the zirconium fuel pins failed in the reactor due to vibrational stress from water jetting. This resulted in a release of fuel pellets directly into the reactor coolant system. This event changed the isotopic mix within the Reactor Coolant System. In particular, detectable quantities of fission products such as Cs-137 and Cs-134 were dispersed throughout the primary side plant systems and the fuel handling facility for the first time in the plant operating history.

- During a refueling outage in 1981, while relocating the reactor head to its outside storage location, the reactor head made contact with the wall above the equipment hatch in the Vapor Container. The impact dislodged particulate radioactivity adhered to the under side of the reactor head. This resulted in contamination of the RCA yard area under and around the equipment hatch.

- Construction of the original PCA storage facility included a PVC drainpipe that connected the PCA storage building to the Waste Disposal Building. The PVC pipe joints failed allowing liquid to flow from the drainpipe into the surrounding soil.

- The use of an underwater plasma torch to section the reactor internals resulted in the release of highly radioactive cutting debris into the shield tank cavity shield water. This changed the radionuclide mix of the residual contamination in the shield tank cavity and, to a certain extent, in the Spent Fuel Pit.

2.2.4 History of Unplanned Events

As part of the HSA, a comprehensive review of all recorded events documented as having occurred outside the normal operational condition was performed to capture those events which contributed to the contamination of the site. These events were typically documented in the format suitable for reporting to regulatory authorities such as Abnormal Occurrence Reports (AOR's), submitted during the early site history, and Plant Incident Reports (PIR's) or Licensee Event Reports (LER's), submitted through the remainder of plant life. Where available, the information in these reports was supplemented by supporting documentation concerning the events in the form of plant memos and radiological survey data.

2.2.4.1 Unplanned Gaseous Releases

Over the lifetime of the plant, a number of unplanned gaseous release events occurred. Short descriptions of these gaseous events as described in AOR/PIR/LER's are documented in the HSA. A detailed study of the particulate releases during the entire operating history of YNPS was used to justify the non-impacted status for a majority of the YAEC owned property. This study considered the impact of the particulate emissions from the primary vent stack as well as those from the radioactive waste incinerator that operated until 1964. The four years of batch incinerator emissions were considered to be of negligible impact when compared to the particulate releases from the primary vent stack over the life of the plant. A careful review of these discharges did not reveal any unmonitored particulate component that could have significantly contributed to the long-term contamination of the site or its environs.

2.2.4.2 Unplanned Liquid Releases

Several AOR's and PIR's reviewed documented unplanned liquid releases that resulted in contamination of the site grounds, buildings and subsurface locations. When subsurface contamination investigations were not performed due to inaccessibility or were not completed to the level suitable for license termination, these locations are targeted for continuing characterization investigation. Table 2-3 provides a listing of the events identified by the HSA that have resulted in contamination of the site. Appendix 2A provides a brief summary of each event based on documentation prepared at the time of the incidents and an assessment of which survey areas were impacted by the events.

2.3 Findings

2.3.1 Overview

As described in Section 2.1.1 above, the preliminary boundaries of the survey areas as depicted on Figures 2-1a, 2-1b and 2-2 were selected based upon operational radiological history. An in-depth assessment of the operational history performed during compilation of the HSA was used to bound and classify the survey areas in accordance with the guidance of NUREG-1575. Survey area classifications are shown in Figures 2-3 and 2-4 in a color-coded site map format. Table 2-1 and Table 2-2 list the survey area dimensions and their classifications in a tabular format.

Generally, of the approximately 2200 acres of land that comprise the YNPS site, less than 30 acres was impacted by plant operations. The majority of these 30 acres is minimally impacted and, as such, is classified as a group of Class 3 open land survey areas. The Class 3 open land survey areas identified at a distance from the site industrial area are areas that received material, primarily soil, from locations within the plant that are impacted areas. The survey areas that form the perimeter of the impacted areas of the site proper were classified as Class 3 open land survey areas and account for the potential translocation pathways of site-related radioactivity into the surrounding environment by winds, surface water, groundwater, and wildlife intrusion.

The Class 2 open land survey areas that abut the Class 1 open land survey areas are potentially contaminated or known to be contaminated, but are not expected to exceed the DCGL. This

creates a buffer zone that will receive a higher level of assessment based upon its likelihood to contain radioactivity at some fraction of DCGL.

Class 1 open land survey areas are identified based upon historical information indicating the potential presence of radioactivity at levels greater than DCGL. Table 2-5 summarizes the radiological conditions of open land areas and the associated MARSSIM classifications as well as the total land area by survey area. The radiological condition of each area is expressed as the minimum, maximum and mean of the sum of fractions of a DCGL for soils.

Subsurface soils and subsurface structures/systems located within or that traverse an open land survey area will be evaluated separately as part of the continuing characterization and subsurface classification process described in Section 2.6 of this document.

All YNPS structures associated with the site are considered impacted to some extent by plant operations and are located within an impacted land survey area. Few of the structures on site will remain in use after the current phase of decommissioning is complete. The majority of the structures will be demolished to grade and will consist of reinforced concrete floor slabs, foundations and sub-grade structures. The floor slabs, adjoining interior walls and above grade exterior walls may all be included within a given survey unit dependent on surface area size limitations. The sub-grade reinforced concrete walls and undersides of floor slabs will be investigated separately. Table 2-1 summarizes the structure survey area classifications and the total interior area to be surveyed. A summary of the current radiological conditions of structures and buildings tabulated by survey area is presented in Table 2-4. This information was further evaluated in consideration of the decommissioning activities previously performed, the potential impact of future decommissioning activities, and the projected end-state of the site at conclusion of all decommissioning activities in order to select the preliminary classification status.

