October 7, 2005

Yankee Atomic Electric Company
49 Yankee Road
Rowe, MA 01367
Attention: Joseph Lynch, Site Closure Project Director

RE: Rowe-BWSC-RTN #1-13411
Phase II – Comprehensive Site Assessment Report
Interim Report - Review
310 CMR 40.000
Yankee Nuclear Power Station
49 Yankee Road

Dear Mr. Lynch:

On January 28, 2005, the Massachusetts Department of Environmental Protection (the Department) received a Phase II - Comprehensive Site Assessment (Phase II) Report for the Yankee Nuclear Power Station (YNPS) in Rowe, MA, as required according to the Department’s Bureau of Waste Site Cleanup (BWSC) regulations at 310 CMR 40.000 (the Massachusetts Contingency Plan, or the MCP). The Phase II Report was submitted on behalf of Yankee Atomic Electric Company (Yankee) by its consultant, Environmental Resources Management (ERM) of Boston, MA. Additional Phase II information was submitted by Yankee to the Department subsequent to the January 28, 2005 Report.

The Yankee plant was shut down in 1992 and is in the process of decommissioning, in accordance with Nuclear Regulatory Commission (NRC) regulations 10 CFR Part 50. As a part of decommissioning activities, the YNPS site is being assessed and remediated in accordance with applicable environmental regulations. All radiological issues associated with decommissioning fall under the authority of the NRC, the Massachusetts Department of Public Health’s Radiation Control Program (the MADPH), the Department, and the United States Environmental Protection Agency (the EPA), as applicable. Any non-radiological contamination at the site falls under the authority of the Department and the EPA, as applicable. The Department has previously classified the YNPS site as a Tier 1B site, according to the BWSC regulations at 310 CMR 40.000.

The Phase II Report contains the results of assessment for both radiological and non-radiological parameters at the site (Stage I of the assessment), but does not contain a Risk Assessment (Stage II of the assessment).
Assessment and remedial actions (excavation, treatment and/or disposal) of soil and sediment are progressing concurrently with site decommissioning (dismantlement of structures, demolition and restoration). Yankee will complete cumulative (radiological and non-radiological) Human Health and Ecological Stage II Risk Assessments for the YNPS site, according to Department regulations and requirements, following cleanup actions and upon the Department's determination that the Phase II Report is complete and satisfactory. The Department considers the Report that was submitted to be an Interim Report, as additional assessment work is still required before the Risk Assessments may be performed (i.e. there are data gaps which need to be filled). As agreed to by the Department (due to the separate yet overlapping authorities of the regulatory agencies involved), the Phase II investigation and Report is being performed within the context of the MCP for the purposes of site closure, but not as a formal Release Tracking Number (RTN) for the entire site. The Department is issuing this Review of Report (the Review) for the Interim Phase II Report according to its authority under M.G.L. c. 21E and the regulations promulgated thereunder at 310 CMR 40.000.

I. ASSESSMENT SUMMARY

1. List of Reports Reviewed

In addition to the Phase II Report dated January 28, 2005, the Department has reviewed numerous other reports for the YNPS site, as part of the Phase II review process. It should be noted that these reports were generally prepared and submitted for other agency purposes (i.e. the NRC, MADPH or the EPA), so the Department has not issued specific reviews of these reports. Rather, the Department utilized these reports as reference documents to aid in review of the Phase II Report. These additional reports include the following:

- Decommissioning Environmental Report, dated December, 1993
- Analysis of Historical Aerial Photography for the YNPS Site, dated April, 1997;
- Technical Basis Document for Background Cs-137 in Soil and Sediment, dated March 3, 1998;
- Deerfield River Sediment Screening Study; dated October, 2000;
- Deerfield River Sediment Screening Study: Follow-Up Assessment; dated March 19, 2001;
- Site Ground Water Data Collection for YNPS Decommissioning, dated February 3, 2003;
- License Termination Plan, Revision 1, dated November, 2004;
- Evaluation of Cs-137 Concentration in Soils of Non-impacted and Reference Areas in the Vicinity of YNPS, dated December 17, 2003:
- Historical Site Assessment, dated January 21, 2004;
- Baseline Environmental Report, dated April 30, 2004;
- YNPS Site Characterization Status Report, dated June 4, 2004;
- An Overview of Sources of Radioactivity in the Environment of the YNPS and Associated Measurement and Control Programs, dated November, 2004;
- Environmental Risk Characterization Work Plan, dated January, 2005;
- Ground and Well Water Monitoring Program, dated February, 2005;
- Subsurface Soil Scoping Sample Plan Close-out, dated February 2, 2005;
- 2004 Annual Radiological Environmental Operating Report, dated April 26, 2005;
• Storm Drain & Septic Drain Sample Plan Close-out, dated May 6, 2005

Assessment and remedial activities, particularly radiological assessment and remedial activities being performed to support the Final Status Survey (FSS) of the License Termination Plan (LTP), are ongoing at the site at this time. This Interim Phase II Report review is based on the data contained within the January 28, 2005 Phase II Report and information from the additional reports cited above; the Department acknowledges that more recent data may have been collected by Yankee but is not addressed in this Report or review.

2. General Information

The YNPS site was divided into three land areas for the purposes of outlining the results of the Phase II Report, and these areas will be referenced in this review. These areas are:
• The Radiologically Controlled Area (RCA), which is the approximately 4-acre parcel immediately surrounding the former operating nuclear plant area;
• The Industrial Area, which is the approximately 13-acre parcel immediately surrounding the RCA, within the YNPS fenceline, which formerly contained industrial structures associated with the plant, also referred to in this Review as "the Facility"; and
• The Non-Industrial Area, which is that portion of YNPS property outside the fenced Industrial Area, containing woodlands, roadways, etc., which encompasses approximately 1,783 acres, including surface water bodies adjacent to and downstream from YNPS.

