YANKEE ATOMIC ELECTRIC COMPANY

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BYR 2006-057

Mr. Stuart A. Richards, Deputy Director
Division of Inspection and Regional Support
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Reference: License No. DPR-3 (Docket No. 50-029)

Subject: Groundwater Protection – Data Collection Questionnaire

Dear Mr. Richards:

The nuclear industry, in conjunction with the Nuclear Energy Institute, has developed a questionnaire to facilitate the collection of groundwater data at commercial nuclear reactor sites. The objective of the questionnaire is to compile baseline information about the current status of site programs for monitoring and protecting groundwater and to share that information with NRC. The completed questionnaire for the Yankee Nuclear Power Station is enclosed. This submittal contains no new regulatory commitments.

Please contact Greg Babineau, Radiation Protection Manager, at (413) 424-2202 or the undersigned at (301) 916-3995, if you have questions about the enclosed information.

Sincerely,

Alice C Carson

YANKEE ATOMIC ELECTRIC COMPANY
Alice C. Carson
Licensing Engineer

Enclosure

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ATTACHMENT 1

Groundwater Protection Questionnaire

1. *Briefly describe the program and/or methods used for detection of leakage or spills from plant systems, structures, and components that have a potential for an inadvertent release of radioactivity from plant operations into groundwater.*

   No leakage or spills can occur at Yankee Nuclear Power Station ("YNPS") that have a potential for inadvertent release of radioactivity from plant operations. YNPS is in an advanced state of decommissioning with all of its spent fuel located in dry cask storage. All systems and structures that contained radioactive liquids have been drained and removed from the site.

2. *Briefly describe the program and/or methods for monitoring onsite groundwater for the presence of radioactivity released from plant operations.*

   The YNPS groundwater program is described in Section 2.7 of the YNPS License Termination Plan (Reference 1) and periodic groundwater reports (References 2-5) Groundwater characterization was initiated after plant shutdown in 1992. The system consists of greater than 50 groundwater monitoring wells. Initial characterization activities focused on shallow aquifer contamination. The system has evolved to include multi-level well clusters to monitor shallow, intermediate, and bedrock aquifers. The wells are located near structures which may have contributed to groundwater contamination, in down-gradient areas, and in up-gradient background areas. The monitoring well network is designed to bound the groundwater plume horizontally and vertically.

   The YNPS groundwater monitoring network has been sampled for a suite of 22 radionuclides including tritium, strontium, and cesium. Currently, sampling is being performed twice per quarter. To date, tritium is the only plant-related radionuclide confirmed in the groundwater. Very low levels of other radionuclides have been measured infrequently, however, the levels have been near the critical level and are believed to be part of the normal background distribution or due to surface water infiltration.

   Development of a numerical model is underway to increase understanding of groundwater fate and transport. Pumping tests, pressure transient tests, and level monitoring are being performed to support groundwater modeling.

3. *If applicable, briefly summarize any occurrences of inadvertent releases of radioactive liquids that have been documented in accordance with 10 CFR 50.75(g).*

   A number of inadvertent releases of radioactive liquids occurred during the operation of YNPS. The occurrences are described in Section 2 of the YNPS License Termination Plan and summarized in Appendix 1 (Table 10 from Reference 4). All of the occurrences in Appendix 1 were considered in the site characterization program, addressed during remediation, and have been or will be verified clean during performance of the Final Status Survey. The most noteworthy release that is believed to be the predominant source of tritium in groundwater, occurred between 1963 and 1965 and involved a leak from the Spent Fuel Pool – Ion Exchange Pit structural interface. The leak is estimated to have resulted in the release of over two

million gallons of water to the soil. Tritium concentrations exceeding 1,000,000 pCi/L were measured in Sherman Spring at the time of the leak. The spring discharges on licensed property and flows into the Deerfield River. The tritium concentration at Sherman Spring decreased exponentially, reaching the minimum detectable concentration (about 300 pCi/L) in about 1992. During recent decommissioning activities, fluctuations up to 6,000 pCi/L have been observed at Sherman Spring as large areas of soil have become uncovered in the up-gradient industrial area.