2.3.2 Radionuclides of Concern at YNPS

An analysis has been preformed to determine the radionuclides that have potential dose significance at License Termination (Reference 2-9). This analysis has used three sources of radionuclide data to assure that all significant nuclides associated with plant operations are identified. The sources are selected Part 61 analyses representing several media types spanning a time period from pre-shutdown to the present, radionuclide distributions identified in the YNPS Decommissioning Plan (Reference 2-6) and source term information from NRC published reports. The significant radionuclides identified from the Part 61 analyses encompassed those identified from the latter two sources. The final listing of potentially significant radionuclides is shown on Table 2-6.

2.4 Impacted Area Assessments

The summary assessments provided in Appendices 2B and 2C of this section include a description, key elements of the history, contaminated media and an evaluation of the principle radionuclides expected to be present in the area. The summary also includes a current decommissioning status and a description of the work remaining to be done to attain the anticipated end-state. A survey area classification statement is provided at the end of each assessment.None of the impacted areas were classified based on the results of scoping or preliminary characterization data. The classifications assigned, based on historical activities performed in these survey areas alone, are substantiated by the large quantity of scoping data available in the form of soil sample analyses and survey data. Summaries of the sampling data as shown on Tables 2-4 and 2-5 are compiled from information detailed in the YNPS HSA. More detailed descriptions, histories and the radiological status of each of these survey areas are also contained within the YNPS HSA.

2.4.1 Buildings, Structures and Open Land Areas Inside the RCA

The following designations are used in identifying survey areas inside of the RCA (Figures 2-3 and 2-4):

AUX	Primary Auxiliary Building
BRT	Vapor Container Support Structure (sub-surface)
NOL	Open Land Areas Inside the RCA
NSY	Yard Structures Inside the RCA
WST	Waste Disposal Building

Summary individual survey area assessments are described in Appendix 2B. In general, all survey areas within the confines of the historical RCA have been assigned a Class 1 status. The exceptions are NSY-10 and NOL-07 which are the ISFSI Pad and the open land area immediately surrounding this structure. The area was excavated to prepare a suitable surface for the new concrete pad structure. The soils removed from this excavation were evaluated by composite sampling and found to contain only naturally occurring radionuclides. The pad and surrounding land have been assigned a Class 3 status pending further evaluations following the final disposition of the spent fuel containers.

2.4.2 Buildings, Structures and Open Land Areas Outside of the RCA

The following designations are used in identifying survey areas outside of the RCA (Figures 2-3 and 2-4):

OMB	Support Buildings Outside the RCA
OOL	Open Land Areas Outside the RCA
SVC	Service Building
TBN	Turbine Building

Summary individual Survey Area assessments are described in Appendix 2C. In general, the impacted areas immediately outside the confines of the historical RCA have been assigned a NUREG 1575 Class 2 status. These buffer zones are areas where radionuclides may have migrated beyond the RCA boundary due to environmental or other translocation vectors.

The exceptions are Survey Areas OOL-12 and OOL-13 where radionuclides are known to have migrated beyond the RCA boundary due to the combination of a recorded contaminating event (PIR 81-09) and a significant rain event. Surface run-off from the RCA yard not channeled into the storm drain system migrated down grade along the rail spur in these areas toward Sherman Reservoir. Although the surfaces of these areas were quickly decontaminated and cleared for general access, some of the contamination carried by the run-off filtered into the crevices of the rails and rail bed remain embedded. These areas have been assigned a Class 1 status.

Survey Area OOL-07 has been assigned a Class 2 status as it contains soils removed from other class 2 areas and soils that have only been evaluated by composite sampling techniques.

The remaining impacted areas are assigned a Class 3 status. These areas were designated as impacted areas for a wide variety of reasons. None of these areas are expected to contain radioactivity in excess of a small fraction of the appropriate DCGL.

2.5 Non-Impacted Area Justification

2.5.1 Non-Impacted Area Description

The majority of the land surrounding the industrial area of the site is classified as non-impacted according to MARSSIM criteria. This portion of the site is open land consisting of approximately 2170 acres. The non-impacted land surrounds the industrial area and all other routinely utilized areas. The non-impacted area is bounded on the east and south by Monroe State Forest, on the southeast by USGen property, on the west by Readsboro Road (with the exception of an 89 acre plot on Kingsley Hill Road), and on the north by the Massachusetts/Vermont state line. The non-impacted area was not involved in plant operations and consists mostly of rugged terrain which is forested and undisturbed. Power lines traverse the area in a northeast by east direction (see figure 2-5). The general site is shown on USGS map Rowe, Massachusetts-Vermont (Reference 2-10).

2.5.2 Decommissioning Activities

There were no decommissioning or remediation activities performed in the non-impacted area. Most of the area is forested. The power line right-of-way is cleared of trees.

2.5.3 Basis of Area Classification

The basis for the "non-impacted" classification of this survey unit is that there is no reasonable possibility of residual contamination based upon the following (References 2-11, 2-12 and 2-13):

- Samples collected as part of the Radiological Environmental Monitoring Program (REMP) throughout the plant's operational and post-operational history show no evidence of any significant radiological impact due to plant operations;

- Aerial photographs from 1966, 1970, 1974, 1980, 1981, 1982, 1989, and 1990 show no evidence of soil disturbance;

- A conservative evaluation of the potential impact of particulate effluents to soils outside of the industrial area using a Gaussian dispersion/deposition model substantiates the conclusion that this source of plant-derived radioactive material would be expected to contribute (at a maximum) a very small fraction of the DCGL. Beyond the impacted area boundary, concentrations of this plant-derived radioactive material would be non-detectable and indistinguishable from background;

- A statistical comparison of soil sample analytical data from the non-impacted area and an environmentally equivalent reference area (unaffected by plant releases) was performed.

