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PNP 2016-032

Technical Specification 5.6.2

May 12, 2016

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: 2015 Radiological Environmental Operating Report

Palisades Nuclear Plant
Docket 50-255
License No. DPR-20

Dear Sir or Madam:

Entergy Nuclear Operations, Inc. is submitting the enclosed Radiological Environmental Operating Report for the Palisades Nuclear Plant. This report was prepared in accordance with the requirements of Technical Specification 5.6.2. The period covered by the enclosed report is January 1, 2015, through December 31, 2015.

This letter contains no new commitments and no revision to existing commitments.

Sincerely,

A handwritten signature in black ink, appearing to read "JAH" followed by a stylized flourish.

JAH/bed

Enclosure 1: Annual Radiological Environmental Operating Report January 1, 2015,
Through December 31, 2015

CC Administrator, Region III, USNRC
Project Manager, Palisades, USNRC
Resident Inspector, Palisades, USNRC

**ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT
JANUARY 1, 2015 THROUGH DECEMBER 31, 2015**

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ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT JANUARY 1, 2015 THROUGH DECEMBER 31, 2015

I. INTRODUCTION

The Radiological Environmental Operating Report provides a summary and data interpretation of the Palisades Nuclear Plant (PNP) Radiological Environmental Monitoring Program as conducted during the 2015 reporting period. This report was prepared in accordance with the requirements of 10 CFR 50, Appendix I, Sections IV.B.2, IV.B.3, IV.C, and Technical Specification 5.6.2.

II. NON-ROUTINE REPORTS

No reportable events occurred during this reporting period.

III. DISCUSSION AND INTERPRETATION OF RESULTS

A. Air Samples

There were 312 air samples collected and analyzed for gross beta and I-131. Air iodine/particulate samples are collected weekly from six air-sampling locations. Air is metered into the sampling unit at an approximate one cubic foot per minute flow rate through a 47-mm air filter (air particulate) and an air iodine cartridge. Both filters are in-line with each other and housed within the same filter holder. Weekly samples were sent to Teledyne Brown Engineering Environmental Services.

Analysis of the airborne particulate sample data, between the five near-site indicator locations and the control location, demonstrated no statistical difference. The average concentration of gross beta for both indicator and control locations were 0.023 pCi/m³ and 0.022 pCi/m³, respectively. The new indicator location 19ST, added at the end of year 2014, had the highest average concentration of 0.026 pCi/m³. All I-131 activity results were below the Minimum Detectable Concentration (MDC) levels.

Four of the seven sample collection anomalies in 2015 occurred with air samples. Of the four air sample anomalies, two compromised the lower limit of detection (LLD) to less conservative values than what is required, and two anomalies were non-consequential. An evaluation of each sample collection anomaly is provided in Section VI, Attachment A.

B. Lake Water (Surface Water)

Palisades' Lake In (Indicator) and Ludington (Control) lake water samples were collected daily and combined into monthly composite samples. One gallon of both Palisades' Lake-In and Ludington Lake-in composites was sent to Teledyne Brown Engineering, Inc. for monthly analysis for gross

beta, gamma spectroscopy, and tritium. No treatment of the water samples with preservative was required. Of the 12 indicator samples, seven had detectable activity with an average concentration of 2.61 pCi/L gross beta. Of the 12 control samples analyzed, three had detectable activity with an average concentration of 2.36 pCi/L gross beta. No tritium was detected above the MDC. One control sample contained naturally occurring K-40 at a concentration of 26.6 pCi/L. This was the only gamma emitter detected which had an activity greater than two standard deviations above the MDC.

No statistical difference was found between the indicator and control location samples and no PNP Offsite Dose Calculation Manual (ODCM) Appendix A, reporting limits were exceeded.

C. Drinking Water

Palisades' Domestic Water and South Haven Municipal Raw Water (Indicators) and Ludington (Control) water samples were collected daily and combined into monthly composite samples. One gallon each of these composites were sent to Teledyne Brown Engineering, Inc. for analysis and analyzed for gross beta, gamma emitters, and tritium. No treatment of the water samples with preservative was required. No tritium or gamma emitters were detected in these samples.

Tritium was not detected in any of the indicator or control water samples. Gross beta emitters were detected in 6 of the 24 indicator samples analyzed and gross beta emitters were detected in 3 of the 12 control samples analyzed.

No statistical difference was found between the indicator and control location samples and no PNP ODCM Appendix A, reporting limits were exceeded.

D. Milk

There are no dairy farms meeting the sampling criteria of being within eight kilometers (km) of PNP. Because of a lack of dairy farms, PNP analyzes broad leaf vegetation samples as a substitute for milk sampling.

E. Thermoluminescent Dosimeters (TLDs) - Gamma Dose

Environmental gamma doses are measured quarterly by placement of TLDs at designated locations. Sensitivity for the TLDs is 3 mrem, with a linear response of 1 mrem to 50 rem.

The PNP direct radiation monitoring program consists of TLDs placed at 23 locations. There are ten inner ring TLDs, one on-site TLD, nine outer ring TLDs, and three control TLDs located in Grand Rapids, Kalamazoo and Dowagiac, MI.

91 of 92 environmental TLDs were collected and analyzed during 2015. TLD #23 was identified to be missing in April 2015. A description of this event is in the anomaly table in Section VI, Attachment A. The on-site TLD is included with the inner ring (site boundary) TLDs for evaluating any dose effect that could be attributed to PNP operations.

The TLD data evaluations were performed by comparing the inner ring TLDs and the outer ring TLDs against the control TLDs.

