

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

Topic: PNPS Updates as of May 12, 2015

Groundwater Wells Monitored Weekly and Bi-weekly: Routine weekly and biweekly testing results from groundwater monitoring well samples collected since October 13, 2014, as well as two comprehensive, quarterly sampling rounds completed the weeks of November 17, 2014, and March 9, 2015, were reported by Entergy. Available split sample results through March 31, 2015 were also reported by MERL. The latest available results for tritium concentrations in wells sampled weekly and biweekly are summarized below in Table 1. All available historical monitoring data received through May 12, 2015, 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 1¹

Sample Collected Week of	Reported By ²	Tritium Concentration (pCi/L)									
		MW-201	MW-205	MW-206	MW-209	MW-211	MW-215	MW-216	MW-218	MW-219	MW-220
10/13/2014	Entergy/GEL		<350		1,150	1,230		3,180	3,030	970	
	MDPH/MERL		545		1,461	1,449		3,573	2,889	1,536	
10/20/2014	Entergy/GEL	<397	<367	<367	1,600	1,270	1,040	5,940	3,200	1,240	
	MDPH/MERL	497	521	554	1,721	1,143	969	6,127	3,127	1,241	
10/27/2014	Entergy/GEL		<394		1,270	1,310		4,630	1,860	889	
	MDPH/MERL		301		1,576	1,631		5,060	2,395	1,091	
11/3/2014	Entergy/GEL	<369	<394	1,080	1,510	1,380	816	4,380	1,920	659	
	MDPH/MERL	<300	<300	1,226	1,438	1,389	1,079	4,810	1,817	744	
11/10/2014	Entergy/GEL		<395		1,520	1,120		3,320	2,640	645	
	MDPH/MERL		<300		1,464	1,415		3,521	2,791	956	
11/17/2014	Entergy/GEL		<373	<390	1,390	1,090	1,280	1,590	3,150	591	
	MDPH/MERL		<300	322	1,499	1,197	887	1,618	2,895	744	
11/25/2014	Entergy/GEL	396	<389		1,450	1,370		5,600	4,010	865	
	MDPH/MERL	541	319		1,431	1,263		5,012	3,427	909	
12/1/2014	Entergy/GEL	<444	<448	<448	1,070	1,110	842	2,680	3,240	729	
	MDPH/MERL	563	472	372	1,631	1,288	964	2,766	2,979	1,019	
12/8/2014	Entergy/GEL		<396		1,560	1,440		5,060	3,210	612	
	MDPH/MERL		<300		1,334	1,188		3,849	2,850	848	
12/15/2014	Entergy/GEL	<415	<397	<350	1,020	985	809	1,650	2,930	857	
	MDPH/MERL	539	496	451	1,364	1,232	983	1,917	3,226	930	
12/22/2014	Entergy/GEL		<408		1,400	1,220		1,820	3,300	789	
	MDPH/MERL		347		1,236	1,244		2,354	3,080	839	
12/29/2014	Entergy/GEL	<359	<349	<371	1,240	1,140	790	1,320	3,820	846	
	MDPH/MERL	549	<300	428	1,538	1,225	904	1,432	3,152	1,155	
1/15/2015	Entergy/GEL	<369	489	<372	1,210	1,180	754	2,830	2,050	899	755
	MDPH/MERL	358	424	<300	1,057	1,141	688	2,285	1,977	830	841

NOTES

1. 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.

2. Previous updates have reported the data from Entergy in the tables as "GEL". To enhance clarity in the presentation of results, the tables report Entergy results prior to 4/1/2015 as "Entergy/GEL". Entergy results subsequent to 4/1/2015 are reported as "Entergy/TBE" to reflect a change in Entergy's contract laboratory.

< = Tritium not detected above the reporting level (RL) shown.