2.5.4 Occurrence of Anthropogenic Radionuclides in the Environmental Background

According to the National Council on Radiation Protection and Measurements (References 2-14, 2-15 and 2-16), radionuclides present in environmental background are both naturally occurring and man-made. Carbon-14 is introduced cosmogenically and by the atmospheric detonation 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.

The range of concentrations of Cs-137 in environmental background due to fall-out from atmospheric atomic device testing is easily detectable in soil. Both Cs-137 and Sr-90 are fission products with similar half-lives. Accordingly, it is expected that Sr-90 due to fall-out from

atmospheric testing would also occur in the environment where weapons derived Cs-137 is present.

2.5.5 Evaluation of the Impact of Elevated Releases of Particulate Radioactive Material

YRC-1178 (Reference 2-11) provides a conservative evaluation of the deposition of particulate activity in gaseous effluents over the operating history of YNPS on soils in the impacted area downwind of the Primary Vent Stack (OOL-08). The study examined Semi-Annual Effluent Reports and Monthly Operating Reports that contain the total activity, by radionuclide, released from the plant in particulate form of gaseous effluents. The particulate fraction released from the Primary Vent Stack is determined from analyses of the waste gas discharge. The gaseous fraction of the effluent was disregarded when considering the impact to soils since there is no expectation that this fraction would be deposited. The individual radionuclide activity annual data were decay-corrected to the time of YRC-1178 (1998). A conservative atmospheric deposition factor was developed and applied to the decay-corrected particulate fraction of released activity to determine the maximum residual deposition on an area extending 100-200 meters beyond the industrial area boundary. The long-term average deposition factor was derived from plant specific meteorological and structural data and was determined to be 8.79E-08m^{-2}. Soil radioactivity concentrations based on a penetration depth of 15 cm and a density of 1.6 gm/cc were calculated to be:

- Sr-90: 2.56E-4 pCi/g
- Cs-134: 4.91E-7 pCi/g
- Cs-137: 1.01E-4 pCi/g
- Co-60: 1.31E-4 pCi/g

These values are below the expected site-specific DCGLs and minimum detectable activities (MDAs). These projections demonstrate that the concentration of gaseous effluent-derived radioactive material in area OOL-08 (an impacted area) are expected to be much less than the soil DCGLs. Since the non-impacted area is further from the source, plant-derived radioactive material concentrations would be even lower than those typical of survey area OOL-08.

2.5.6 Statistical Evaluations

2.5.6.1 Description of Reference Areas

Cesium-137 derived from atmospheric nuclear weapon detonations occurs in all land areas, regardless of their proximity to YNPS. In order to assess properly the impact of plant operations alone on the non-impacted area of the site, the contribution from this source of Cs-137 must be quantified. To that end, reference areas that were not reasonably expected to contain plant-derived Cs-137 were identified. Reference 2-17 describes the selection criteria, sampling protocol, and summary results for these reference background areas. The areas selected were in the vicinity surrounding Pelham Lake. This area was selected for the following reasons:

- It is the direction of least prevalent winds, and therefore has the least likelihood of having been impacted by YNPS air effluents.
- It is in a separate valley and there is no known surface or groundwater communication between the two valleys. Therefore it most likely has not been impacted by liquid effluents.
- It has soil and flora typical of the non-impacted survey area surrounding the YNPS site.

2.5.6.2 Approach and Methodology for Evaluation of the Non-Impacted Area

Thirty (30) surface soil samples were collected from the non-impacted area in August of 1998. The locations of each sample point and the general location of the plant site relative to the survey area are presented in Figure 2-5. Sixty surface soil samples were also obtained (in 1996) from a selected reference area beyond the boundaries of the YNPS-owned property as described in Section 2.5.6.1. The means and maximum values of the reference background area and the non-impacted areas compare favorably with the global concentrations of Cs-137 found from atmospheric deposition in topsoil.

Two types of statistical tests were performed to evaluate whether the soils from the non-impacted area contain excess Cs-137 relative to the soil samples from the reference area. These analyses are presented in Reference 2-11. The Student t-test was used to compare the mean values of the two data sets. The second test was a single-tailed Fisher's "F-Test" of the variances of the Cs-137 concentrations in the reference area and the non-impacted area. This comparison is also known as the Analysis of Variance or the Variance Ratio. The test compares the variances of both data sets.

Additional statistical analyses were performed on the shapes of the sample distribution to provide additional evidence that these two distributions may have the same source. These were tests for skewness and normality. These tests indicated that the parameters for the data sets are alike.

2.5.7 Summary

The classification of the area as non-impacted is based upon historical photographs, results of Radiological Environmental Monitoring Program surveys, particulate gaseous effluent deposition modeling and a statistical analysis of Cs-137 soil concentrations relative to a set of background reference areas.

2.6 Continuing Investigation of Subsurface Contamination

Subsurface radioactivity is residual radioactivity that is underneath structures such as building floors/foundations or that is covered with soil or some other material. Some areas known to be impacted are still under investigation. The reasons for this vary. Survey area information, as presented in the YNPS HSA, is the primary resource for identifying areas that may require subsurface investigation.

Appropriate samples will be obtained to identify the depth at which contamination, if any, above DCGL limits occurs. The evaluation of soil under concrete and asphalt will also be addressed. Survey plans will be developed for sampling of soil under contaminated slabs, especially at the location of expansion joints, cracks, and other potential contamination pathways from the concrete surface to the sub-slab soil.
Figure 2-6 illustrates the locations where targeted subsurface investigations will be performed. A finding of subsurface soil above the DCGL will prompt further investigation in order to determine the horizontal and vertical extent of the contamination. In general, the investigation will continue until the area of contamination is well defined. This is generally accomplished when soil from peripheral cores are less than DCGL. The conclusion in that case is that the investigation has bounded the extent of contamination. All subsurface areas known to be impacted will be investigated and soil radioactivity levels will be reduced to less than the soil DCGL.