The Phase II Report contained the following information:

• A summary of previous assessment work, including analytical data (non-radiological and radiological) in tabular form;
• Updated basemaps, depicting the locations of soil sampling locations, groundwater monitoring wells, and surface water and sediment sampling locations, as well as exceedances of applicable standards;
• A brief description of site history;
• A description of site geology and hydrogeology;
• Groundwater contour maps of the Industrial Area and immediate vicinity;
• Updated maps of tritium concentrations in groundwater; and
• Recommendations for completing the cumulative radiological and non-radiological investigations at the site, in coordination with the completion of decommissioning activities.

3. Non-Radiological Assessment Results

Non-radiological analyses have been performed at the site on numerous samples of soil and groundwater, and to a lesser degree for sediments, surface water and fish. Non-radiological analyses at the site began in a limited fashion as part of regular monitoring in the late 1990s, and have been performed recently as part of Phase II assessment activities. Non-radiological analyses were also performed at the Southeast Construction Fill Area (SCFA) located at the site, as part of the Department’s Solid Waste requirements for assessment and remedial activities at the SCFA. Non-radiological analyses at the site have included various portions of the following parameter list (i.e. not all samples in each medium have been analyzed for the whole list):
• Volatile organic compounds (VOCs) by EPA Method 8260;
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- "Heavy" metals, including the thirteen Priority Pollutant metals, plus hexavalent chromium, and limited analyses of boron and lithium;
- Semi-volatile organic compounds (SVOCs) by EPA Method 8270;
- Polychlorinated biphenyls (PCBs) by EPA Method 8082;
- Total petroleum hydrocarbons (TPH);
- Extractable petroleum hydrocarbons/volatile petroleum hydrocarbons (EPH/VPH) by the Department’s Office of Research & Standards method; and
- Dioxins and furans.

The assessment and remediation of PCBs at the YNPS is being performed according to the authority and oversight of the EPA, in accordance with EPA/TSCA requirements and approvals.

A. Soil:

A total of 23 soil samples were obtained from 10 background locations, to establish background conditions for soils. A total of 250 soil samples were obtained from various depths from 36 locations within the Industrial Area of the YNPS, and a total of 192 soil samples were obtained from the Non-Industrial Area of the YNPS. Analytical results were compared to the Department’s BWSC Method 1 S-1 and S-2 soil standards, which are outlined in the MCP. Note – the classifications for soils at the site range from S-1/GW-1 (unrestricted), to S-2/GW-1 (accessibility restricted), to S3/GW-1 (inaccessible). It should also be noted that these Method 1 standards were used for preliminary evaluation, comparison and planning purposes in guiding, assessment and remedial actions, but that once these actions are completed, the final Risk Assessment will be a Method 3 site-specific assessment to establish that site conditions are protective of human health, safety, public welfare and the environment into the future.

Exceedances of soil standards were found in the Industrial Area as follows:

- Sample SB-005, located near the eastern boundary of the Industrial Area, exceeded the S-1 standard of 200 milligrams/kilogram (mg/kg), or parts-per-million (ppm) for EPH, with a concentration of 226 mg/kg;
- Samples SB-020, SB-020F, SB-020G, SB023, & SB-074, located south of the former site trash incinerator (on the hillside between the Industrial Area and the Administration Building), exceeded the S-1 standard of 4 picograms/gram (parts-per-trillion, or ppt) for dioxin, with the highest dioxin level at 36.9 ppt;
- A number of soil samples (in areas either currently undergoing PCB remediation or in areas slated for PCB remediation), exceeded the S-2 standard for PCBs of 2 mg/kg (due to PCBs in paint chips), with the highest PCB level beneath the former Vapor Container (VC) at 240 mg/kg and the highest level within the Southeast Construction Fill Area (SCFA) at 12 mg/kg;
- Sample SB-056, along the site access roadway near the Industrial Area entrance, exceeded the S-2 standards for several polycyclic aromatic hydrocarbons (PAHs), with a benzo(a)pyrene (BAP) level of 1,400 micrograms/kilogram (ug/kg), or parts-per-billion (ppb), versus the S-2 standard of 700 ug/kg;
- Sample SB-071, near a former fuel oil tank, exceeded the S-2 standards for several polycyclic aromatic hydrocarbons (PAHs), with a BAP level of 1,000 ug/kg.

Exceedances of soil standards were found in the Non-Industrial Area as follows:

- Samples SB-157 and SB-158, in the Visitors Center parking lot, exceeded the S-1 standard of 200 mg/kg for TPH, with a concentration of 320 mg/kg;
- Nine samples in the vicinity of the former railroad bed on-site (near SB-105), just outside the northwest corner of the fenced Industrial Area, exceeded S-2 standards for up to seven different
PAHs, at levels up to 300 mg/kg total PAHs; and

- Nine samples in the area of the Old Shooting Range (near SB-135) exceeded the S-2 criteria of 600 mg/kg for lead, with lead levels up to 2,900 mg/kg (the contamination was limited to surficial soils).

B. Groundwater

The first groundwater monitoring well was drilled at the site in 1977, and a total of 65 monitoring wells have been installed at the site to date. A total of 27 new, intermediate-depth and deep monitoring wells were installed in 2003 and 2004 (with Department oversight), and 22 existing, shallow monitoring wells were properly abandoned (in accordance with Department guidelines) in 2004 and 2005 due to demolition activities as part of decommissioning. Currently, there are a total of 42 monitoring wells on-site, with 20 shallow (water-table) wells, 12 intermediate depth wells, and 10 deep, bedrock wells. A total of 58 monitoring wells, and the Facility potable supply well were sampled in 2003 and 2004.

