The Commonwealth of Massachusetts
Executive Office of Health and Human Services
Department of Public Health
Bureau of Environmental Health
Environmental Toxicology Program
250 Washington Street, Boston, MA 02108-4619
Phone: 617-624-5757 Fax: 617-624-5777
TTY: 617-624-5286

M E M O R A N D U M

To: Suzanne K. Condon, Associate Commissioner
Director, Bureau of Environmental Health (BEH)

From: Meg Blanchet, Assistant Director (initial MB)
BEH Environmental Toxicology Program (ETP)

Cc: Martha J. Steele, Deputy Director, BEH
Bob Gallaghar, Acting Director, BEH Radiation Control Program
Margaret Round, Senior Environmental Analyst, BEH/ETP

Re: Status of Groundwater Monitoring Program at Pilgrim Nuclear Power Plant

Date: June 25, 2010

The purpose of this memorandum is to provide a summary of the past and current status of groundwater monitoring activities conducted at Pilgrim Nuclear Power Plant (PNPP) in Plymouth, MA and identify data gaps that should be addressed. Information contained in this memorandum is based on information currently available to the MDPH Bureau of Environmental Health (BEH) through review of public records and via site visits to PNPP that included review of technical reports and discussions with Entergy staff and their hydrogeological consultants. The PNPP is currently owned by Entergy and has been operating since 1972.

Background

Information evaluating subsurface conditions at the PNPP site prior to the plant's construction and completion in 1972 was available in a 1967 Dames & Moore report. The 1967 report describes the existence of an upper layer of variable and erratic sandy soil conditions, and more dense and compact material below a depth of approximately 35 feet. Based on 35 exploratory borings installed in 1967 to explore land conditions prior to construction of PNPP, subsurface conditions in the area of the plant (down to approximately 35 feet) were variable and typical of a glacial outwash deposit. Specifically, borings encountered discontinuous layers of silty fine sand, fine sand, clayey silts, and clayey sands. Beneath the upper 35 feet of variable strata, poorly graded to well-graded sands with varying amounts of gravel and cobbles were found. The sands underlying the 35 feet of variable strata were found to be generally dense and relatively 'incompressible'. Bedrock was encountered at a depth of approximately 80 feet. Boulders ranging in size from one to three feet were encountered throughout the overburden soils from the ground surface down to bedrock and significantly larger boulders were also expected to be present.

Based on the investigations of subsurface conditions, the 1967 Dames & Moore report concluded that the proposed plant structures could be adequately supported on foundations placed after the upper variable strata of sand were removed and/or replaced with compact backfill. During a recent site visit, PNPP staff confirmed that much of the soil immediately beneath the power station consists of construction fill that was brought in at the time the plant was built.

Hydrogeologic information contained in most reports MDPH reviewed (e.g. Dames and Moore, 1967; Final Safety Analysis Report [FSAR], 1985; and Site Hydrogeologic Assessment Reports, 2007, 2009) indicates that groundwater flow at PNPP is believed to be to the north and east toward Cape Cod Bay based on an assumption that flow patterns at the site mimic the regional topographical trends. In the absence of site-specific data, this assumption seems reasonable in a general sense based on local topography, that is, the facility is located at a lower elevation than land directly to the west/northwest. In general terms, groundwater will follow surface topography and flow from higher to lower elevations, in this case towards Cape Cod Bay.

Better characterization of site-specific groundwater flow direction and gradients at PNPP however seems warranted as localized variations on groundwater flow under and around the footprint of the facility has not been well characterized. Water levels measured in borings prior to PNPP construction indicated a variable groundwater table at the site likely attributed to local zones of perched water. A higher groundwater table, estimated at approximately 15 feet below ground surface, was attributed to a localized condition of poorly draining soils. It was also noted that groundwater levels would be expected to fluctuate with the tides and vary approximately 1.5 feet.