4. *If applicable, briefly summarize the circumstances associated with any onsite or offsite groundwater monitoring result indicating a concentration in groundwater of radioactivity released from plant operations that exceeds the maximum contaminant level (MCL) established by the USEPA for drinking water.*

   One monitoring well at YNPS, MW-107C, exhibits a tritium concentration of about 40,000 pCi/L. MW-107C is located about 45 feet below the surface near the former location of the Spent Fuel Pit northwest corner. Evaluations to date indicate that MW-107C is located in an isolated sand lens with limited connection to other aquifers. The tritium concentration has slowly decreased for several years. Aquifer testing (pump test) is currently underway to establish the degree of connectivity among aquifers as well as other parameters to validate the conceptual model.

5. *Briefly describe any remediation efforts undertaken or planned to reduce or eliminate levels of radioactivity resulting from plant operations in soil or groundwater onsite or offsite.*

   Decommissioning of YNPS is near completion. The systems, components, and structures that could have contributed to radioactivity in groundwater have been removed and disposed. Significant volumes of soil have also been removed from the site. The remaining soils and below grade concrete structures may still contribute to the observed tritium in groundwater. The natural attenuation of groundwater radioactivity will be monitored until the groundwater radioactivity meets federal and state requirements.

References

1. YAEC Letter to USNRC, "Submittal of Revision 1 to the Yankee Nuclear Power Station's License Termination Plan (LTP)," dated November 19, 2004, BYR 2004-133.
2. YAEC Letter to USNRC, "Hydrogeologic Report of 2003 Supplemental Investigation" (YA-REPT-00-004-04), dated March 16, 2004, BYR 004-023.
3. YAEC Letter to USNRC, "Interim Groundwater Monitoring Report – September 2004" (YA-REPT-00-013-04), dated September 27, 2004, BYR 2004-107.
4. YAEC Letter to USNRC, "Report of Continuing Hydrogeologic Investigations in 2004" (YA-REPT-00-010-05), dated April 14, 2005, BYR 2005-035.
5. YAEC letter to USNRC, "Summary Groundwater Report for the Yankee Nuclear Power Station – 2005" (YA-REPT-00-004-06), dated April 5, 2006, BYR 2006-026.

APPENDIX 1

Summary of Unplanned Releases of Radioactive Material at YNPS

(Source: YA-REPT-00-010-05, Table 10)

The following is a chronological summary of events that have occurred in the yard area inside the Radiologically Controlled Area (RCA), based on a review of Abnormal Occurrence Reports (AORs) and Plant Incident Reports (PIR).

AOR 61-15: Radioactive Spill

On September 20, 1961 a container of main coolant was dropped on the asphalt in the Potentially Contaminated Area between the Primary Auxiliary Building and the Waste Disposal Building while being carried to the Radiochemistry Lab. The half liter sample contained ~35 μCi . The spill was absorbed using absorbent paper and the spill area decontaminated by mopping. Fixed contamination remaining was ~0.05 mr/hr at 1" from the pavement.

Impacted Areas **NOL-02/ NOL-05**

AOR 63-12: Shield Tank Cavity Fill Water Spill

On September 18, 1963 while filling the shield tank cavity, a ½" sampling valve located over the ion exchange pit was inadvertently left open. A spill of approximately 10 gallons of water from the safety injection tank resulted. Part of this water ran off the deck of the pit and onto a section of the blacktop surface on the west side of the pit. The radiation level at the immediate spill area was 70-100 mr/hr measured at 1 inch. Contamination levels were 10^6 to 10^7 dpm for areas of several square inches. Run off water caused contamination levels of 20-60,000 dpm/ft^2. The area was decontaminated the following day.

Impacted Areas **NOL-01/NOL-02**

Impacted Structures **NSY-02**

AOR 63-17: De-watering Pump Packing Leakage

October 8, 1963. The leakage from the fuel chute de-watering pump is piped via a garden hose to a 30 gallon drum placed in a storm catch basin (ECB-005) located between the railroad tracks and the NE corner of the spent fuel pit. The bottom rim of the barrel was very corroded and water was dripping from two or three rust hole locations. At the time there was 6"-8" of water in the barrel with activity of 6 x 10^{-5} μCi/ml. It was believed only minimal water was leaked to the storm system.