Monitoring well drilling revealed the following information on the geology and hydrogeology of the site:

- The geologic stratigraphy of the site, from top to bottom, consists of up to 40 feet of stratified sand and gravel ("stratified drift") at the surface, underlain by up to 210 feet of glacial lodgement till, which is underlain by up to 170 feet of glaciolacustrine sediments, underlain by metamorphic bedrock (albite gneiss) of the Lower Cambrian Hoosac Formation;
- The entire sequence of unconsolidated ("overburden") materials above bedrock thickens considerably towards the Deerfield River, with a maximum depth to bedrock of 280 feet at monitoring well MW-103B;
- There are a number of thin, discrete, permeable sand layers ("stringers") within the relatively impermeable glacial till;
- Groundwater flow maps show that groundwater flow beneath the Industrial Area (shallow, intermediate and bedrock) is primarily towards the Deerfield River below Sherman Dam (towards the vicinity of Sherman Spring), with some indication of a minor amount of radial flow towards Sherman Reservoir.

Analytical results of groundwater samples were compared to the Department's groundwater standards for the site, as contained in the MCP. The Department has determined that the GW-1 groundwater classification applies for the entire site. Exceedances of groundwater standards were outlined as follows:

- Shallow well MW-5, bedrock well MW-107B, and intermediate well MW-107D, located in the immediate vicinity of the former Vapor Container, exceeded the GW-2 standard of 0.3 micrograms/liter (ug/l, or parts-per-billion) for PCBs, with the highest PCB level at 5.5 ug/l in well 107B (PCBs are attributed to paint chips washed into the flush-mounted wells by surface water);
- Intermediate well MW-105C, located just northwest of the former Turbine Building, exceeded the GW-2 standard of 1.0 ug/l for the VOC 1,1- dichloroethylene (1,1-DCE), with a 1,1-DCE level at 1.7 ug/l.
- Intermediate well MW-101C, located in the immediate vicinity of the former Vapor Container, contained a TPH level of up to 3,470 ug/l (above the GW-1 standard of 1,000 ug/l), and also contained the VOC acetone up to 14,000 ug/l, above the GW-1 standard of 3,000 ug/l.
- Intermediate well MW-102C, located in the immediate vicinity of the former Vapor Container, and bedrock well MW-103B, near the Industrial Area entrance, exceeded the GW-3 standard of 30 ug/l for lead, with lead levels of 37 ug/l and 100 ug/l, respectively;
- Bedrock well MW-108B, located near the former Screenwell House, exceeded the GW-2 standard of 30 ug/l for the SVOC bis-2-ethylhexylphthalate (bis-2) with a bis-2 level of 36 ug/l.
C. Surface Water

Eleven surface water samples were collected from five locations along Wheeler Brook, as part of the Solid Waste Comprehensive Site Assessment (CSA) investigation for the SCFA. Surface water samples were also collected in 2003 and 2004 from: Sherman Spring; four locations in Sherman Reservoir near the East Storm Drain outfall; one location in Sherman Reservoir near the Facility discharge structure, one location at the beginning of the West Storm Drain Ditch, and two locations in the Deerfield River at the outfall of the West Storm Drain Ditch.

Surface water results were not provided in the Phase II Report (the Department previously received and separately reviewed the non-radiological surface water analyses as part of the CSA for the SCFA).

D. Sediment

Sediment samples were collected in 2003 and/or 2004 from the following locations: 6 background samples from the northern portion of Sherman Reservoir; a total of 44 samples from 36 locations in Sherman Reservoir near the Facility; 19 samples from the Deerfield River just below Sherman Dam (primarily near the outfall of the West Storm Drain Ditch); 11 samples from the West Storm Drain Ditch; and 5 locations on Wheeler Brook (as part of the Solid Waste SCFA CSA). Analytical results of sediment samples were compared (maximum to maximum) with the background samples, as background sediments contain naturally-occurring inorganics and potentially other contaminants. The background samples were non-detectable (ND) for PCBs and SVOCs, ND for most VOCs (except for low levels of 1,1-DCE, 2-butanone, acetone and toluene, apparently due to laboratory contamination) and contained low levels of TPH. Although not performed by ERM, contaminant levels can also be compared to the Department’s Threshold Effects Concentrations (TEC) levels for sediments.

The Phase II Report states that the following samples were greater than three times the background samples, for the following parameters:

- Samples SD-008 and SD-009, in Sherman Reservoir near the Discharge Structure, contained copper at least five times the background level;
- Samples SD-011 and SD-012, in Sherman Reservoir near the Intake Structure, contained lead at least five times and three times the background level, respectively;
- Sample SD-041 in Sherman Reservoir north of the facility (700 feet from shore), contained TPH at 250 mg/kg, at least three times the background level;
- Sample SD-302 and SD-303 in the West Storm Drain Ditch contained total SVOCs at least three times and five times the background level, respectively; and
- Sample SD-304 in the West Storm Drain Ditch contained lead at least three times the background level.

The Department’s sediment screening guideline for PCBs in sediments is 60 ug/kg. PCBs were detected in sediments as follows:

- 11 of the 44 samples in Sherman Reservoir had detectable PCBs, ranging from 47 ug/kg to 980 ug/kg;
- 10 of the 19 samples from the Deerfield River (at the West Storm Drain Ditch outfall) had detectable PCBs, ranging from 15 ug/kg to 1,020 ug/kg;
- 8 of the 11 samples from the West Storm Drain Ditch had detectable PCBs, ranging from 72 ug/kg to 950 ug/kg; and
- All 5 samples from Wheeler Brook were ND for PCBs.
The areas of PCB detection in Sherman Reservoir and the West Storm Drain Ditch are the areas of completed, ongoing, and/or planned PCB remediation in accordance with EPA TSCA requirements.

