Issue/Title: Pilgrim Nuclear Power Station (PNPS): Tritium in Groundwater Monitoring Wells

Topic: PNPS Updates as of November 20, 2014

Previous Plans: Routine testing results from groundwater monitoring well samples collected during the weeks of August 18, 2014, and August 25, 2014 were reported by Entergy-GEL[1]. Split sample results for the weeks of August 18, 2014 and August 25, 2014 were also reported by MERL. Recent results are described below and all available historical monitoring data received through October 16, 2014 are also posted on MDPH's website at: http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/radiation/environmental-monitoring.html

Table 1[2]: Week of August 18th

Location	Date	MERL pCi/L	Entergy - GEL pCi/L
MW 201	8/18/2014	302	NDA<379*
MW 202	8/18/2014	-	-
MW 202 I	8/18/2014	-	-
MW 203	8/18/2014	-	-
MW 204	8/18/2014	-	-
MW 205	8/18/2014	NDA<300*	NDA<359*
MW 206	8/18/2014	NDA<300*	NDA<376*
MW 207	8/18/2014	-	-
MW 208-S	8/18/2014	-	-
MW 208-I	8/18/2014	-	-
MW 209	8/18/2014	990	1000
MW 210	8/18/2014	-	-
MW 211	8/18/2014	1229	1150
MW 212	8/18/2014	-	-
MW 213	8/18/2014	-	-
MW 214	8/18/2014	-	-
MW 215	8/18/2014	1083	839
MW 216	8/18/2014	3739	4110
MW 217	8/18/2014	-	-
MW 218	8/18/2014	2002	2020
MW 219	8/18/2014	2287	2440
MW 3	8/18/2014	-	-
MW 4R	8/18/2014	-	-
SW-boat ramp	8/18/2014	-	-
SW-intake	8/18/2014	NDA<300*	NDA<363*

Table 2: Week of August 25th

Location	Date	MERL pCi/L	Entergy - GEL pCi/L
MW 201	8/25/2014	NDA<300*	NDA<398*
MW 202	8/25/2014	345	NDA<380*
MW 202 I	8/25/2014	NDA<300*	NDA<405*
MW 203	8/25/2014	-	-
MW 204	8/25/2014	417	NDA<383*
MW 205	8/25/2014	NDA<300*	NDA<389*
MW 206	8/25/2014	NDA<300*	NDA<387*
MW 207	8/25/2014	387	NDA<365*
MW 208-S	8/25/2014	NDA<300*	NDA<364*
MW 208-I	8/25/2014	NDA<300*	NDA<375*
MW 209	8/25/2014	986	987
MW 210	8/25/2014	532	NDA<371*
MW 211	8/25/2014	1133	870
MW 212	8/25/2014	704	527
MW 213	8/25/2014	304	NDA<372*
MW 214	8/25/2014	NDA<300*	NDA<365*
MW 215	8/25/2014	986	667
MW 216	8/25/2014	4012	3680
MW 217	8/25/2014	366	NDA<365*
MW 218	8/25/2014	2221	2050
MW 219	8/25/2014	2253	2150
MW 3	8/25/2014	NDA<300*	NDA<370*
MW 4R	8/25/2014	589	542
SW-boat ramp	10/6/2014	**	NDA<427*
SW-intake	8/25/2014	NDA<300*	NDA<372*

*** NDA = not detected at less than activity value listed**
**** Analysis pending**
- not analyzed this week

[1] Previous updates have reported the data from Entergy in the tables as "GEL". To enhance clarity in the presentation of results, the tables will now report Entergy results as "Entergy-GEL".

[2] PNPS screening level for tritium in groundwater monitoring wells is 3,000 pCi/L, which is 1/10th of the NRC-approved Pilgrim Offsite Dose Calculation Manual standard for tritium in non-drinking water sources. The EPA drinking water standard is 20,000 pCi/L. The nearest municipal drinking water wells are approximately 2.5 miles from the plant.