Impacted Areas **OOL-01**

Impacted Sub-surface Areas/Structures **- East Storm Drain System**

AOR 64-08: Seal Water Tank Spill

On September 3, 1964 after filling the seal water tank, leaking shutdown cooling pump seals back-flowed into the tank causing it to overflow out the vent connection into the common relief valve discharge line and onto the Primary Auxiliary Building roof. An

estimated 35 gallons of water containing a total of 270 μCi was spilled. A sample from the seal tank had gross activity of 2×10^{-3} μCi/ml. The puddle on the roof had 1×10^{-3} μCi/ml. The next day decontamination of the roof was begun. The roof drain system drains into the storm drain system via a sub-surface piping connection. A sample of the storm drain (WCB-009) showed 1×10^{-6} μCi/ml. The predominant isotopes were Co^{58}, Co^{60} and Mn^{54}. Service Water was diverted to the storm drain to dilute and flush the system.

Impacted Areas **- AUX-01 Roof and Roof Drain System**

Impacted Sub-surface Areas/Structures **- West Storm Drain System**

AOR 64-13: Leakage from Ion Exchange Pit

On October 3, 1964 after filling the ion exchange pit to its normal level, the operator forgot to close the fill valve. Water continued to flow into the pit from the Primary Water Storage Tank by gravity feed. Four hours later the operator noticed water seeping up through the blacktop on the west side of the pit, knew why and went to close the valve. Two days later the water on the blacktop was sampled. The liquid had a specific activity of 8×10^{-8} μCi/ml. It contained Ag^{110m} at 5×10^{-7} μCi/ml and Co^{60} at 1×10^{-6} μCi/ml, both below MPC. The blacktop was rinsed down with service water to the storm drain (ECB-005).

NOTE:

There were indications of an accelerating IX-pit leakage problem necessitating additions of make-up water to the pit as early as September of 1963. A 2.5 gpm leak was repaired in May 1965 (Primary/Auxiliary Operators logbook entries - Survey Area NSY-02 ref. #1 and #1 and #7).

Impacted Areas **NSY-02/NOL-01**

Impacted Sub-surface Areas/Structures **- East Storm Drain System internal and external to piping (backfill) / AUX-01 North external perimeter (backfill) / SFP-01 West external perimeter (backfill) / BRT-01 Eastern external perimeter**

AOR 66-7: Spent Fuel Pit Water Spill

On September 27, 1966 while doing shipping cask operations in the spent fuel pool, a 2" priming valve for the cooling and purification pump was left open. Later, when running the L.P.S.T makeup pump, water flowed through the left open priming valve and started filling the SFP. After a period of time the level in the pool approached the overflow point. By the time the Shift Supervisor realized the reason for the high level and closed the priming valve the water had just started overflowing. It was estimated that a total of 33 gallons of water ran out over the spent fuel pit exterior wall, over a small section of asphalt paving and into an immediately adjacent storm drain (. A few gallons of this also leaked into the new fuel vault. A sample of spent fuel pool water taken immediately after the incident a gross activity of 3.2×10^{-5} μCi/ml. A sample taken four days previous to the occurrence indicated the gross activity to be 5.4×10^{-5} μCi/ml and tritium concentration of 5.4×10^{-3} μCi/ml. A continuous service water and intermittent fire-water flush of the east side culvert system (ECB-005) was initiated and continued for a 24 hour

period. Sufficient dilution water (75,000 gallons) was added to the culvert to reduce the gross and tritium activity to 1.4×10^{-8} μCi/ml and 2.4×10^{-6} μCi/ml, respectively, when averaged over 24 hours. Samples of drainage water leaving the east side culvert were taken 24 and 42 hours afterwards and indicated gross levels of 2.0×10^{-9} μCi/ml (by outside lab) and $<5 \times 10^{-9}$ μCi/ml (by in-house) and tritium (after 24 hours) of 3.4×10^{-5} μCi/ml. This occurrence resulted in a total release of 4 μCi gross β-γ and 670 μCi of tritium activity.