E. Fish

Fish were collected and analyzed for PCBs as part of Phase II assessment work at three locations – near the East Storm Drain Outfall in Sherman Reservoir; the northern end of Sherman Reservoir, and Harriman Reservoir.

The Phase II Report states that PCB levels were detected in the fish samples from Sherman Reservoir near the East Storm Drain. The Phase II Report states that “...the levels...do not pose a risk to consumers of recreationally-caught fish.”.

4. Radiological Assessment Results

Radiological assessment for the YNPS has been performed by Yankee as part of various programs. Regularly scheduled monitoring was performed on-site and off-site according to the Radiological Environmental Monitoring Program (REMP) for the YNPS, and radiological monitoring was also performed on-site during the operation of the plant for various reasons, outside the scope of the REMP program. As part of the decommissioning of the plant, considerable radiological assessment of the YNPS facility and site has been performed, and is ongoing at the present time, to satisfy the NRC requirements for License Termination, as demonstrated by the Final Status Survey (FSS).

A. REMP MONITORING

The REMP program was initiated at the site in 1958, prior to startup of the YNPS, and has continued to the present. The REMP program has been conducted to satisfy NRC regulations to continuously monitor the areas surrounding the YNPS for possible radiological releases to the environment, and has consisted of the following:

- Radiological monitoring of air, soil, groundwater, surface water, sediment, fish, food crops, milk and direct radiation at various locations at or surrounding the site;
- Analysis of REMP samples by gamma spectroscopy, including Ag-108m, Ag-110m, Ba/La-140, Ce-141, Ce-144, Co-57, Co-58, Co-60, Cr-51, Cs-134, Cs-137, Fe-59, I-131, Mn-54, Nb-95, Ru-103, Ru-106, Sb-124, Sb-125, Se-75, Zn-65, and Zr-95. The Phase II Report states that any other gamma-emitting radionuclides would be detected and reported by these analyses, if they were present. In addition to the gamma spectroscopy, REMP samples have also been routinely analyzed for the presence of gross beta and tritium (as quarterly analysis of the composite of monthly samples of water from the Deerfield River). Tritium (H-3) is a weak beta emitter and is a Hard-To Detect (HTD) radionuclide;
- Air sampling has been performed at 2 background and 5 other “indicator”, i.e. downwind, locations at and around the YNPS site, for both airborne particulates and gases, on a bi-weekly (composited quarterly) basis. The Phase II Report states that “No Yankee plant-related radioactivity was detected on either the particulate filters or the charcoal cartridges in the last twenty years”. Charcoal cartridges were used during plant operation (and for a short time after shutdown) for radiiodine sampling;
- Soil sampling has been performed at the air sampling locations on 4 occasions since 1978, and numerous soil samples were also analyzed for Cs-137 in the “Evaluation of Cs-137 Concentration
in Soils of Non-impacted and Reference Areas in the Vicinity of YNPS” study, dated December 17, 2003. The Phase II Report states that review of this data indicates the presence of only naturally-occurring K-40 and Th-232 and Cs-137 from weapons testing fallout;

- Groundwater samples have been collected from the Facility’s potable water well and from Sherman Spring at the site (which flows overland to the Deerfield River), on an annual basis. The Phase II Report states that no gamma-emitting radionuclides were found in either location. Tritium was detected in Sherman Spring beginning in 1963, with a maximum concentration of approximately 2 million picocuries/liter (pCi/l) in 1965. Tritium levels in Sherman Spring have declined steadily since at least 1983, with levels in 2004 ranging from non-detectable (ND) to 890 pCi/l.

- Tritium in Sherman Spring is attributed to discharge (to the spring and the river) of the tritium-contaminated groundwater plume at the site, which originated from leak(s) in the Spent Fuel Pool/Ion Exchange Pit Complex (SFP/IXP Complex). Tritium concentrations were measured in the water within the SFP/IXP Complex in 1966, at a concentration of 5.4 million pCi/l. There are no specific drinking water, surface water, or groundwater standards established in Massachusetts for tritium; the EPA drinking water standard (MCL) for tritium is 20,000 pCi/l;

- Surface water samples have been collected at a background location upstream at Harriman Reservoir, at Sherman Reservoir near the Facility Discharge Structure, and at Bear Swamp Reservoir (4 miles downstream from the plant), on both a continuous (composited monthly) and monthly grab-sampling basis. The Phase II Report states that no gamma-emitting radionuclides were found in surface water at any of the locations. Tritium was detected at the Bear Swamp location from at least 1985 to 1991, at concentrations ranging from approximately 300 pCi/l to approximately 600 pCi/l, versus ND to approximately 200 pCi/l at the upriver Harriman Reservoir location (background levels of tritium are present in rainwater, primarily from natural sources but with some residual component from weapons testing). As noted above, there is no surface water standard for tritium; the EPA MCL for tritium is 20,000 pCi/l;

- Sediment samples were collected at a background location upstream at Harriman Reservoir, at apparently 3 locations in Sherman Reservoir (including near the Facility Discharge Structure), and at the Deerfield River #4 Station dam (the #4 Dam, 22.5 miles downstream from the plant), on a semi-annual basis. The Phase II Report states that, due to previous licensed liquid releases, low levels of Co-60 and Cs-137 were found in some Sherman Reservoir sediments near the Facility’s Circulating Water outfall. Yankee states that: “these low levels were most likely due to the increased amount of organic material in the sediments of that area”...; “the impacts are localized to the south end of the reservoir and the areas in the immediate proximity of the storm drain outlets”...; “samples from other areas of the Sherman Reservoir and the Deerfield River contained no detectable amounts of plant-related radioactivity.”...; and “Sediment samples in a follow-up study were also analyzed for Sr-90. Although detected, the results of Sr-90 were consistent with background from fallout associated with nuclear weapons testing.”. The “2004 Annual Radiological Environmental Operating Report, dated April 26, 2005” states that in 2004, Cs-137 levels were approximately 7 times higher than the background levels in samples from station SE-91 in Sherman Reservoir, near the plant, “attributable in part to plant licensed discharges”.