Routine Groundwater Testing Results:

With a few exceptions, results for the majority of groundwater monitoring wells at PNPS have indicated historically low tritium concentrations. The week of August 25th was a comprehensive sampling round and results for all wells are shown in Table 2. Entergy results showed no-detectable tritium or tritium just above the limits of detection (which ranged from 364 to 405 pCi//L) for most monitoring wells that are monitored on a quarterly basis. Groundwater wells currently being monitored on a weekly or bi-weekly basis are described in more detail below.

Groundwater Wells Monitored Weekly and Bi-weekly:

The latest available tritium results for weekly and bi-weekly groundwater monitoring reported by Entergy and MERL since June 9, 2014 are summarized in Table 3.

Week of Sample Collection	Reported By[1]	Table 3: Tritium Concentration in Ground Water Monitoring Wells (pCi/L)[2]								
		MW-201	MW-205	MW-206	MW-209	MW-211	MW-215	MW-216	MW-218	MW-219
6/9/2014	Entergy-GEL	NDA<357	1,510	NDA<359	754	899	743	1,400	1,280	12,300
	MDPH/MERL	NDA<300	1,426	NDA<300	NDA<300	725	645	1,801	1,107	13,487
6/16/2014	Entergy-GEL		382		522	924		5,970	1,320	5,210
	MDPH/MERL		467		462	595		4,903	1,049	4,716
6/23/2014	Entergy-GEL	NDA<339	426	NDA<339	477	966	715	4,790	1,170	9,450
	MDPH/MERL	NDA<300	515	NDA<300	541	925	935	4,141	1,437	7,719
6/30/2014	Entergy-GEL		451		786	795		3,380	1,950	9,360
	MDPH/MERL		NDA<300		NDA<300	544		3,041	1,651	7,908
7/7/2014	Entergy-GEL	NDA<361	NDA<409	NDA<364	873	1,040	1,110	4,320	2,650	735
	MDPH/MERL	NDA<300	NDA<300	NDA<300	681	1,085	818	3,585	2,090	793
7/14/2014	Entergy-GEL		NDA<416		878	1,120		5,910	2,220	5,650
	MDPH/MERL		NDA<300		780	1,032		4,909	1,997	4,721
7/21/2014	Entergy-GEL	NDA<390	NDA<387	NDA<395	606	1,150	772	1,990	1,920	3,030
	MDPH/MERL	NDA<300	NDA<300	NDA<300	411	586	324	996	1,683	3,104
7/28/2014	Entergy-GEL		NDA<387		720	1,010		4,910	1,670	2,720
	MDPH/MERL		NDA<300		458	652		5,191	2,064	3,352
8/4/2014	Entergy-GEL	NDA<381	NDA<392	NDA<377	952	1,120	917	2,230	2,360	5,020
	MDPH/MERL	NDA<300	NDA<300	NDA<300	662	982	819	2,017	1,801	4,484
8/11/2014	Entergy-GEL		NDA<381		1,050	1,090		5,120	1,980	2,120
	MDPH/MERL		NDA<300		914	1,273		4,709	1,943	2,039
8/18/2014	Entergy-GEL	NDA<379	NDA<359	NDA<376	1,000	1,150	839	4,110	2,020	2,440
	MDPH/MERL	302	NDA<300	NDA<300	990	1,229	1,083	3,739	2,002	2,287
8/25/2014	Entergy-GEL	NDA<398	NDA<389	NDA<387	987	870	667	3,680	2,050	2,150
	MDPH/MERL	NDA<300	NDA<300	NDA<300	986	1,133	986	4,012	2,221	2,253
9/2/2014	Entergy-GEL		NDA<398		922	856		2,770	2,120	1,660
	MDPH/MERL		NDA<300		892	1,136		2,992	1,987	1,802
9/8/2014	Entergy-GEL	NDA<389	NDA<396	NDA<387	1,150	1,200	1,140	5,450	2,140	1,750
	MDPH/MERL						808	5,271	2,057	1,453
9/15/2014	Entergy-GEL		NDA<431		1,180	1,320		4,740	2,110	1,670
	MDPH/MERL		NDA<300		1,186	1,093		4,418	1,781	1,287
9/22/2014	Entergy-GEL		NDA<383					3,090	2,090	1,210
	MDPH/MERL	NDA<300	NDA<300	NDA<300	1,080	1,102	891	3,465	2,055	1,423
9/29/2014	Entergy-GEL		NDA<417					5,430	2,300	
	MDPH/MERL		NDA<300		1,116	1,046		5,399	2,346	1,064
10/6/2014	Entergy-GEL		NDA<388					6,610	2,310	
	MDPH/MERL									