Table 1(cont)¹

Sample Collected Week of	Reported By ²	Tritium Concentration (pCi/L)									
		MW-201	MW-205	MW-206	MW-209	MW-211	MW-215	MW-216	MW-218	MW-219	MW-220
1/22/2015	Entergy/GEL		554		946	842		1,980	2,330	676	803
	MDPH/MERL		<300		1,039	1,067		1,882	2,066	970	727
2/4/2015	Entergy/GEL	<382	<344	<366	1,020	1,010	812	2,580	2,240	927	634
	MDPH/MERL	<300	352	<300	1,282	1,051	600	2,371	2,384	1,009	645
2/12/2015	Entergy/GEL				1,130			3,220	1,710		
	MDPH/MERL				929			3,572	1,651		
2/19/2015	Entergy/GEL	<377			1,420	930				1,300	
	MDPH/MERL	<300			971	1,046				1,215	
2/23/2015	Entergy/GEL		<387	<380	1,360	1,110	620	1,000	3,530	2,060	<377
	MDPH/MERL		575	<300	1,181	1,043	675	1,163	2,908	1,799	<300
3/3/2015	Entergy/GEL		391		639	1,020		2,060	3,960		500
	MDPH/MERL		508		1,101	1,219		1,946	3,597		
3/9/2015	Entergy/GEL		<410	<393	966	987	540	1,830	3,450	571	435
	MDPH/MERL		441		960	935		1,811	2,942	1,014	
3/16/2015	Entergy/GEL		488		1,350	1,660		3,070	2,190	1,710	
	MDPH/MERL		533		962	950		2,895	1,714	1,852	
3/23/2015	Entergy/GEL	<368	<361	<365	779	1,420	851	548	1,960	1,340	
	MDPH/MERL		337		564	1,132		570	2,131	1,294	
3/30/2015	Entergy/GEL		<361		902	1,290		1,000	1,980	1,120	
	MDPH/MERL		<300		807	1,006		1,194	1,497	1,024	
4/7/2015	Entergy/TBE	<325	489		651	1,230	752	420	1,550	829	
	MDPH/MERL										
4/13/2015	Entergy/TBE		601	<350	919	1,310		947	1,560	1,210	
	MDPH/MERL										
4/20/2015	Entergy/TBE	<335	592	<334	947	1,070	1,010	1,240	1,210	1,310	
	MDPH/MERL										

NOTES

1. 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.
 2. Previous updates have reported the data from Entergy in the tables as "GEL". To enhance clarity in the presentation of results, the tables report Entergy results prior to 4/1/2015 as "Entergy/GEL". Entergy results subsequent to 4/1/2015 are reported as "Entergy/TBE" to reflect a change in Entergy's contract laboratory.
- < = Tritium not detected above the reporting level (RL) shown.

Biweekly tritium results for MW-201 since mid-October 2014 are consistent with recent historical results. As shown in Table 1, results for MW-201 indicate tritium concentrations ranging from not detected above the laboratory reporting levels (RL), to detected at 563 pCi/L.

Tritium concentrations in monitoring well MW-205 have continued historically low trends. Weekly sampling of MW-205 has been in place since January 2014 in order to monitor potential downgradient impacts of tritium in groundwater originating from the area of MW-219 and catch basin 10 (CB-10). As shown above in Table 1, weekly results for MW-205 since mid-October 2014 indicate tritium concentrations below the laboratory RL, or just above the RL. Tritium was detected in MW-205 for eighteen of the twenty-four sampling events included in this update at concentrations ranging from 301 pCi/L to 601 pCi/L.

Biweekly results for MW-206 indicate a range of tritium concentrations from below the laboratory RLs, to above the RL at 1,226 pCi/L. Tritium concentrations at MW-206 are lower than historical concentrations; however, this well continues to show intermittent peaks and follows a trend consistent with MW-216.

Weekly tritium results for MW-209 and MW-211 are also similar to historical results. Both wells are downgradient from the Neutralization Sump Discharge Line separation area discovered in April 2013 and described in previous updates. Tritium concentrations for MW-209 range from 564 pCi/L to 1,721 pCi/L. Tritium concentrations detected at MW-211 ranges between 842 pCi/L and 1,660 pCi/L. Biweekly results for MW-215, located downgradient of MW-211, also remained within its historical range, with results ranging from 540 pCi/L and 1,280 pCi/L.

Tritium results for MW-216, located downgradient of, and proximate to, the northeast corner of the Power Block, continues to be monitored on a weekly basis. Tritium concentrations detected in MW-216 continue to be higher with results fluctuating between 420 pCi/L and 6,127 pCi/L since October 13, 2014. Investigation of possible sources contributing to the tritium concentrations detected in MW-216 are currently ongoing and are described in the Investigation Activities/Plans section below.