- The “Deerfield River Sediment Screening Study; dated October, 2000” contains data showing that Co-60 was present in sediment samples from 1971 (earliest data reported) until 1976 at an average of 1.40 pCi/g behind Sherman Dam, 0.61 pCi/g behind the #5 Dam (Monroe Bridge), and 0.19 pCi/g behind the #4 Dam, versus non-detectable (ND) levels at the Harriman Reservoir background location. Cs-137 levels were elevated during this time period behind Sherman Dam, but apparently not downriver.

- The October, 2000 Report shows that from 1979 to 1994, Co-60 levels averaged 0.12 pCi/g behind Sherman Dam, 0.07 pCi/g behind the #5 Dam, and 0.09 pCi/g behind the #4 Dam, versus ND levels at the Harriman Reservoir background location.
Fish were collected semi-annually for sampling at a background location upriver at Harriman Reservoir, and in Sherman Reservoir. The 2004 REMP Report states that “No plant-related gamma-emitting radionuclides were detected in 2004 fish samples”. However, the data presented in the Phase II Report indicates that Cs-137 levels in fish from the Sherman Reservoir location were higher than those from the Harriman Reservoir background location in 10 out of the last 14 years. Yankee states that variations in Cs-137 levels in fish may also be due to species differentiation and eating habits (i.e. bottom feeders tend to accumulate more Cs-137 and there may be a greater proportion of bottom feeders near the Facility than at the Harriman Reservoir background location);

- Food crops (fruit and leafy vegetables) were collected annually from 1 to 4 indicator locations in the area of the YNPS, with one background location at Williamstown, MA. Maple syrup was also collected annually from one or more locations in the area of YNPS. The Phase II Report states that no plant-related radionuclides were detected;

- Milk sampling was performed until 1999 at two indicator dairy farms within 5 miles of YNPS, and at one control dairy farm location. Sampling was performed monthly from June to November of each year (grazing season), however sampling was discontinued after 1999 as no dairy farms remained in the area to sample. The Phase II Report states that levels of Sr-90 and Cs-137 found in both the indicator and control locations are typical of weapons testing fallout values; and

- Direct radiation measurements have been monitored at 33 locations around YNPS, using dosimeters, which are collected quarterly for readout. The 2004 REMP Report states that “... there was no significant overall increase in direct radiation exposure rates in the plant vicinity beyond the industrial area of the plant.”

**B. FINAL STATUS SURVEY MONITORING**

In order to satisfy NRC requirements for the FSS, numerous soil samples and a limited number of additional sediment samples have been obtained and analyzed for radiological analyses by gamma spectroscopy, to at a minimum quantify the radionuclides Ag-108m, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Eu-155, Nb-94, and Sb-125. As outlined in FSS requirements, a minimum of 5% of soil samples have also been analyzed for the Hard-To-Detect (HTD) radionuclides H-3 (tritium), Am-241, C-14, Cm-243/244, Fe-55, Ni-63, Pu-238, Pu-239/240, Pu-241, Sr-90, and Te-99, all groundwater samples have been analyzed for tritium, and a majority of the groundwater samples have also been analyzed for gross alpha, gross beta, and the gamma spectroscopy and HTD radionuclides.

Yankee states that the FSS list of radionuclides is analyzed as part of the entire gamma spectroscopy library (with the exception of HTD radionuclides). If any other radionuclides were detected by gamma spectroscopy above minimum detectable activities (MDAs), they would have been reported as part of these analyses, however Yankee reports that no such additional plant-related radionuclides have been detected by gamma ray spectroscopy above MDAs, in any media at the YNPS site. Yankee also states that the REMP analysis is more simplified than the FSS and served as an indicator of any radionuclides which may have resulted from plant operation.

ERM and Yankee state that the Derived Concentration Guideline Levels (DCGLs), or radiological cleanup levels, established at the site for all media will meet the following:

- The NRC LTP/FSS standard of no more than 25 mrem/year (mrem/yr) total radiation dose above background, or Total Effective Dose Equivalent (TEDE) attributable to the site; and

- The MADPH standard of no more than 10 mrem/yr TEDE attributable to the site.

Yankee states that compliance with the Department’s Risk Assessment standards for cumulative risk
(radiological and non-radiological) of no more than $1 \times 10^5$ Excess Lifetime Cancer Risk (ELCR) and no more than a Hazard Index (HI) of 1 will be demonstrated by the following:

- Calculations which include the data collected during the FSS; and
- As required by the Department’s July 29, 2005 Beneficial Use Determination (BUD) permit for subsurface structures at the site, the incorporation of a three-foot layer of clean soil over the central portion of the YNPS site (the 3.5 acre BUD Fill Area).

1. **Soil:**

More than 1,500 samples have been obtained from the RCA and the remainder of the Industrial Area, and numerous soil samples have been obtained from the Non-Industrial Area. Decommissioning activities within the Industrial area have resulted in the proper removal of substantial volumes of soil off-site, as radiological waste, according to NRC requirements. Confirmatory soil samples are being obtained after remedial activities are completed. Samples for the FSS are taken to demonstrate that the established soil DCGLs are being met to comply with the NRC and MADPH standards.