As part of the final status survey program, a follow-up program of systematic subsurface sampling will be performed in the entire area delineated in Figure 2-6. Evaluations of volumetric contamination levels in the vertical column across each subsurface survey zone will be performed to substantiate the evaluation that all subsurface locations have been identified and are below the clean-up criteria.

2.7 Continuing Investigation of Groundwater Contamination

2.7.1 History

The basic site geology has been well documented in licensing studies and documents. Figure 2-7 illustrates the locations of existing and proposed groundwater monitoring wells. The first site monitoring wells, B-1 and B-3, were installed within the Radiologically Controlled Area (RCA) in December 1977 and October 1979, respectively. Well B-3 was used to monitor groundwater level only; and no samples were analyzed for radionuclides. Well B-3 was closed in January 1997.

Following the decision to terminate plant operation, monitoring wells CB-1, -2, -3, and -4, and CW-1, -2, -3, -4, -5, and -6 were installed just down gradient of locations where spills or leaks are known to have occurred. The location, extent and impact of leaks resulting in the contamination of the site are discussed in the Historical Site Assessment and have been summarized in previous subsections of this LTP.

The YNPS Radiological Environmental Monitoring Program (REMP) has identified tritium in Sherman Spring. Tritium was also identified in samples routinely drawn for REMP from monitoring well B-1. The identification of H-3 in the groundwater as a substance of concern was documented in the YNPS Decommissioning Plan; however, recent samples have not detected tritium in Sherman Spring.

The additional wells installed after 1993 further defined the extent of H-3 migration beneath the plant industrial area and toward the Deerfield River and Sherman Dam. Analyses for H-3 from wells, along with REMP results for Sherman Spring, provided a working model for groundwater flow in the shallow outwash aquifer beneath the site. They also served as a basis to help locate additional monitoring wells (CB-6, -8, -9, CW-7, and -8) installed in 1994 to further define general groundwater flow and the H-3 plume at the site. The shape of the H-3 plume, based on analyses from the above wells, can be seen in Figure 2-8.

Additional core borings that serve as draw points for groundwater samples (CB-5, -7, -8, -10, and -12, and CW-10) were installed up gradient or cross-gradient of the PAB/SFP/IX Pit complex, in impacted locations beneath building slabs. While these are not actual monitoring wells with installed screens, they do provide scoping type groundwater data when water is present within the bore holes.

A series of deep-bedrock wells were installed during the summer of 2003 in order to investigate the possible existence of a deep plume of contamination. The wells currently in existence, that were installed prior to 2003, are at the level of the glacial outwash or in unfractured till. These wells monitor the concentration of the radionuclides in the groundwater to depths of about 30-70 feet. The new wells investigated depths to bedrock which ranged from 43 to 280 feet.

Figure 2-7 shows the location of these new bedrock monitoring wells (MW100-107). The designation ‘A’, ‘B’, or ‘C’ for these wells signifies outwash, bedrock, or intermediate depth wells, respectively. Intermediate wells were installed at depths where aquifers were encountered that yielded positive tritium results.

2.7.2 Evaluation of Historical Data

Figure 2-8 shows the current data for H-3 in samples taken from wells near the plant structures.

CB-11A was installed in the PAB following detection of H-3 in samples from standing water exposed during concrete floor removal in that building in 1997. Subsequent samples from that well revealed elevated H-3 concentrations in a highly localized zone. Several new monitoring wells were placed in the vicinity of that well to assure that any significant related information was investigated.

The data set existing as of 2001 was reviewed and evaluated. This evaluation led to the development of the revised groundwater monitoring program which is currently in progress.

2.7.3 Groundwater Monitoring Program

During the second quarter of 2003, the radionuclide groundwater monitoring program was reviewed and YNPS procedures updated in order to continue and expand the groundwater investigation effort. These procedures address:

- Ground and Well Water Monitoring
- Radiochemical Data Quality Assessment
- Site Characterization and Site Release Quality Assurance Program Plan for Sample Data Quality and
- Groundwater Level Measurements and Sample Collection in Observation Wells .

The program includes analyses of a standard suite of radionuclides based upon known contaminants from plant spills and leaks, and historical evidence from other facilities undergoing decommissioning (see Section 2.3.2). This program also implements a standard "low-flow" method for sample collection. Preconditions for well purging and limits on sample turbidity and changes in pH prior to sampling were implemented for the round of sampling performed during the summer of 2003. These controls minimize the entrainment of particulate matter in the well water samples and avoid bias due to inclusion of particulate matter.

The program requires the comparison of each data set to the historical trend and allows the inclusion of new radionuclides or wells, or deletion of radionuclides or wells based on the analytical evidence. Any program changes are formally approved and documented.

2.7.4 Ongoing Groundwater Investigations

The preliminary assessment of the groundwater and soil data indicate that the only radionuclide identified in migration towards the Sherman Dam area is tritium. Some of the new wells had tritium concentrations that were in excess of what had been measured for existing wells and in one case greater than the EPA standard for tritium in drinking water. This indicates that the plume may have a more complicated flow path than previously considered. The YNPS QA program has been adjusted to account for this new information.

Although this new information shows concentrations in excess of the EPA drinking water standard, the dose consequence is insignificant and does not change the strategy for going forward towards FSS. Groundwater investigations will continue in November 2003 and quarterly thereafter. Additional wells are planned for Spring 2004.