It is also unknown how sub-surface conditions may have changed since the plant was constructed. PNPP staff reported that all underground pipes are buried within 10 feet below ground surface (bgs), and the reactor building reaches 28 feet below grade. According the 2007 Hydrogeologic Assessment, the PNPP station reportedly extends to a depth of approximately 40 feet bgs and cuts through many of the discontinuous silt and clay layers. The potential effect of a vertical connection between these layers is unknown.

Finally, based on a review of historical documents related to a transformer release at PNPP, GZA (2009) noted that groundwater contours generated using 1997 groundwater elevation data indicated a shallow groundwater flow gradient towards the southeast may also be present in some areas, rather than easterly toward Cape Cod Bay as would be expected based on regional topography and drainage conditions. The 2009 GZA report noted that additional data points would be needed to adequately assess horizontal and vertical gradients across the site and in the vicinity of the PNPP structures.

Groundwater Monitoring Wells

PNPP signed onto the Nuclear Energy Institute (NEI) Groundwater Protection Initiative in Spring 2006. This program is a voluntary initiative that falls outside of current NRC requirements and provided nuclear power plants across the U.S. with specific guidance for the development and implementation for a formalized site-specific groundwater protection program. The NEI Groundwater Protection Initiative identified specific actions nuclear power plants should take to be prepared to manage and respond to inadvertent releases of radioactive substances that may result in low but detectible levels of plant-related materials in groundwater. Specific actions identified by the NEI Initiative included: 1) characterization of geology, hydrology, and groundwater flow characteristics and gradients based on current site conditions, 2) evaluation of systems, structures, and components (SSCs) and work practices that involve or contain radioactive materials that could potentially reach groundwater, 3) establishment of an on-site groundwater monitoring program to ensure timely detection of inadvertent releases of radioactive materials to groundwater, 4) development of a remediation protocol to prevent migration of radioactive materials off-site, and 5) establishment of proper record-keeping of any leaks, spills, or remediation efforts. In addition, subsequent to the NEI initiative, the Electric Power Research Institute (EPRI) also developed technical guidelines for implementation of groundwater protection programs at nuclear power plants. These national guidelines also include a recommendation that analysis be conducted to understand the contribution of atmospheric deposition of tritium to local groundwater including a site-specific review of processes involving tritium releases, dispersion, deposition, runoff, infiltration, and recharge to aquifer. These recommendations also provide methods for empirical evaluation of groundwater and rainwater monitoring data to determine whether detected levels of tritium in groundwater are attributable solely to rainwater infiltration (considering background sources) or may also be attributable to leakage from systems, structures, and components (SSCs).

In 2007, PNPP conducted a Site Hydrogeologic Assessment and identified areas where groundwater monitoring wells should be located based on a risk ranking of operational plant systems and available site geology and hydrology information. It is important to note that this assessment relied primarily on a review of existing historical and regional geological and hydrological information summarized in the previous section and did not involve new subsurface investigations or sampling to better characterize local hydrogeological conditions at the facility. Also, the 2007 document did not contain specific details on how previous monitoring well locations were selected. PNPP initiated routine monitoring of six groundwater wells in 2007.

The original six groundwater monitoring wells have been sampled quarterly at PNPP since 2007 for the presence of tritium and other gamma radionuclides. Five of the original wells are located in the immediate vicinity of the plant operations and one is located up-gradient of the plant near Rocky Hill Road near Entergy’s Waste Water Treatment Plant. Four of the six monitoring wells were installed in 2007; two of the 6 monitoring wells existed previously.

In April 2010, Entergy installed six additional wells at PNPP. Three of the new wells (MW-202I, MW-205, and MW-206) were added to the narrow stretch of land between the facility buildings and the shoreline near the discharge canal. These three new wells, in combination with MW-201, MW-202S, and MW-204 already in place since 2007, enhanced the previous groundwater monitoring system in terms of detecting potential leaks with a narrow groundwater pathway. Another new well, MW-207, was also installed joining the existing well MW-203 in the vicinity of the Augmented Off-gas System (AOG) pipe. However, it is important to note that there are currently no groundwater monitoring wells located east/southeast of MWs 201 and 206 between the facility buildings and this area of the shoreline. Finally, a shallow and deep well couplet, MW-208S and MW-208I, were installed south of the reactor building at the perimeter of the protected area and behind an outdoor storage area. The approximate locations of all groundwater monitoring wells at PNPP are shown in Figure 1.