Impacted Areas **SFP-01 North external wall /NOL-01**

Impacted Sub-surface Areas/Structures **East Storm Drain System internal and external to piping (backfill between SFP-01 and ECB-005)**

AOR 66-8: Abnormal Activity in Storm Drain

On September 27, 1966 after the Spent Fuel Pit water spill, a water sample was taken from both east and west storm drain culverts, even though the spill was collected by the east side only. An average of two samples from the west side showed gross activity of 6.7×10^{-7} μCi/ml. Investigation showed the activity was due to a leaky relief valve on the safety injection heating system being discharged into the PAB floor drain. The PAB floor drain was arranged to discharge through the PAB wall into WCB-009, an outside storm drain. It was estimated that no more than 8 gallons could have leaked from the relief valve during the previous 24 hour period. The relief valve was thought not to have been leaking on the previous day. Analysis of safety injection tank water showed gross activity of 3×10^{-5} μCi/ml and tritium activity of 1.1×10^{-1} μCi/ml. A sample collected 24 hours later and analyzed by an outside lab showed gross activity of 1.2×10^{-8} μCi/ml and tritium activity of 5.1×10^{-5} μCi/ml. This occurrence resulted in a total estimated release of 0.8 μCi gross β-γ and 3.32 mCi tritium.

Impacted Area **- OOL-05/OOL-06**

Impacted Sub-surface Areas/Structures **- West Storm Drain system**

AOR 66-9: Plastic Garden Hose Failure

On November 1, 1966 during a routine drainage on the fuel chute pump discharge line, a plastic garden hose used for the draining burst and flowed into a storm drain served by the east culvert (ECB-005). The burst was caused by heat tracing which softened the line enough so that static pressure inside the line was sufficient to cause the hose to separate at the hose coupling. Approximately 10 gallons of 3.0×10^{-3} activity water (for a total of 113 μCi) was released. The spill area was hosed down with service water. The service water and a fire hose were left running all night at ~250 gpm for dilution of the culvert. The east culvert was sampled after the spill with results as follows:

	Activity (μCi/ml) – YAEC	Activity (μCi/ml) – ConRad
11/1/66 @ 1930	4.4×10^{-6}	2×10^{-5}
@ 2145	1.99×10^{-7}	9.1×10^{-7}
@ 2300	3.18×10^{-7}	9.0×10^{-7}

	Activity (μCi/ml) – YAEC	Activity (μCi/ml) – ConRad
11/2/66 @ 0800	6.3×10^{-8}	2.3×10^{-7}
11/4/66 @ 2200	1.4×10^{-8}	2.4×10^{-8}

Since the effects of dilution showed the spill was under control no further action was taken.

Impacted Areas - **NOL-01/OOL-01**

Impacted Sub-surface Areas/Structures - **East Storm Drain system**

AOR 68-1: Waste Holdup Tank Moat Spill

On January 16, 1968 approximately 200 gallons of water spilled from the activity dilution decay tank from a valve bonnet failure event caused by freezing. The spilled water had an activity of 6.87×10^{-4} μCi/ml β-γ and 9.24×10^{-1} μCi/ml tritium. A total of 520 μCi β-γ and 698 mCi tritium was spilled into the moat. Since the moat was kept isolated no release of activity to the storm drains occurred.

Impacted Areas -

Impacted Sub-surface Areas/Structures - **NSY-07**

PIR 75-7: Yard Area Contamination

On July 16, 1975 a contaminated area of ground was found near the ion exchange pit reading ~500,000 dpm. Over the next few days the entire site within the restricted area fence was surveyed. Fourteen areas, ten of which were in the clean area, were found to be contaminated >1000 dpm/100 cm^2. Most of this was cleaned up and the remaining was sealed in place using asphalt sealer and covered with clean soil. For more detail see 'Summary of Yard Decontamination Effort in 1975'.

Impacted Areas - **NOL-01 through NOL-06**

PIR 77-16: Service Building Radioactive Sump Transfer Line Puncture

On December 21, 1977 while conducting core borings inside the controlled area the boring bit inadvertently punctured the 2 ½" stainless steel line leading from the service building sump tanks to the primary auxiliary building. The sump line ran at a depth of 15 feet underground where the damage occurred and the boring depth was 61 ½ feet. The damage was not detected until the next day when the sump pump started and water issued from the borehole. The sump pump ran through two cycles resulting in 20 gallons of water discharged from the rupture. The water contained the following:

Radionuclide	Total Activity, μCi	Concentration, μCi/ml	Fraction of MPC
I^{131}	16.50	2.18×10^{-4}	3.63
I^{133}	2.76	3.65×10^{-5}	0.18
Cs^{134}	0.34	4.46×10^{-6}	0.01
Cs^{137}	0.50	6.67×10^{-6}	0.02

Radionuclide	Total Activity, μCi	Concentration, μCi/ml	Fraction of MPC
Co^{60}	0.58	7.69×10^{-6}	0.01

It was determined that no measurable levels of activity were released offsite or to the storm drain. The line was repaired and a sand and concrete casing poured around it. No mention was made of the leaked upon soil.