2. **Groundwater**

All 58 monitoring wells were sampled in 2003 and 2004 for gross beta, gross alpha and tritium. Additional analyses for specific wells were performed in accordance with site procedure AP-8601, *Ground and Well Water Monitoring for the Yankee Nuclear Power Station Site*, including gamma spectroscopy and Hard-to-Detect radionuclides. The Phase II Report states that “Tritium continues to be the only plant-related radionuclide detected in groundwater at YNPS”. The source of the tritium plume in groundwater at the site appears to have been the leak(s) in the Spent Fuel Pool/Ion Exchange Pit complex (SFP/IXP complex). The Phase II Report and 2004 Hydrogeological Report include the following information:

- The shallow tritium plume extends laterally from the SFP/IXP complex towards Sherman Spring and the Deerfield River;
- The deeper tritium plume extends from the base of the SFP/IXP complex into the sand layers within the glacial till and the glaciolacustrine unit, to the top of bedrock (and into bedrock in at least one well), and is more limited laterally, extending from the SFP/IXP complex a shorter distance towards Sherman Reservoir;
- Detectable tritium levels in groundwater in 2004 range from a maximum of 41,800 pCi/l in the vicinity of the SFP/IXP complex to 620 pCi/l in well MW-106C, between Sherman Spring and the river;
- The highest levels of tritium in groundwater at the site in 2004 were found in well MW-107C (near the SFP/IXP complex) at a depth of approximately 30 feet, with a maximum concentration of 41,800 pCi/l;
- The highest levels of tritium at depth in 2004, in glaciolacustrine sands just above the top of bedrock, were found in well MW-107D (near the SFP/IXP complex) at a depth of approximately 70 feet, with a maximum concentration of 12,760 pCi/l; and
- Tritium was detected in 1 of the 10 bedrock monitoring wells on-site in 2004, at well MW-105C, with a maximum concentration of 5,280 pCi/l.

Yankee has stated that groundwater being dewatered from excavations during decommissioning activities, specifically at the base of the SFP/IXP complex, will be collected, sampled and discharged in accordance with the YNPS NPDES permit and NRC protocol, and that regularly scheduled groundwater sampling will resume in the Fall of 2005, or when demolition and site re-grading activities are completed. Yankee has proposed to install two new, monitoring well clusters at locations within and adjacent to the SFP/IXP complex, once remedial work is completed in that area.
3. Sediment

In addition to the REMP sediment monitoring program, Yankee performed additional sediment sampling at Sherman Reservoir and the Deerfield River (between Sherman Dam and the Monroe Bridge dam) as part of the 2000 and 2001 sediment studies. The Phase II Report states that the studies mirrored the results of REMP sediment monitoring, with no plant-related radioactivity found in the Deerfield River, and low levels of Cs-137 and Co-60 found in sediments in Sherman Reservoir near the plant.

II. DEPARTMENT DETERMINATIONS

Personnel of the Department have reviewed the Phase II Report for the YNPS in accordance with MGL c. 21E, and the regulations promulgated thereunder at 310 CMR 40.0000, i.e. the Massachusetts Contingency Plan (the MCP), and the Department's publication Standard References for Monitoring Wells (WSC-310-91). The Department has determined that the Phase II Report is acceptable in accordance with MGL c. 21E and 310 CMR 40.0000, subject to the conditions outlined below.

1. The Department considers the Phase II Report that was submitted to be an Interim Report, as additional assessment work is still required before the Phase II Report can be considered complete and the Risk Assessment may be performed. The assessment work outlined below at Conditions 2 through 12 shall be completed, and the results of this additional assessment work shall be included in the Final Phase II Report and Final Risk Assessment Scope-of-Work, which shall be submitted to the Department by July 15, 2006, as outlined at Condition 14 of this Review.

2. The additional environmental monitoring work required for the Final Phase II Report (as outlined in this review) shall be analyzed for the following parameters:

A. Non-radiological:

1. All VOC analyses shall be performed by EPA Method 8260, which shall specifically include methyl ethyl ketone, methyl isobutyl ketone, and acetone. Tentatively identified compounds (TICs) will be reported in a minimum of 5% of the VOC samples and will be quantified as required by CAM-WSC-II-A, Quality Assurance and Quality Control Requirements for SW-846B Method 8260B, Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) for the Massachusetts Contingency Plan (MCP);
2. All soil samples shall be analyzed for VOCs by EPA Method 8260, and for the thirteen Priority Pollutant metals;
3. All groundwater samples shall be analyzed for VOCs by EPA Method 8260, and for the thirteen Priority Pollutant metals (plus boron);
4. All surface water samples shall be analyzed for the thirteen Priority Pollutant metals plus lithium and boron;
5. All sediment samples shall also be analyzed for the thirteen Priority Pollutant metals plus lithium, boron and total uranium;
6. In any areas (soil, groundwater, surface water and sediment) where previous data indicates levels of oil and hazardous materials (OHM) greater than applicable reportable concentrations or substantially elevated relative to background for sediment and surface
water, and confirmatory sampling (showing reduction to acceptable risk levels as outlined in Condition 5 of this review) following remediation has not yet been performed, the following analyses shall also be performed:

A. Semi-volatile organic compounds (SVOCs) by EPA Method 8270;
B. Polychlorinated biphenyls (PCBs) by EPA Method 8082; and
C. Extractable petroleum hydrocarbons/volatile petroleum hydrocarbons (EPH/VPH) by the Department’s Office of Research & Standards method.