Currently, no off-site groundwater monitoring wells are included in the PNPP groundwater monitoring program nor are they required as part of the NEI Initiative program. One monitoring well, MW3, is located up-gradient at the property boundary near Rocky Hill Road and serves largely as a background or comparison well. Based on a review of available information on areas of Plymouth that are served by both private and public water supply wells, it appears that no public or private drinking water wells are located within a 2-mile radius of PNPP. The closest drinking water well is approximately 2.5 miles southeast of PNPP.

Groundwater is analyzed for tritium and for gamma radionuclides using gamma spectroscopy. Tritium is a good indicator contaminant for groundwater monitoring and gamma spectroscopy results can also be used to help identify a potential source if a groundwater well indicates a possible leak. Based on its chemical properties, tritium is highly soluble in water; thus it flows with groundwater. Gamma radionuclides, on the other hand, adsorb strongly to soils and do not move as quickly from their release point. Thus, tritium will be detected in groundwater earlier than other tested contaminants.

When compared to the number of groundwater monitoring wells routinely monitored at other nuclear power plants located in the northeast, PNPP has fewer groundwater monitoring wells. While we understand (based on information we have gathered) that many nuclear power plants across the country have increased their numbers of monitoring wells in response to detection of subsurface tritium leaks we believe it would be optimal to increase the number of wells prior to such an occurrence at PNPP.

Seabrook Nuclear Power Plant in New Hampshire (owned and operated by Florida Power & Light) has 22 on-site groundwater monitoring wells that are sampled and analyzed on a quarterly basis and they reportedly have plans to install an additional five wells. Prior to the detection of tritium in groundwater at Vermont Yankee (also owned and operated by Entergy), the groundwater monitoring program consisted of three on-site groundwater monitoring wells. Installation of up to 21 additional monitoring wells was required in order to identify the source of tritium. At Indian Point in New York, cracks in the spent fuel pools prompted the installation of a series of monitoring wells across the site to determine the extent of radioactive contamination in the groundwater. Now, approximately 40 monitoring wells are in place to better assess radioactive contamination in groundwater. In New Jersey, tritium leaks are currently being monitored at three of the state's four nuclear power plants; numerous wells have been installed at these plants to investigate the various leak sources.

Sampling Frequency at PNPP

Since November 2007, samples have been collected quarterly by Entergy and analyzed for tritium and gamma radionuclides by an Entergy contract lab. Split groundwater samples were also sent to the MDPH/RCP Massachusetts Environmental Radiation Laboratory (MERL) for analysis until state funding for the lab was substantially reduced in May 2009. MDPH/BEH/RCP redirected existing resources from the Radioactive Materials Program to resume some efforts of the MERL in May 2010 and began accepting split samples from PNPP again at that time. MDPH/RCP also received a split sample for MW201 from Entergy on 3/12/2010 and the sample was analyzed by a MDPH contract laboratory for tritium and gamma spectroscopy analysis.

Groundwater Sampling Results

Table 1 shows all results of tritium in the original six monitoring wells since groundwater sampling began in 2007. Tritium has been detected at various concentrations in all of the monitoring wells (including the up-gradient well MW-3) sampled since 2007. The maximum concentration of tritium detected in groundwater at PNPP prior to May 2010 was 3300 picocuries per liter (pCi/L) from MW201 in November 2007. Tritium results from this particular well appear to have generally decreased since the initial sampling was conducted and after Entergy repaired a hole in the pavement above this well. PNPP staff reported to MDPH that based upon their observations and remedial efforts followed by declining levels of tritium in groundwater, they concluded that the higher level of tritium in MW-201 was likely the result of atmospheric deposition. Although the PNPP monitoring wells are not used for drinking water, the tritium concentrations are all well below the U.S. Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) for drinking water (20,000 pCi/L). The NRC has established a tritium screening level of 3000 pCi/L for groundwater monitoring results, which is one tenth of the NRC tritium standard for non drinking water (i.e. surface water) sources (30,000 pCi/L).