2.8 Continuing Characterization Activities

2.8.1 Introduction

Surveys of impacted site structures and open land areas will be performed to support final status surveys for surfaces, materials, and soils that will remain at the time of license termination. This includes concrete building floors at ground level, concrete building foundation walls and footings below ground level, asphalt covering the soil in open areas, and soil. Some of the soils to be characterized are located beneath the concrete floors and asphalt. Materials from structures that will be removed from site prior to license termination will be dispositioned either under the free release criteria (consistent with the guidance of NRC Circular IEC-81-02, "Control of Radioactively Contaminated Material") or as radioactive waste shipped to a licensed waste processing or burial facility. Sub-grade structures that are not part of a designated structural survey area (e.g., concrete support structures) will be evaluated within the overlying open land survey area or subsurface survey area when they are potentially impacted by the migration of sub-surface contamination. Confirmatory spot checks on other such sub-surface structures or objects will validate a non-impacted status where appropriate.

The remaining investigation activities are of two general types:

- Survey used to determine the presence of radioactivity (impacted or non-impacted), or
- Survey performed with final status survey quality requirements that may be used as a final status survey if the release criteria are met.

In the case of the first type of survey, the quality requirements invoked will be specific to the purpose of the investigation. If the survey will be used in support of FSS design elements, then the data quality objective (DQO) process applied to the FSS plan design will be applied to the data quality to ensure it is adequate for the intended purpose.

2.8.2 Characterization Survey Plans Prepared Under a Quality Assurance Project Plan (QAPP)

Characterization Survey planning includes review of the Historical Site Assessment (HSA), scoping survey data, DCGLs, and other relevant information supporting the initial classification of the survey area or unit.
The DQO process described in MARSSIM is implemented by generation of a survey plan. The DQO process is a series of planning steps for establishing criteria for data quality and developing survey designs. The goals of this process are to provide a more effective survey design and a basis for judging the usability of the data prior to collection. DQOs are statements intended to clarify the survey objectives, define the types of data to be collected, and specify the limits on the decision errors used as a basis for establishing data requirements. The impetus of this DQO planning process is a Quality Assurance Project Plan (QAPP). This QAPP integrates all technical and quality aspects of the project and details how these elements will be implemented.

The survey design includes the selection of instruments and techniques needed to provide scans, static measurements, and samples of the proper quality and quantity to allow decisions to be

made regarding the suitability of the current MARSSIM area classification. Technical basis documents will be developed as needed to justify the use of the measurement methods and to assess instrument detection limits.

Approved site procedures for field and laboratory instrument calibration and operation, survey techniques and reporting, data entry and management, and training and qualification of personnel will ensure that the plan is implemented consistently and according to applicable standards.

2.8.3 Characterization Survey Plans

The purpose of a Characterization Survey Plan is to describe the methods to be used in the planning, design, execution, and evaluation of characterization surveys. The “as found” condition of a given survey area is documented in the survey area classification packages. These packages contain sufficiently detailed information on the operational history and current decommissioning status to allow generation of a Characterization Survey Plan or to use the existing data provided it is qualified to be adequate as characterization data. If the completed classification package indicates that additional characterization is required to investigate potential presence of plant-derived radionuclides on the exterior of sub-grade surfaces or beneath the concrete floor of the end state structure, the results of such investigations will be included in the survey area classification information.

2.9 References

2-1. YAEC Historical Site Assessment.

2-2 NUREG-1575: Multi-Agency Radiation Survey and Site Investigation Manual, Revision 1, dated August 2000.

2-3 YAEC Deed Study Project Rowe and Monroe, Massachusetts, dated December 18, 1998.

2-4 DRAFT NUREG/CR-5849 (ORAU 92/C57): "Manual for Conducting Radiological Surveys in Support of License Termination," by J.D. Berger, dated June 1992.

2-5 YAEC License Termination Plan, dated December 1997.

2-6 YNPS Decommissioning Plan, dated March 29, 1994

2-7 Title 29 Code of Federal Regulations, "Labor."

2-8 Title 40 Code of Federal Regulations, "Protection of Environment."

2-9 Technical Basis Document YA-REPT-00-001-03, Radionuclide Selection for DCGL Determination, dated November 5, 2003.

2-10 USGS topographic quadrangle Rowe, Massachusetts – Vermont, 42072-F7-TM-025, dated 1990.

2-11 Technical Basis Document YA-REPT-00-006-03, "Statistical Evaluation of Non-Impacted Area, Evaluation of 137Cs Concentration in Soils of Non-impacted and Reference Areas in the Vicinity of YNPS."

2-12 EG&G 10617-1233, UC-702, "An Aerial Radiological Survey of the Yankee Rowe Nuclear Power Station and Surrounding Area," EG&G Energy Measurements, dated September 1993.

2-13 YRC-1178, Radionuclide Soil Concentrations Surrounding YNPS Resulting from Gaseous Release During Plant Operation, dated March, 1998.

2-14 NCRP Report 47 "Tritium Measurement Techniques," dated May 28, 1976.

2-15 NCRP Report 50 "Environmental Radiation Measurements," dated December 27, 1976.

2-16 NCRP Report 81 "Carbon-14 in the Environment," dated May 15, 1985.

2-17 RP 98-20, "Technical Basis Document for Background Concentrations of Cesium-137 in Soil and Sediment," RP 98-20, dated March 3, 1998.