Monitoring wells MW205 and MW206 have continued their historically low tritium trends. At the request of MDPH, weekly sampling of MW205 has been in place since January 2014 in order to monitor potential down-gradient impacts of tritium in groundwater originating from the area of MW219 and catch basin 10 (CB-10) where higher tritium levels were detected in groundwater in December 2013. As shown in Table 3, weekly results for MW205 since early June 2014 have ranged from no tritium detected to 1510 pCi/L, and results have been consistently non-detect in MW205 since the beginning of July. Entergy bi-weekly results for MW206 showed no detectible tritium in samples collected since June 9, 2014. Available results for MERL split sample analyses have shown generally consistent tritium results.

MDPH continues to monitor weekly results for MW218 and MW219 which are located in the vicinity of the neutralization sump discharge line separation discovered in April 2013. MW218 is located down-gradient of the pipe separation area and, as shown in Table 3, tritium results from Entergy for this well have remained generally consistent with detections ranging from between approximately ~1000 pCi/L to slightly greater than 2000 pCi/L since June 9, 2014. MW219 is located down-gradient of CB-10 and the tritium elevations detected in this monitoring well last spring (e.g. 14,400 pCi/L in May 2014 described in a previous investigation update) have shown a general decreasing trend. Available results for MERL split analyses for MW218 and MW219 were generally consistent with Entergy's results. As previously reported, Entergy believes that an increase in surface water runoff to CB-10 may be flushing residual tritium in soil down into the underlying groundwater, which in turn has impacted MW219. Recent investigation activities associated with CB-10 are further described in the Investigation Activities/Plans section below.

Tritium results for MW216, located just down-gradient from the end of the deep foundation on the northeast corner of the turbine and reactor buildings, continue to be monitored on a weekly basis. Tritium detected in this monitoring well continues to be elevated with both Entergy and MERL results fluctuating between approximately ~1000 pCi/L to less than ~7000 pCi/L since June 9, 2014. Investigation of possible tritium sources contributing to the elevated tritium detected in MW216 are currently ongoing and are described in the Investigation Activities/Plans section below.

MW209 and MW211 are also located down-gradient of the neutralization sump discharge line separation area and are currently being sampled weekly. As shown in Table 3, available results for MW209 from both Entergy and MERL indicated consistent detections of tritium in this well generally at or near ~1000 pCi/L. The latest tritium results for MW209 from Entergy indicated 1,180 pCi/L of tritium in a sample collected September 15, 2014. Results reported by Entergy and MERL for MW211 also indicated consistent trends generally at or near ~1000 pCi/L with the most recent results indicating 1,320 pCi/L of tritium detected by Entergy in a sample collected September 15, 2014. Finally, Entergy and MERL results for MW201 showed low or no detections of tritium and MW215 remained within typical ranges.

Surface Water Sampling Results:

Since the discovery of elevated tritium in MW219, surface water samples at the location downstream of MW205 have been collected on a weekly basis. Weekly surface water sampling results reported by Entergy from June 9 through October 10, 2014 for the location downstream of MW205 indicated no detectable tritium. Results of MERL split surface water sample analyses have also been non-detect through the week of September 29th and subsequent weekly surface water samples are currently being analyzed. Entergy results for the quarterly surface water sample collected from the boat ramp area were non-detect and MERL results are currently pending.