In addition to tritium, MERL also analyzes split samples using gamma spectroscopy against a suite of more than 30 isotopes which serve as sentinel indicators for the presence of other radionuclides including beta and alpha emitters. Gamma spectroscopy provides a rapid and effective screening determination for radionuclides. In the event that gamma emitters above background levels are present, the MDPH/RCP protocol calls for additional testing for beta emitters such as strontium-90, and alpha emitters such as transuranic elements. Based on analyses conducted between November 2007 and May 2009, no fission product radionuclides have been detected above background levels in split samples. Results from the contract laboratory analysis of the March 2010 split sample from MW201 were also consistent with background. During the site visits, PNPP staff reported that no plant-related gamma radionuclides have been detected in PNPP groundwater samples, but they have consistently detected natural gamma activity which has provided them with reassurance regarding the sensitivity of their methods.

In May 2010, the MERL was re-opened and Entergy began once again sending split samples to MDPH. The most recent groundwater monitoring results from samples taken on May 17, 2010, indicated a tritium concentration of 5800 pCi/L at MW-205, one of the new wells. The MERL split sample for this well showed a consistent result (5259.96 pCi/L). MERL results for monitoring wells MW-204 and MW-202S located on either side of MW-205 showed tritium detections of 852.44 and 622.39 pCi/L, respectively. Entergy re-sampled MW-205 and adjacent wells 202S and 202I on June 11, 2010 to confirm the results and provided split samples to MERL. The second sample from MW-205 detected tritium at 8800 pCi/L, the highest level of tritium detected in PNPP groundwater to date (Entergy's results for 202S and 202I were not provided). Confirmatory results from MERL on the second round of samples are still pending, but preliminary results for MW-205 appear to be consistent with Entergy's reported 8800 pCi/L.

Precipitation Sampling Effort

At the May 18, 2010 site visit, Entergy staff reported that they started a precipitation sampling program in August 2009 to further investigate their contention that tritium detected in groundwater monitoring wells is due primarily to air deposition. Currently, there are four precipitation samplers located adjacent to MW201, MW202, MW203, and MW204. There is also an offsite precipitation sampler located approximately 4.5 miles to the S/SE of PNPP. The monitors collect all the precipitation over a one-month period and then are sampled for tritium. Tritium results for the precipitation monitors are shown in Table 2.

To date, no tritium has been detected in precipitation samplers located adjacent to MW201 or at the control location 4.5 miles S/SE. Low levels of tritium have been detected on a few occasions in samplers located adjacent to MW202, MW203, and MW204 at concentrations slightly greater than the detection limit (note: the lower limits of detection varies ranging from <400 pCi/L to <414 pCi/L). The maximum concentration of tritium detected in a precipitation sample to date is 669 pCi/L collected from the sampler located near MW203 on March 11, 2010. Based on the limited precipitation data available since fall 2009, concentrations of tritium detected in groundwater monitoring wells are roughly up to two times higher than concentrations of tritium that have been detected in adjacent precipitation samples.

Surface Water Sampling

PNPP collects surface water samples from three locations on a routine basis and reports results to the NRC. Surface water is sampled monthly at one location on-site in the discharge canal and two locations off-site (Bartlett Pond - 2.7 km and Powder Point Control - 13 km from the plant). According to the Annual Reports from 2005-2008, no tritium was detected in any of the surface water samples.

Summary

With the exception of tritium results for MW-201 early on, groundwater sampling at the PNPP since 2007 has generally shown tritium detections in the range of 450-1,500 pCi/L, and tritium has been detected in every monitoring well during almost all sampling rounds. The most recent groundwater monitoring results in which a new well, MW-205, showed the highest groundwater detection to date (8,800 pCi/L) reinforces concerns that the source of tritium in groundwater at the facility may not be just atmospheric deposition or natural background, as PNPP officials believe. It is also important to note that prior to the now well known “leaks” at Vermont Yankee, the majority of all groundwater monitoring results at that plant were non-detect (ND). Although none of the tritium concentrations detected at PNPP to date pose health concerns, they do indicate that additional data (e.g., via installation of additional monitoring wells or surface water sample locations) and investigation is needed to further identify the source(s) of the concentrations detected and potential extent of tritium detections.