MDPH continues to monitor weekly results for MW-218, which is located in the vicinity of the Neutralization Sump Discharge Line separation area near MW-211 on the west side of the Power Block. Tritium results for MW-218 show a recent uptick in concentrations from the historical low observed in May 2014 (1,070 pCi/L), with results ranging from 1,210 pCi/L to 4,010 pCi/L. MDPH has observed that recent results for this well appear to be following a trend consistent with MW-216 and MW-206 located on the east side of the Power Block and have asked Entergy to work with their consultants to further evaluate possible tritium sources these wells may have in common.

Concentrations of tritium in weekly samples collect at MW-219, located immediately downgradient of CB-10, have continued to decrease subsequent to the inspection and re-grouting activities conducted at CB-10 in September and October 2014. Details of past tritium elevations in MW-219 and the subsequent inspection and repair activities at CB-10 are described in previous updates. Results for MW-219 during the current update period show a range of tritium from 571 pCi/L to 2,060 pCi/L.

In December 2014, Entergy installed a new monitoring well, MW-220, located on the western side of the Power Block in the vicinity of CB-11. Entergy reported that the installation of MW-220 is to replace the previously decommissioned MW-203 and to provide additional data to

characterize the groundwater flow in this area on the west side of the Power Block. Initial results for MW-220 show tritium concentrations ranging from 435 pCi/L to 841 pCi/L, with general agreement between Entergy and MERL analytical results. Entergy is currently sampling MW-220 on a weekly basis. A map showing the approximate location of this new well is posted on MDPH's website at:

<http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/radiation/environmental-monitoring.html>

Groundwater Wells Monitored Quarterly:

As shown below in Table 2, laboratory results reported by Entergy showed no detectable tritium above the laboratory RL or tritium just above the RL for most monitoring wells that are monitored on a quarterly basis. MERL split sample results for the November 2014 quarterly sampling round generally agree with Entergy results, or show detections due to a lower RL.

Table 2¹

Sample Collected Week of	Reported By	Tritium Concentration (pCi/L)												
		MW-202	MW-202I	MW-204	MW-207	MW-208S	MW-208I	MW-210	MW-212	MW-213	MW-214	MW-217	MW-3	MW4R
11/17/14	Entergy/GEL ²	<387	<389	<406	<399	<394	<387	<406	624	<393	<401	<391	<395	581
	MDPH/MERL	<300	<300	400	363	<300	306	502	588	302	<300	386	<300	718
3/9/2015 - 3/23/15	Entergy/GEL ²	<389	<389	491	<383	<380	<395	426	573	<390	<354	<394	<385	<374
	MDPH/MERL													

NOTES

1. 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.

2. Previous updates have reported the data from Entergy in the tables as "GEL". To enhance clarity in the presentation of results, the tables report Entergy results prior to 4/1/2015 as "Entergy/GEL". Entergy results subsequent to 4/1/2015 are reported as "Entergy/TBE" to reflect a change in Entergy's contract laboratory.

< = Tritium not detected above the reporting level (RL) shown.

Surface Water Sampling Results:

Since the detection of elevated tritium in MW-219 in December 2013, surface water samples at the location downstream of MW-205 (i.e., "Intake" location) have been collected on a weekly basis. Weekly surface water results for the current update period indicate no detectable tritium at the Intake location with one exception: tritium was detected at 305 pCi/L by MERL in an Intake split sample collected on October 13, 2014. This detection was slightly above MERL's laboratory RL of 300 pCi/L. Entergy results for the Intake sample collected on October 13, 2014 were below GEL's RL of 351 pCi/L. Upon receipt of MERL results for this surface water sample, MDPH prioritized analysis of subsequent weekly surface water samples from this location. MERL results for subsequent samples indicated no tritium was detected above the laboratory RL of 300 pCi/L. MDPH requested that Energy determine if operations conducted

on the day of, or the days leading up to, the October 13, 2014 Intake sample could have influenced the results (e.g., timing of a permitted discharge with respect to sample collection). Information received from Entergy to date indicates that the facility was 100% operational in early October 2014, and no liquid tritium discharges occurred via their discharge canal during that time. Both the Entergy and MERL results for the quarterly surface water sample collected from the boat ramp area showed no detectable activity above the laboratory RLs.

Investigation Activities/Plans:

On March 6, 2015, representatives from MDPH, MEMA, NRC and Entergy met to discuss the ongoing tritium in groundwater investigation. Entergy provided an update of recent groundwater monitoring trends and the current status of ongoing investigation activities, which are described below.