Investigation Activities/Plans:

Entergy recently conducted additional soil sampling to further characterize subsurface soil contamination previously identified in the area of the neutralization sump discharge line separation (results of initial soil sampling conducted in July 2013 have been described in previous investigation updates). In early August 2014, Entergy collected soil samples from five locations near the pipe separation area at various depths (e.g. approximately 5, 10, and 15 feet below ground surface), and analyzed for tritium and gamma radionuclides. Based on sample results reported by Entergy, results for 4 of the 5 soil borings indicated low levels of tritium (i.e. ND – 185 pCi/kg) and no gamma radionuclides (i.e. manganese-54, cobalt-60, cesium-137) were detected. Sample results for the 5th soil boring (i.e. Hole 4) located in closest vicinity to the pipe separation area showed low level detections of tritium (i.e. 43.6 – 73.8 pCi/kg), cobalt-60 (i.e. ND - 222.0 pCi/kg) and cesium-137 (240 - 1050 pCi/kg) at various

depths, and no detections of manganese-54. Results of split soil sample analyses conducted by MERL yielded consistent results. All samples collected from Hole 4 were also analyzed for hard-to-detect (HTD) radionuclides by Entergy's contract laboratory and results for HTDs were non-detect. Soil results for Hole 4 are consistent with those previously reported for July 2013 results and Entergy reports they will continue to work with the NRC in addressing these findings.

In August, Entergy conducted an investigation and evaluation of the appendix R duct bank area, which is the electrical duct bank that exits the reactor building auxiliary bay near the neutralization sump discharge line. Water previously discovered in the vicinity of an electrical junction box in the reactor building auxiliary bay that connects to the Appendix R duct bank was one of the observations that led to the discovery of the neutralization sump discharge line separation in spring 2013. Results of Entergy's recent investigation of the appendix R duct bank confirmed that no integrity issues are apparent and determined that all components were intact.

Entergy also conducted inspection, investigation, and cleaning of Catch Basins 10 and 11 (CB-10, CB-11) in August. MDPH staff was on-site to observe the inspection of CB-10 which is located up-gradient of MW219. As previously reported, an increase in tritium from MW219 during May and June, 2014 indicated some change in potential source(s) of tritium to this monitoring well. Entergy reported that paving activities in the area of CB-10 occurred in late April, and as a result, there has been increased surface water runoff into CB-10. Entergy therefore believes that this increased water runoff into CB-10 may be flushing residual tritium in soil down into the underlying groundwater, which in turn has impacted MW219. Entergy reported that results of the August investigation activities indicated that CB-10 and CB-11 required cleaning to remove accumulated silt from the bottom of the basins and this work was subsequently completed. In addition, it was determined that the grouting around the storm drain entry pipes located within CB-10 and CB-11was degraded. Entergy reported that they re-entered both basins to re-grout and seal these pipe joints the week of October 6, 2014.

As part of Entergy's investigation into possible sources of tritium detected in MW216, an inspection was also conducted of Junction Box 3 (JB-3), a catch basin in the area of MW216

that accepts roof drain runoff. Entergy reported that results of the August JB-3 inspection indicated that the catch basin appeared to be completely intact and no repair work would be needed. Entergy also reported that a sample of water that had accumulated within JB-3 was collected on August 7, 2014 and had been analyzed for tritium. Results of this sample indicated no tritium detected (NDA<410 pCi/L).

Entergy continues to work with their consultant to evaluate the potential for water migration from inside the plant to groundwater via seismic gaps[3] as another possible tritium source to MW216. These ongoing investigation activities include evaluation of possible migration pathways, identification of sampling locations where water may be accumulating within these seismic gaps, and inspection of the integrity of the sealant barriers within them which Entergy reports has been an issue identified at other nuclear power plants.

In addition to the ongoing MW216 investigation activities, Entergy recently reported collection of samples from condensate drains (associated with air conditioning units used for office spaces in the summer) which drain from the roof in downspouts that are directed to JB-3. Entergy reported that tritium was detected in the air conditioning condensate at concentrations ranging from 3500-4000 pCi/L and they plan to continue to work with their consultant to evaluate whether this could be a contributor to tritium levels detected in MW216.

Looking Forward:

MDPH will continue to closely follow all investigational activities that are currently underway at PNPS, notably investigations planned to further evaluate possible tritium sources in the vicinity of MW219 and MW216.

[3] "Seismic gaps" are engineered spaces between two foundations that allow them to move independently in a seismic event.