It is our understanding that current well locations were selected based on the general assumption that groundwater flows towards Cape Cod Bay. However, as discussed previously in this memo, localized variations in groundwater flow beneath and around the footprint of the facility have not been well characterized. PNPP’s previous consultant noted that additional data points would be needed to adequately assess horizontal and vertical gradients and flow directions across the site and in the vicinity of the structures (GZA, 2009). Thus, further assessment of site-specific hydrogeology would be required to rule out a possible cross-gradient groundwater pathway. In addition, much of the information on localized groundwater flow direction is based on information gathered prior to PNPP construction and subsurface conditions may have changed during construction and subsequent operation of the plant. Factors that could influence localized groundwater flow after construction of PNPP need to be further evaluated such as the impact of some facility structures reaching a depth below the water table and mounding of groundwater.

As mentioned, Entergy officials attribute tritium detection in groundwater monitoring wells to atmospheric deposition and subsequent transport via rainwater. However, based on the limited precipitation data available, concentrations of tritium detected in groundwater monitoring wells are roughly up to two times higher than concentrations of tritium that were sometimes detected in adjacent precipitation samples. According to the 2007 EPRI guidance document, if tritium in groundwater is much higher than tritium in rainwater, this would indicate that further assessment is warranted to determine if the higher tritium levels detected in the groundwater are associated with leakage from the systems, structures and/or components (SSC) of the plant (e.g., leak from underground pipes) or whether it is associated solely with atmospheric deposition and infiltration of tritiated water vapors.

In addition to the installation of more groundwater monitoring wells east/southeast of the facility buildings Entergy must also address uncertainties and provide documented evidence of their contention that tritium detected in groundwater is attributed to natural sources and deposition of licensed atmospheric releases. There are analytical methods available to provide such evidence. For example, to understand the contribution of atmospheric deposition pathway(s) of tritium to groundwater, a site-specific assessment of physical, meteorological and hydrogeological processes, including licensed air discharges from stacks and vents, dispersion, deposition, runoff, infiltration, and recharge of aquifer is needed. With this information, modeling can be performed using site-specific empirical calculations from monitoring and hydrogeological studies to predict atmospheric dispersion and deposition of radionuclides using available software. Current practice within the industry has found that since atmospheric dispersion modeling is already conducted as part of the Radiological Environmental Monitoring Program (REMP) for the calculation of offsite radiation doses attributed to gaseous radioactive releases from the plant, the refinement of the model using monitoring data, deposition velocity and scavenging coefficients can then be used to estimate both dry and wet deposition of tritium.

Although Entergy staff has previously reported that they suspect tritium detections in groundwater can be attributed natural sources and to air transport and deposition of licensed air emissions, it remains unclear why conditions at PNPP would be different from other nuclear plants. MDPH has observed a notable difference in monitoring for tritium in groundwater at other nuclear power plants in the northeast – that is that PNPP seems to consistently have detections of tritium, albeit low levels. MDPH has been unable to identify other nuclear power plants of similar vintage to PNPP that have consistently comparable levels or frequency of tritium detections in routine monitoring wells. Further, an evaluation of the sensitivity of detection limits at other plants does not seem to explain the greater frequency of tritium detections at Pilgrim. At the May 18, 2010 site visit, MDPH asked Entergy staff to provide additional explanation as to why tritium is being detected in their groundwater monitoring wells at current levels. PNPP staff indicated they would gather additional information on tritium measured in groundwater and analytical detection limits from other plants in the Entergy fleet to further investigate this question; however MDPH has not received additional data from Entergy to date.