MDPH recently received soil data from Entergy for samples collected proximate to CB-10 and CB-11, and analyzed for gamma radionuclides. Entergy reported the collection of soil samples between December 15, 2014 and December 22, 2014, to characterize the nature and extent of radionuclide impacts after rerouting the Neutralization Sump Discharge Line to CB-10 resulted in increased tritium concentrations detected in MW219 in December 2013. Results for ten soil borings were forwarded to MDPH: five soil borings to assess soils in the vicinity of CB-10 and five soil borings to assess soils near CB-11. Samples were collected at depths ranging from 4.5 feet below ground surface (bgs) to 15.5 feet bgs and analyzed for tritium and gamma radionuclides (i.e., Cesium-137, Cobalt-60, and Manganese-54). Tritium was detected in the soil proximate to CB-10 at concentrations ranging from non-detect to 175 pCi/kg. Tritium was not detected in soil proximate to CB-11. The analytical results show that Manganese-54 and Cobalt-60 were not detected above RLs in any of the ten soil borings. Cesium-137 was detected in the vicinities of both catch basins (i.e. approximately 10-15 feet bgs) at concentrations ranging from non-detect to 2,400 pCi/kg. Additional analyses for “hard-to-detect” (HTD) radionuclides, including Iron-55, Nickel-63, and Strontium-90, were performed for two samples collected near CB-10 that showed the highest concentrations of Cesium-137. No HTD radionuclides were detected above the reporting levels (RLs) in these samples. Entergy reports they are working with the Nuclear Regulatory Commission (NRC) to identify a remedial option associated with these findings.

Energy continues to work with their consultant to evaluate the potential for water migration from inside the plant to groundwater via seismic gaps, an issue identified as a tritium source at other nuclear power plants and described in previous updates. Seismic gaps exist between some of the Power Block structures and are intended to allow for independent movement of the buildings in the event of an earthquake. Entergy recently completed an effort to reseal the seismic gap that bisects the Reactor Bay and the Turbine Building (Condenser Bay) during their scheduled refueling and maintenance outage. Entergy and their consultant believe the Reactor Bay/Condenser Bay seismic gap is a potential pathway for tritiated water to move outside the building, and that sealing it will reduce the elevated tritium concentrations observed in downgradient wells such as MW-216. MDPH has also asked Entergy to evaluate whether recent trends observed in MW-218 could be associated with a seismic gap pathway.

Entergy continues to analyze on-site precipitation samples collected following rain events to evaluate the potential role of tritium washout in groundwater associated with the facility's permitted air emissions. Entergy has reported tritium concentrations detected in precipitation samples ranging from non-detect to approximately 4,000 pCi/L, although tritium concentrations observed in some groundwater wells (e.g. MW-216) cannot be solely attributed to a washout pathway.

As required by the NRC in response to the Fukushima Dai-ichi tragedy, Entergy has begun implementing a Flexible Coping Strategies Integrated (FLEX) Plan. Entergy's FLEX Plan has included the installation of three deep groundwater wells, meant to serve as a secondary source of cooling water should one be needed. In fall 2014, three FLEX wells were installed south of the Power Block to depths of approximately 80 feet, reaching the underlying bedrock. Subsequent to production tests, Entergy collected one discrete sample at each FLEX well location and one from each of 16 holding tanks containing water generated by the tests. The 19 water samples were analyzed for tritium and the results were shared with MDPH. The Entergy results indicate that tritium was not detected in any of the samples above the RL, which ranged from 402 to 466 pCi/L. MDPH received split samples for the FLEX wells from Entergy and MERL performed a tritium analysis on all 19 samples. MERL analysis showed tritium slightly above the RL of 300 pCi/L in three of the 19 samples ranging from 304 to 388 pCi/L. While these three samples showed tritium slightly above the RL, the levels of tritium detected by MERL analysis are approximately two orders of magnitude below the EPA standard for tritium in drinking water (20,000 pCi/L). Although installation of these three deep

groundwater wells was for emergency cooling purposes and unrelated to the ongoing tritium in groundwater investigation, the tritium sampling results provide data representative of deep groundwater at PNPS. Entergy has reported that they plan to run production tests at these three deep groundwater wells every two years. At the request of MDPH, Entergy has agreed to sample these FLEX wells for tritium and provide split samples to MERL on an annual basis.

Looking Forward:

MDPH will continue to closely follow all investigation activities currently underway at PNPS, paying particular attention to the evaluation of potential tritium sources from the Power Block, surface water results, and deep well monitoring.