B. Radiological:

1. Radiological analyses by gamma spectroscopy, as required below at Conditions 2.B.2 through 2.B.6, shall at a minimum quantify the radionuclides Ag-108m, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Eu-155, Nb-94, and Sb-125. In addition, any other plant-related radionuclides detected by gamma spectroscopy above MDAs shall be reported as part of these analyses;
2. All soil samples shall be analyzed for the presence of radionuclides by gamma spectroscopy, and, as outlined in the LTP requirements, a minimum of 5% of these samples shall also be analyzed for the Hard-To-Detect (HTD) radionuclides H-3 (tritium), Am-241, C-14, Cm-243/244, Fe-55, Ni-63, Pu-238, Pu-239/240, Pu-241, Sr-90, and Te-99;
3. All groundwater samples shall be analyzed in accordance with site procedure AP-8601, Ground and Well Water Monitoring for the Yankee Nuclear Power Station Site, which includes analysis for the HTD radionuclide tritium and gross alpha/gross beta for all samples, and gamma spectroscopy analysis plus analysis for the remaining HTD radionuclides Am-241, C-14, Cm-243/244, Fe-55, Ni-63, Pu-238, Pu-239/240, Pu-241, Sr-90 and Te-99 in any samples which contain elevated levels of tritium;
4. All surface water samples shall be analyzed for the presence of radionuclides by gamma spectroscopy and also for the HTD radionuclide tritium;
5. All sediment samples shall be analyzed for the presence of radionuclides by gamma spectroscopy, and a minimum of one (1) sediment sample from each sediment location shall also be analyzed for the HTD radionuclides tritium, Am-241, C-14, Cm-243/244, Fe-55, Ni-63, Pu-238, Pu-239/240, Pu-241, Sr-90, and Te-99; and
6. All fish samples shall be analyzed for the presence of radionuclides by gamma spectroscopy, and also for the HTD radionuclides tritium, Am-241, C-14, Cm-243/244, Fe-55, Ni-63, Pu-238, Pu-239/240, Pu-241, Sr-90, and Te-99.

3. Quality Assurance/Quality Control Plan (QA/QC) protocols for non-radiological environmental monitoring should follow those outlined in the Quality Assurance Project Plan (QAPP) for Site Closure, Yankee Nuclear Power Station (YNPS), Rowe, Massachusetts, QAPP YNPS-001 (Revision 2, August 6, 2004, with Revision 3 update pending in September 2005). This follows the requirements of the current revision of USEPA SW-846 methods (USEPA, Region I, 1999) and, where applicable and appropriate, according to the procedures and methods defined in MA DEP’s Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data in Support of Response Actions for the Massachusetts Contingency Plan (MCP), Waste-Site Cleanup Compendium of Analytical Methods (WSC-CAM) VI A (MA DEP, May 21, 2004). Radiological monitoring shall follow applicable NRC, EPA, and MADPH protocol.

4. All radiological analytical data shall be reported as appropriate in the Phase II Report as activity concentrations, not as modeled doses, i.e. pCi/l or pCi/g, not as mrem/yr or mrem/hr, unless the analysis result is defined as mrem (i.e., dosimeter results).
5. Ongoing assessment activities shall be planned and completed in order to be able to document that the following remedial standards will be met for the site: The NRC LTP/FSS standard of no more than 25 mrem/yr total radiation dose (above background) attributable to the site; the MADPH standard of no more than 10 mrem/yr total radiation dose (above background) attributable to the site; and the Department's Risk Assessment standards for cumulative risk attributable to the site (radiological and non-radiological) of no more than $1 \times 10^{3}$ Excess Lifetime Cancer Risk (ELCR) and no more than a Hazard Index (HI) of 1. As noted previously, the cumulative Risk Assessment will include the data collected during the FSS, and will incorporate the completion of a three-foot layer of clean soil over the BUD Fill Area.

6. Yankee shall demonstrate in the Final Phase II Report that sufficient soil samples have been obtained and analyzed for the appropriate soil parameters as outlined at Condition 2 of this Review, at the locations outlined below (the Department acknowledges that a considerable amount of soil sampling has already been performed for non-radiological parameters, and that extensive radiological soil surveys and sampling have been, or are being, performed to complete the FSS):

   A. Sufficient background sample locations;
   B. Sufficient samples to fully characterize the scope and extent of all of the previously detected areas of non-radiological soil criteria exceedances outlined in Sec I.3.A of the Assessment Summary of this Review, and to comply with EPA requirements for PCB assessment and remediation; and
   C. Sufficient samples to fully characterize the scope and extent of radiological contaminants in soil at the site, including, at a minimum, the following:
      • Soil sampling at the former SFP/IXP Complex and any other potential sources of radiological contamination at the site, at depths sufficient to define the lower limits of such soil contamination;
      • Soil sampling in the new Facility septic system leach field, and the new and old Administration Building septic system leach field; and
      • Soil sampling at the base of all excavations or excavated areas, sufficient to ensure that soil levels meet the remedial cleanup standards for the site, prior to any backfilling or regrading of those areas; and
   D. Sufficient samples to complete the cumulative Risk Assessment for the site.

7. New groundwater monitoring well clusters (triplets) shall be installed by May 1, 2006 at the proposed locations near the SFP/IXP complex (MW-110 & MW-111), consisting of shallow, intermediate and deep wells. In addition, a shallow and intermediate-depth monitoring well cluster shall be installed by the same deadline along the downgradient edge of the old Facility septic system leach field.

8. All remaining site groundwater monitoring wells, the new monitoring wells required in Condition 7 of this Review, and the former Visitors' Center potable well (radiological analyses only), shall be sampled and analyzed during a minimum of one additional monitoring round as part of the Phase II Investigation for all of the groundwater parameters outlined at Condition 2 of this Review, and the analytical results shall be included as part of the Final Phase II Report. All wells which were temporarily closed during decommissioning activities shall be rehabilitated, sampled and resurveyed as part of the Phase II Investigation, if possible. Yankee shall identify all wells which remain closed as part of decommissioning activities, and any additional wells which may be required to be abandoned. The results of the last two years of sampling and analysis of the Facility potable well shall be included in the Final Phase II Report.
9. The groundwater monitoring wells required in Condition 7 shall be installed in accordance with the procedures outlined in the Department's publication *Standard References for Monitoring Wells* (WSC-310-91), and all groundwater sampling shall be performed in accordance with the USEPA publication *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*, dated July 30, 1996.