Although the additional groundwater monitoring wells installed in April 2010 are an enhancement to PNPP's previous groundwater monitoring efforts, given the recent sampling results and that many nuclear power plants across the country are dealing with aging underground pipes and tritium leaks in groundwater, it would be prudent for PNPP to consider installation of a few additional wells. In particular, MDPH recommends that the area along the shore east/southeast of the facility be better addressed as part of the plant's routine monitoring program. PNPP staff have reported that their consultant, ERM, Inc., is currently preparing a report that will include additional information on hydrology and potential tidal influence at PNPP. In addition, Entergy plans to hire a consultant to conduct an enhanced risk ranking of subsurface structures and underground piping at PNPP. Both of these reports are expected to be informative in helping MDPH to determine specific locations for additional groundwater monitoring wells, such as in the area east/southeast of MW-201, MW-206 and the facility buildings along the shoreline.

At this time, there are no surface water sample locations in the bay between the facility shoreline and the breakwater. Given the recent detections of tritium in groundwater monitoring well MW-205 and based on the assumption that groundwater discharges to Cape Cod Bay MPDH believes that samples of surface/bay water should be collected on a routine basis from the area inside the breakwater. Specifically, it would be prudent to sample surface water in the off-shore area directly down-gradient from monitoring wells MW-205, and MW-202S/I and to also sample surface water at the entrance of the breakwater.

Recommendations

While much has been learned through review of site-related documents and site visits to PNPP, MDPH has identified several data gaps that Entergy should address in order to improve their groundwater monitoring program such that a more complete picture is available and importantly to prevent potential off-site implications. Specifically, MDPH recommends that Entergy: 1) install at least two additional groundwater monitoring wells in the area directly east/southeast of the facility buildings to better characterize an area that currently has no monitoring wells and that may be impacted by facility operations or leaks, 2) collect surface/bay water samples from two locations in the bay between the facility shoreline and breakwater (i.e., directly down-gradient from monitoring wells MW-205, and MW-202S/I and to also sample surface water at the entrance of the breakwater) to ensure no detectable levels of tritium are present, 3) provide better characterization of site-specific groundwater flow gradients in and around PNPP subsurface structures and components (this is consistent with the NEI initiative guidelines and is reportedly being addressed with a detailed hydrogeological study being conducted by ERM), and 4) provide better characterization of possible groundwater sources of tritium (also recommended by NEI guidance and reportedly being addressed by Entergy) and documentation on the potential contribution of the licensed tritium releases including mass balance analysis and dispersion modeling.

Table 1

Summary of Tritium Detected in Groundwater Monitoring Wells

Plymouth Nuclear Power Plant, Plymouth, MA

All Results Reported in picocuries per liter

(pCi/L)

Sample Collection Date	Reported By	Tritium Concentration (pCi/L)					
		MW-201	MW-202	MW-203	MW-204	MW-3	MW4
November 29, 2007	Entergy	3192 ± 162	451 ± 135	NDA<447	1366 ± 144	N.S.	N.S.
	Entergy	3300 ± 164	525 ± 138	N.A.	1586 ± 150	N.S.	N.S.
	Entergy		733 ± 142			N.S.	N.S.
	MDPH/MERL	3014 ± 98	522 ± 66	371 ± 63	1277 ± 77	N.S.	N.S.
January 22, 2008	Entergy	2409 ± 158	572 ± 141	NDA<455	564 ± 141	635 ± 142	N.S.
	Entergy	2304 ± 155	426 ± 138	444 ± 138	796 ± 142	471 ± 139	N.S.
	Entergy					578 ± 140	N.S.
	MDPH/MERL	2112 ± 105	553 ± 84	397 ± 81	844 ± 88	496 ± 83	N.S.
	Entergy	2200 ± 97	519 ± 92	740 ± 93	339 ± 90	421 ± 91	N.A.
	Entergy	2130 ± 100	336 ± 93	NDA < 243	676 ± 95	355 ± 94	N.A.
February 21, 2008	Entergy	N.S.	N.S.	N.S.	N.S.	642 ± 141	N.S.
	MDPH/MERL	N.S.	N.S.	N.S.	N.S.	445 ± 95	N.S.
	MDPH/MERL	N.S.	N.S.	N.S.	N.S.	401 ± 95	N.S.
April 24, 2008	Entergy	1332 ± 144	976 ± 145	525 ± 137	899 ± 141	758 ± 139	917 ± 141
	MDPH/MERL	1256 ± 107	468 ± 94	333 ± 91	591 ± 96	506 ± 94	614 ± 96
July 17, 2008	Entergy	1875 ± 154	622 ± 141	461 ± 141	808 ± 143	NDA<452	979 ± 145
	MDPH/MERL	1588 ± 113	495 ± 95	325 ± 91	566 ± 96	473 ± 94	670 ± 98
October 8, 2008	Entergy	1784 ± 140	574 ± 129	455 ± 128	850 ± 132	NDA<412	547 ± 129
	MDPH/MERL	1595 ± 112	567 ± 95	306 ± 90	761± 98	420 ± 92	541 ± 94
	MDPH/MERL		623 ± 96				