Table 2-1

Floor and Total Area of Buildings and Features

SURVEY AREA	DESCRIPTION	MARSSIM CLASS	FLOOR AREA (m^2)	TOTAL AREA (m^2)	RATIO (total : floor)
SVC-01	NORTH PART OF SERVICE BLDG (CLEAN SIDE)	3	921	921	1
SVC-02	RAD PORTIONS OFSERVICE BLDG AND ANNEX	1	444	444	1
SVC-03	CLEAN SIDE OF SERVICE BLDG ANNEX	3	366	366	1
TBN-01	TURBINE BLDG AND OFFICE PADS	3	1517	1517	1
SPF-01	SPENT FUEL POOL AND TRANSFER CHUTE	1	60	302	5.03
SPF-02	NEW FUEL VAULT	1	95	141	1.48
BRT-01	CONCRETE PEDESTALS, PAD AND ANNULUS	1	2095	2095	1
NSY-01	NORTH AND SOUTH DECON PADS AND FTE	1	224	224	1
NSY-02	IX-PIT, VALVE GALLERY/ PAB STAIRWAY	1	95	390	4.1
NSY-03	SI DIESEL/ACCUMULATOR TANK/BATTERY ROOM	1	380	482	1.12
NSY-04	SAFE SHUTDOWN	1	103	120	1.16
NSY-05	FIRE WATER TANK AND PUMP HOUSE	1	184	184	1
NSY-06	PCA#2 (NEW)	1	219	219	1
NSY-07	WHT / ADT / WASTE GAS PADS	1	390	390	1
NSY-08	NEW SI TANK	1	80	80	1
NSY-09	ELEVATOR SHAFT	1	6	21	4.5
NSY-10	ISFSI	3	985	1078	1.09
NSY-11	CHEM WASTE PIT	1	17	78	4.5
NSY-12	TANK #1 BASE	1	31	31	1
NSY-13	TANK #39 BASE	1	70	70	1
WST-01	PCA #1 (OLD)	1	109	109	1
WST-02	PCA WAREHOUSE	1	604	604	1
WST-03	WASTE DISPOSAL BLDG	1	230	437	1.9
WST-04	COMPCTOR BLDG	1	165	165	1
AUX-01	PAB/ EAST END	1	289	772	2.6
AUX-02	PAB / WEST END	1	130	189	1.45
OMB-01	PUMPHOUSE AND SCREENWELL	3	230	541	2.35
OMB-02	SECURITY GATEHOUSE AND DIESEL GENERATOR	3	270	868	3.2
OMB-03	ADMINISTRATION BUILDING	3	297	798	2.6
OMB-04	WAREHOUSE AND LOADING DOCK PAD	3	625	625	1
OMB-05	FURLON HOUSE	3	432	1076	2.5
OMB-06	SEAL PIT	3	120	329	2.74

TABLE 2-2

Area of Open Land Survey Areas

SURVEY AREA	DESCRIPTION	MARSSIM CLASS	AREA (m^2)
OOL-01	SHERMAN POND SEDIMENTS	3	73971
OOL-02	YANKEE NON-RAD YARD AREAS	3	7134
OOL-03	SHERMAN RESERVOIR DAM AND SOUTH SHORELINE	3	16177
OOL-04	US GENERATION / SHERMAN STATION OVERLYING GROUNDWATER PLUME	3	17870
OOL-05	US GENERATION / DEERFIELD RIVER FRONTAGE	3	28574
OOL-06	YANKEE WESTERN ACCESS	3	37281
OOL-07	SOILS DEPOSIT AREA	2	2108
OOL-08	YANKEE SITE EXCLUSION ZONE	3	133368
OOL-09	SOUTHEAST CONSTRUCTION FILL AREA	3	2387
OOL-10	ISFSI/ACCESS, EXCLUSION ZONE, BUFFER ZONE	2	8408
OOL-11	EAST RCA BUFFER ZONE	2	1220
OOL-12	WAREHOUSE RAIL SPUR	1	876
OOL-13	US GENERATION/RAIL SPUR TERMINUS	1	1148
OOL-14	US GENERATION/WHEELER BROOK FRONTAGE	3	2354
OOL-15	US GENERATION/SHERMAN RESERVOIR EAST SHORELINE	3	4662
OOL-16	FURLON HOUSE PARKING LOT	3	2481
OOL-17	ASPHALT, BRICK AND CONCRETE STORAGE YARD	3	3247
NOL-01	EASTERN LOWER RCA YARD	1	1364
NOL-02	NORTHEASTERN UPPER RCA YARD	1	1990
NOL-03	SOUTHEASTERN UPPER RCA YARD	1	1575
NOL-04	SOUTHWESTERN UPPER RCA YARD	1	1753
NOL-05	NORTHWESTERN UPPER RCA YARD	1	1586
NOL-06	WESTERN LOWER RCA YARD	1	1329
NOL-07	ISFSI RCA YARD	3	1717

Table 2-3

AOR / PIR List of Unplanned Liquid Releases

Impacted Survey Area	AOR/ PIR #	Description
NOL-2/NOL-5	61-15	Radioactive Spill – 9/20/61
NOL-1/NOL-2 and NSY-2	63-12	Shield Tank Cavity Fill Water Spill – 9/18/63
OOL-5/OOL-6	63-17	De-watering Pump Packing Leakage – 10/8/63
AUX-1	64-08	Seal Water Tank Spill – 9/3/64
NOL-1/NSY-2 and OOL-5/OOL-6	64-13	IX Pit High Level – Leakage Coming Up through Pavement[1]– 10/3/64
SFP-1/NOL-1/ OOL-1	66-07	Spent Fuel Pit Water Spill – 9/27/66
OOL-5/OOL-6	66-08	Abnormal Activity in Storm Drain – 9/27/66
NOL-1/OOL-1	66-09	Hose Failure – 11/1/66
NSY-7	68-01	Waste Hold-up Tank Moat Spill – 1/16/68
NOL-1 thru 6	75-07	Yard Area Contamination – 7/16/75
NOL-2	77-16	Service Building Radioactive Sump Transfer Line Puncture – 12/21/77
NOL-2/NSY-2	80-09	Resin Spill – 8/6/80
NOL-1/NOL-6 OOL-12/OOL-13 and OOL-1	81-09	Contamination of Yard Area During Rx Head Removal – 5/15/81
WST-1/WST-2 and WST-3	84-16	Drain Pipe Failure[1] – 9/10/84
NOL-1	94-03	Leakage from Frozen Fuel Chute Dewatering Line 2/17&18/94
NOL-1	94-09	NST Tell-Tales/Fuel Chute Dewatering Line 2/23/94

[1] Routine leakage points, paths for subsurface contamination.