10. Groundwater elevations shall be measured at all site monitoring wells during at least one additional monitoring round as part of the Phase II Investigation, and a groundwater contour map shall be prepared from this data. Groundwater elevation data from the new monitoring wells shall be included in the groundwater contour map, if available.

11. Surface water samples and sediment samples (as co-located samples, unless otherwise specified) shall be obtained during one additional monitoring round as part of the Phase II Investigation from the following sampling locations, and shall be analyzed for the appropriate surface water and sediment parameters as outlined at Condition 2 of this Review (unless otherwise modified by this Condition).

   A. **Background:** A minimum of 3 additional surface water and 6 additional sediment samples located in the Deerfield River, above the Harriman Station outfall to Sherman Reservoir;

   B. **Sherman Reservoir:** Sufficient samples to fully characterize the nature and extent of any plant-related contaminants, to include at a minimum characterization of:

      1. elevated levels of metals near the Intake Structure, Discharge Structure, and the East Storm Drain Ditch Outfall (a minimum of 1 surface water and 4 sediment samples at each of these three areas); and
      2. elevated levels of radionuclides in the vicinity of the Facility (number of additional samples to be in accordance with FSS sampling requirements for that area);

   C. **Surface springs:** One location along the true, seep line of Sherman Spring; one location at the historic “Sherman Spring” sampling site; and one location at the seep area of the “second spring” south of Sherman Spring. If any of these locations cannot be sampled because they are dry during the Fall of 2005, they shall be sampled in the Spring of 2006;

   D. **Deerfield River below Sherman Dam:** A minimum of three sediment samples shall be collected from each of the following river sediment sampling locations, which shall be analyzed separately, not as a composite sample (one surface water sample shall be collected at each of the following river sediment sampling locations):

      1. One location at the outfall location of Sherman Spring, in the river;
      2. One location at the outfall location of the “second spring” in the river;
      3. One additional location in the river between Sherman Dam and the West Storm Drain Ditch;
      4. Two locations in the river at the West Storm Drain Ditch outfall to the river (these samples shall also specifically include PCB analyses);
      5. Three additional locations between the West Storm Drain Ditch and the Monroe Bridge Dam, upstream of the former, capped Monroe Sludge Landfill (these samples shall also specifically include PCB analyses);
      6. One location behind the Bear Swamp (Fyfe Brook) dam (for radiological analyses only); and
      7. One location behind the No. 4 dam in Charlemont (for radiological analyses only).

12. Fish sampling shall be performed during one additional monitoring round as part of the Phase II Investigation using the same protocol as that used in the REMP fish sampling program. Fish samples shall be obtained at the following sampling locations, and shall be analyzed for the radiological
parameters as outlined at Condition 2.B.6 of this Review:

A. The historical background REMP fish sampling location at Harriman Reservoir;
B. A location near the facility at the southern end of Sherman Reservoir; and
C. A location in the Deerfield River, between the outfall of the West Storm Drain Ditch and the Monroe Bridge Dam.

The Department reserves the right to require additional fish (and possibly other biota) sampling of Sherman Reservoir and/or the Deerfield River, after the results of the Phase II surface water, sediment and fish sampling are received from Yankee.

13. Yankee shall comply with all other applicable local, state and federal regulations and requirements, including those of the NRC, EPA, MADPH, and the Rowe Conservation Commission.

14. By July 15, 2006, Yankee shall submit to the Department the Final Phase II Assessment Report for the YNPS site, which shall include the following:

(A) Updated basemap(s), depicting the locations of all: existing and abandoned groundwater monitoring wells; soil, surface water, sediment and fish/biota sampling locations, and geologic cross-sections;
(B) Tabular summaries of all analytical data obtained as part of the Phase II Assessment, including both radiological and non-radiological data, detection limits for all parameters, and appropriate standards or criteria for each media shown (for reference purposes);
(C) A groundwater contour map;
(D) Contour maps of the top of bedrock, top of the glaciolacustrine unit, and top of the glacial till unit;
(E) Contour maps of gross alpha and gross beta activity in site groundwater monitoring wells for at least one previous (2003 or 2004) monitoring round;
(F) All historic summaries (or data), if available, of REMP monitoring performed prior to 1971; the ASTM Phase I BWSC (21E) assessment report for the Non-Industrial Area of the Facility; and the actual PCB analytical data for the fish sampling previously performed; and
(G) A Final Scope-of-Work (SOW) to complete a cumulative (radiological and non-radiological) Risk Assessment in accordance with the requirements at 310 CMR 40.0000.

15. The cumulative (radiological and non-radiological) Risk Assessment shall be completed in accordance with Department requirements and submitted to the Department by no later than October 1, 2006.

Upon review of the Risk Assessment, the Department will determine the extent of additional remedial activities which may be required at the site, and the Department will establish the long-term monitoring requirements for the site.

16. Appropriate Health & Safety (H&S) measures shall be utilized for all assessment and remedial work at the YNPS.
The Department reserves the right to require additional investigatory or remedial work at the YNPS site, if continued monitoring results indicate such a need. If you should have any questions or comments regarding this correspondence please contact Larry Hanson (#413-755-2287) or David Howland (#413-755-2280) of this office.

Sincerely,

Michael J. Gorski
Regional Director

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cc:    Kenneth Dow, Gregory Babineau - Yankee
       John McTigue, LSP – ERM, Inc.
       Rowe Board of Selectmen
       Rowe Board of Health
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       Citizens Awareness Network – Deborah Katz, Jonathan Block
       Vermont Dept. of Public Health