Impacted Areas - **NOL-02**

Impacted Sub-surface Areas/Structures - **Soils surrounding perforation and transfer line backfill**

PIR 80-9: Resin Spill

On August 6, 1980 while pumping resin to a cask a hose developed a pinhole leak. Pumping was stopped immediately. The failure of the hose allowed the release of several gallons of water and about one quart of resin. A 15 by 20 square foot area was contaminated. Radiation readings on the resin were up to 1 mrad/hr and the spilled liquid readings were up to several hundred thousand dpm/100 cm^2. Extensive decontamination was required including removal of some of the blacktop to ensure no release to the environment.

Impacted Areas - **NOL-02/NSY-02**

Impacted Sub-surface Areas/Structures - **South and East exterior walls of NSY-02. Also sub-slab area of NSY-02 (IX-pit) due to transfer by surface (decon/rain) water into cracks between asphalt and IX-pit walls.**

PIR 81-9: Contamination of Yard Area During Reactor Head Removal

On May 15, 1981 while removing the reactor head to the railroad car outside the VC the head made contact with the shield wall. No damage occurred and lowering to the car continued. Later when finished contaminated people and areas were found. Smearable levels on the railroad car plywood 15 feet east of the head read up to 200 mrad/hr beta. This was sealed by painting and covered in herculite. General levels on the blacktop were from 1000 to 500,000 dpm/100 cm^2 and covered an area of roughly 30 feet by 50 feet. The total activity released to the ground was ~250 μCi with ~10 μCi discharged to Sherman Pond. This was below 10 CFR 20 reporting requirements. The area was cleaned up but due to rainfall trace activity levels were detected in the east storm drains. The storm drain sumps were pumped out and cleaned to eliminate further contamination.

Impacted Areas - **NOL-01/NOL-06/OOL-12/OOL-13**

Impacted Sub-surface Areas/Structures - **BRT-01/in cracks and crevasses under VC Equipment Hatch and along rails/ties in OOL-12 and OOL-13**

PIR 84-16: Drain Pipe Failure

On September 10, 1984 work was commenced to remove the drain line between the Waste Storage Building and the PCA storage building. The line was 3 ½ feet below grade at the PCA storage building end. The joints in this pipe were degraded resulting in leakage into the soils surrounding the joints. Samples of the soil under the pipe showed the presence of Co^{60} and Cs^{137}. In the most contaminated area showed 50,000 dpm with a

single hot spot of 29,300 pCi/gm Co^{60}. Average contamination at 2 feet below this joint was ~2100 pCi/gm. Average Cs^{137} levels were about 17 times less than the average Co^{60} levels. Since this area of the yard was paved there was little likelihood of water transport from the surface. The entire pipe and ~420 ft^3 of dirt and rock were removed as radwaste. The depth of the soil removed was typically from 5 to 9 feet below grade. The soil left at the bottom of the excavation contained Co-60 at a concentration of approximately 30 pCi/gm. Clean fill was brought in and all areas above the excavation were sealed under a concrete cap (New Radwaste Warehouse floor). For groundwater movement data see **PIR 84-16.**

Impacted Areas – **WST-01/WST-02**

Impacted Sub-surface Areas/Structures – **WST-02 at a depth of in excess of 9 feet below grade, activity remains in excess of DCGL. Partial remediation under 50.75g.**

PIR 94-03 and PIR 94-09: Leakage from Frozen Fuel Chute Dewatering Line and NST Tell-tales

On February 17 & 18, 1994 a fuel chute dewatering line and a neutron shield tank telltale drain line ruptured due to freezing. Freezing was due to inadequate heat tracing and insulation. A 3.5 liter sample from the fuel chute line indicated 1000 ncpm. From the NST telltale line a sample indicated Co^{60} and Cs^{137}. The ground below showed no contamination. The area by the rail tracks and pumpback house also showed no contamination. The snow pile along the south side of the rails by the new fuel vault showed Co^{60}, Cs^{137} and Mn^{54}. All positive areas were sent to the rad drains and the areas de-posted.

Impacted Area – **NOL-01**