TABLE 2-4

Current Radiological Conditions of Buildings in the Industrial Area by Survey Area

Survey area	Description	Nominal exposure rate (mr/hr)	Nominal loose surface contamination (dpm/100cm^2)
SVC-01	NORTH PART OF SERVICE BLDG (CLEAN SIDE)	8	<1000
SVC-02	RAD PORTIONS OF SERVICE BLDG AND ANNEX	8	<1000
SVC-03	CLEAN SIDE OF SERVICE BLDG ANNEX	6	<1000
TBN-01	TURBINE BUILDING AND OFFICES	10	,<1000
SFP-01	**SPENT FUEL PIT AND TRANSFER CHUTE**	**500-10,000**	**300-8700**
SFP-02	**NEW FUEL VAULT**	**100-5000**	**<1000**
BRT-01	CONCRETE PEDESTALS, PAD AND ANNULUS	15	<1000
NSY-01	**NORTH AND SOUTH DECON PADS AND FTE**	**20-700**	**>1000**
NSY-02	IX-PIT, VALVE GALLERY/ PAB STAIRWAY	300	<1000
NSY-03	SI DIESEL/ACCUMULATOR TANK/BATTERY PADS	11	<1000
NSY-04	SAFE SHUTDOWN SYSTEM BUILDING	10	<1000
NSY-05	FIRE WATER TANK AND PUMP HOUSE	13	<1000
NSY-06	PCA#2 (NEW)	10	<1000
NSY-07	WHT / ADT / WASTE GAS PADS	40	<1000
NSY-08	NEW SI TANK	20	<1000
NSY-09	**ELEVATOR SHAFT**	**500**	**<1000**
NSY-10	**ISFSI**	**2000-5000**	**<1000**
NSY-11	**CHEM-WASTE TRANSFER PUMP PIT**	**2000 - 15000**	**>1000**
NSY-12	TANK #1 BASE AND PIPECHASE	15	<1000
NSY-13	**DEMIN WATER STORAGE TANK #39 BASE**	**2500**	**<1000**
WST-01	**PCA #1 (OLD)**	**30-200**	**<1000**
WST-02	**PCA WAREHOUSE**	**60-150**	**>1000**
WST-03	WASTE DISPOSAL BLDG	15	<1000
WST-04	COMPCTOR BLDG	20	<1000
AUX-01	PAB/ EAST END	10	<1000
AUX-02	PAB / WEST END	10	<1000

Survey area	Description	Nominal exposure rate (ur/hr)	Nominal loose surface contamination (dpm/100cm^2)
OMB-01	PUMPHOUSE AND SCREENWELL	11	<1000
OMB-02	SECURITY GATEHOUSE AND DIESEL GENERATOR	6	< 1000
OMB-03	ADMINISTRATION BUILDING	No data	<1000
OMB-04	WAREHOUSE AND LOADING DOCK	6	<1000
OMB-05	FURLON HOUSE	No Data	<1000
OMB-06	SEAL PIT	No Data	<1000

Note: The entries in **BOLD** in the table are either currently in use or the reported exposure rates are influenced by adjacent buildings or tanks that are currently in use.

Table 2-5
Summary of Radiological Conditions of Open Land Areas
(SOF = Sum of Fractions of Proposed Soil DCGLs as submitted)

SURVEY AREA	DESCRIPTION	MARSSIM CLASS	MEDIUM	SOF (min)	SOF (max)	SOF (mean)
OOL-01	SHERMAN POND SEDIMENTS	3	Sediment	0.004	0.287	0.098
OOL-02	YANKEE NON-RAD YARD AREAS	3	Soil	0.002	0.045	0.018
OOL-03	SHERMAN RESERVOIR DAM AND SOUTH SHORELINE	3	Sediment Soil	0.160 0.004	0.160 0.332	0.160 0.036
OOL-04	USGEN / SHERMAN STATION OVERLYING GROUNDWATER PLUME	3	Sediment Soil	0.009 0.006	0.009 0.035	0.009 0.020
OOL-05	USGEN/ DEERFIELD RIVER FRONTAGE	3	Sediment Soil	0.009 0.001	0.107 0.034	0.038 0.018
OOL-06	YANKEE WESTERN ACCESS	3	Sediment Soil	0.007 0.004	0.047 0.080	0.022 0.029
OOL-07	SOILS DEPOSIT AREA	2		no data		
OOL-08	YANKEE SITE EXCLUSION ZONE	3	Sediment Soil	0.005 0.004	0.019 0.345	0.010 0.051
OOL-09	SOUTHEAST CONSTRUCTION FILL AREA	3	Soil Asphalt	0.004 0.014	0.113 0.153	0.022 0.077
OOL-10	ISFSI/ACCESS, EXCLUSION ZONE, BUFFER ZONE	2	Soil	0.003	0.391	0.027
OOL-11	EAST RCA BUFFER ZONE	2		no data		
OOL-12	WAREHOUSE RAIL SPUR	1	Soil	0.013	0.013	0.013
OOL-13	USGEN/RAIL SPUR TERMINUS	1	Soil	0.004	0.031	0.014
OOL-14	USGEN/WHEELER BROOK FRONTAGE	3	Soil	0.004	0.030	0.014
OOL-15	USGEN/SHERMAN RESERVOIR EAST SHORELINE	3	Soil	0.007	0.017	0.012
OOL-16	FURLON HOUSE PARKING LOT	3		no data		
OOL-17	ASPHALT, BRICK AND CONCRETE STORAGE YARD	3		no data		
NOL-01	EAST LOWER RCA YARD	1	Soil	0.004	0.513	0.153
NOL-02	NORTHEASTERN UPPER RCA YARD	1	Soil	0.002	0.422	0.079
NOL-03	SOUTHEASTERN UPPER RCA YARD	1	Soil	0.003	224.5	4.3
NOL-04	SOUTHWESTERN UPPER RCA YARD	1	Soil	0.005	0.676	0.099
NOL-05	NORTHWESTERN UPPER RCA YARD	1	Soil	0.003	0.133	0.021
NOL-06	WEST LOWER RCA YARD	1	Soil	0.003	0.402	0.074
NOL-07	ISFSI RCA YARD	3	Soil	0.003	0.15	0.006