Table 1 (continued)
Summary of Tritium Detected in Groundwater Monitoring Wells
Plymouth Nuclear Power Plant, Plymouth, MA
All Results Reported in picocuries per liter
(pCi/L)

Sample Collection Date	Reported By	Tritium Concentration (pCi/L)					
		MW-201	MW-202	MW-203	MW-204	MW-3	MW4
March 18, 2009	Entergy	1292 ± 137	688 ± 131	681 ± 131	774 ± 132	498 ± 129	627 ± 130
	MDPH/MERL	1346 ± 88	622 ± 79	485 ± 77	829 ± 82	327 ± 74	427 ± 76
	MDPH/MERL	1189 ± 86					
May 27, 2009	Entergy	1205 ± 137	615 ± 131	419 ± 129	959 ± 134	NDA<417	734 ± 132
	MDPH/MERL	1184 ± 86	608 ± 78	471 ± 76	995 ± 84	327 ± 74	815 ± 81
	MDPH/MERL					394 ± 75	
September 23, 2009	Entergy	1726 ± 140	757 ± 131	663 ± 130	1004 ± 133	NDA<411	818 ± 131
December 15, 2009	Entergy	987 ± 134	919 ± 133	632 ± 130	875 ± 133	NDA<415	623 ± 130
March 12, 2010	Entergy	1180 ± 110	1040 ± 110	900 ± 110	930 ± 110	360 ± 100	590 ± 100
	MDPH Contractor	944 ± 180	N.A.	N.A.	N.A.	N.A.	N.A.

Notes:

Entergy results presented as value ± 1-sigma uncertainty. MDPH reported ± 2-sigma values divided by two for comparison.

NDA< = Not detected at less than activity value listed.

N.A. = Not analyzed

N.S. = Not sampled

Table 2
Summary of Precipitaion Monitoring Results
Plymouth Nuclear Power Plant, Plymouth, MA
All Results Reported in picocuries per liter (pCi/L)

Date	Tritium Concentration (pCi/L)				
	Near MW-201	**Near MW-202**	**Near MW-203**	**Near MW-204**	**Control**
August 29, 2009	< 407	< 407	< 407	***528***	-
September 30, 2009	< 405	< 405	< 405	< 405	-
October 31, 2009	< 405	< 405	< 405	***435***	< 405
November 30, 2009	< 405	< 405	< 405	< 405	< 405
December 31, 2009	<414	<414	***388***	<413	<413
February 18, 2010	<411	<411	<411	***632***	<411
March 11, 2010	<404	<404	***669***	<404	<404
April 1, 2010	< 405	< 405	< 405	< 405	< 405
May 5, 2010	<400	***424***	***557***	<400	<400

Notes:
Results provided to MDPH by Entergy on 6/2/10
Detectable tritium results are shown with bold and gray background
Control sampler is located ~4.5 miles SSE of PNPP

Figure 1 - Approximate Monitoring Well Locations, Pilgrim NPS