Table 2-6 Radionuclides of Concern At YNPS		
H-3	Tc-99	Eu-155
C-14	Ag-108m	Pu-238
Fe-55	Sb-125	Pu-239,240
Co-60	Cs-134	Pu-241
Ni-63	Cs-137	Am-241
Sr-90	Eu-152	Cm-243,244
Nb-94	Eu-154	

Table 2-7

Well Depths and Sampling Results

Well No.	Well Type*	Depth of Well (feet)	3rd Quarter 2003 Results (pCi/l)		
			H-3	Gross Alpha	Gross Beta
B-1	Intermediate Bedrock	79	1.36E03	2.80E00	9.16E00
CB-1	Shallow Intermediate	25	1.76E03	-	1.35E01
CB-2	Shallow Intermediate	24.5	4.11E02	-	1.62E01
CB-3	Shallow	13	-	4.5E00	2.48E01
CB-4	Shallow	19	-	-	1.41E01
CB-5	Intermediate	59	-	-	-
CB-6	Shallow	25	-	-	1.90E01
CB-7	Shallow	17	-	-	2.6E01
CB-8	Shallow Intermediate	19	-	3.9E00	1.32E01
CB-9	Shallow Intermediate	24	2.33E03	-	6.7E00
CB-10	Shallow	11	9.0E02	-	-
CB-11A	Shallow	20	-	-	1.31E01
CB-12	Shallow	7	-	-	-
CW-1	Shallow Intermediate	21	N/A†	N/A†	N/A†
CW-2	Shallow	20	-	9.2E00	4.25E01
CW-3	Intermediate and Bedrock	23	-	-	1.83E01
CW-4	Shallow Intermediate	17	-	-	1.77E01
CW-5	Shallow and Bedrock	16.5	-	-	1.28E01
CW-6	Shallow	22	-	-	1.10E01
CW-7	Shallow Intermediate	31	-	-	1.13E01
CW-8	Shallow Intermediate	26	-	-	1.11E01
CW-9	Shallow Intermediate	N/17A	N/A†	N/A†	N/A†
CW-10	Bedrock	30	-	4.2E00	1.16E01
CW-11	Shallow	9	3.67E03	-	8.6E00
DW-1	Bedrock	280	-	-	3.89E00
MW-1	Shallow Intermediate	21	-	3.3E00	3.39E01
MW-2	Shallow	17	1.25E03	-	8.3E00
MW-3	Shallow	20	N/A†	N/A†	N/A†
MW-5	No log available	20	3.81E03	-	9.0E00

* "Shallow" = outwash; "Shallow Intermediate" and "Intermediate" = till or lacustrine; "Bedrock" = bedrock
† Well has been closed and grouted over, and thus are no longer available for sampling.

Table 2-7

Well Depths and Sampling Results

Well No.	Well Type*	Depth of Well (feet)	3rd Quarter 2003 Results (pCi/l)		
			H-3	Gross Alpha	Gross Beta
MW-6	No log available	17	-	5.64E00	1.05E01
NSR-1	Shallow and Bedrock	23	N/A†	N/A†	N/A†
OSR-1	Shallow	13	-	-	-
CFW-1	No log available	8	-	-	-
CFW-2	No log available	20	-	-	7.37E00
CFW-3	No log available	34	-	-	-
CFW-4	No log available	53	-	-	-
CFW-5	No log available	5	-	-	-
CFW-6	No log available	6	-	-	-
CFW-7	No log available	Not known	-	-	-
MW-100A	Shallow	20	<2E03‡	-	-
MW-100B	Bedrock	43	<2E03‡	-	-
MW-101B	Bedrock	152	<2E03‡	-	-
MW-101C	Intermediate	99	<2E03‡	-	-
MW-102A	Shallow	38	8.7E03‡	-	-
MW-102B	Bedrock	130	<2E03‡	-	-
MW-102C	Intermediate	99	1.48E04‡	-	-
MW-103A	Shallow	25	<2E03‡	-	-
MW-103B	Bedrock	295	<2E03‡	-	-
MW-103C	Intermediate	125	1.9E03‡	-	-
MW-104B	Bedrock	194	<2E03‡	-	-
MW-104C	Intermediate	97	7.29E03‡	-	-
MW-105B	Bedrock	74	6.03E03‡	-	-
MW-105C	Intermediate	37	7.72E03‡	-	-
MW-107B	Bedrock	110	<2E03‡	-	-
MW-107C	Intermediate	32	4.8E04‡	-	-
MW-107D	Intermediate	80	9.15E03‡	-	-

‡ Results from initial well screening performed during drilling (not official 3rd Quarter 2003 results)

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