The quarterly average gamma readings in mrem were:

Inner Ring	9.5
Outer Ring	11.2
Control	10.9

The highest average reading was observed at outer ring location number 2 with a value of 14.0 mrem and a maximum reading of 14.65 mrem. This location is historically the highest above the outer ring average, but not attributed to plant operations, since the inner ring in the same sector is not significantly above the average reading of the inner ring. This location is on a dirt road by an animal farm which contributes to the higher natural background at this location due to radon daughter products.

The average control dose, 10.9 mrem, plus two standard deviations, was 12.4 mrem. No Inner Ring reading exceeded this amount. This demonstrates that there was no direct radiation effect due to PNP operations.

Note: It should be noted that the critical aspect of environmental TLD monitoring is the comparison between Indicator and Control TLD dose in the same monitoring period – more so than the comparison from one year to the next.

All TLD's were analyzed by Environmental Dosimetry Company. The Quality Assurance status report for Environmental Dosimetry Company is provided in Attachment G.

F. Crops

Two principal area crops, apples and blueberries, were collected in 2015. Approximately 1 kg of sample is placed in a plastic bag for shipment to the

vendor for analysis. No special treatment of the samples with a preservative is necessary.

The blueberry samples collected were not from the location defined per procedure CH 6.10 in Section VI, Attachment C. A summary of this event is captured in Section VI, Attachment A.

Apples were grown locally, and collected in the vicinity of indicator station 4-JS (3.5 miles SE). There was no activity detected in the blueberry or apple samples with the exception of naturally occurring K-40 which was detected in the apple sample at a concentration of $1.02\text{E}+03$ pCi/kg and in the blueberry samples at a concentration of $5.74\text{E}+02$ pCi/kg.

G. Sediment

Sediment samples are collected semi-annually from a location $\frac{1}{2}$ mile north and at the southern site boundary of the plant along the waterline. No treatment of the samples with a preservative is necessary prior to shipment to the vendor for analysis. A total of four sediment samples were collected and analyzed.

The only gamma emitters detected in the sediment samples collected in September was naturally occurring K-40. The concentration of K-40 detected was greater than two standard deviations above the mean for the southern and northern sample. One of the samples collected in December 2015 contained K-40, Th-232, and Th-228 at a concentration greater than two standard deviations above the mean. The other sample collected in December 2015 contained K-40 and Th-228 at a concentration greater than two standard deviations above the mean.

H. Fish

Fish samples are collected semi-annually. Samples consist of species of commercially and/or recreational important species near the plant discharge area. Control samples are obtained in an area not influenced by plant discharge. Each one-liter quantity of fish sample is frozen for preservation for shipment to Teledyne Brown for analysis.

Six fish samples were collected in the vicinity of PNP and seven control samples were collected from Ludington Pumped Storage Facility. The only activity detected in the fish samples was from naturally occurring K-40. The average activity of naturally occurring K-40 in the control samples was $3.32\text{ E}+03$ pCi/L. The average activity of naturally occurring K-40 in the samples collected at PNP was $3.04\text{ E}+03$ pCi/L.

I. Broad Leaf Vegetation

PNP derived an acceptance criterion for broadleaf sample Cs-137 results based upon background sampling. The acceptance value has been determined to be 146 pCi/Kg, which is the background average plus one standard deviation. This means that any sample result above this would be statistically valid and would require additional evaluation pertaining to the source of activity.

There is documented evidence that Cs-137 exists in the biosphere from activities 25 to 50 plus years ago. Cs-137 is readily transported through the environment due to its chemical properties. When in solution (during rainfall events) it can be efficiently taken up by plants. The evidence presented documents that there is a fairly wide ranging span of Cs-137 concentration in the environment that is far enough away from the site to not be associated with deposits from plant effluents.

In support of this conclusion is the fact that Location 1 is in a heavily wooded area where sample media would typically attain activity from the sediment rather than gaseous effluents. Location 2 and control are in areas that are more open and next to roads which allows a better opportunity to receive activity from gaseous releases. I-131 was released during the course of the year at a consistent quantity and would have been detected in the foliage if the Cs-137 was from plant gaseous effluents.

2015 sample results were reviewed and assessed based on the above criterion. Location 1, located in a wooded area, had Cs-137 identified in four samples collected in 2015 with an average of 49.2 pCi/Kg. Location 2, located near the site boundary and on the edge of a wooded area had one sample indicate Cs-137 at 56.2 pCi/Kg. No positives were indicated at the control location which is also on a wooded area edge. All positives are well below the 146 pCi/Kg acceptance value.

J. Non-Routine Samples

Seven monthly samples were taken from the closest commercial well water at the seasonal Palisades Park housing subdivision south of PNP. Another seven samples were taken from the community well at the seasonal Palisades Park facility also. Wells are not turned on before April 15th and are secured by October 15th of each year. These samples were sent to Teledyne Brown Engineering, Inc. for analysis and analyzed for gross beta, gamma spectroscopy, and tritium. Three of the commercial well samples contained detectable beta activity and none of the community well samples contained detectable beta activity. Of the three commercial wells that detected beta activity, none of the activity was

detected in a concentration greater than two standard deviations above the mean. None of the commercial or community well samples contained a detectable tritium concentration.

All of the activity detected in Palisades Park housing water samples is attributed to naturally occurring activity.

K. Gaseous and Liquid Radwaste Effluent Composite Samples

Gaseous and liquid radwaste effluent composite samples were collected and analyzed on site and by Teledyne Brown Engineering, Inc. No special sample treatment with a preservative is required prior to laboratory analysis. The liquid effluent composite sample is produced from samples collected from each batch release. The gaseous radwaste effluent weekly composite sample results are based on analyzing weekly stack gas particulate and iodine filters.

Although not a direct reporting component in the PNP Annual Radiological Environmental Operating Report, results of the gaseous and liquid monthly radwaste effluent composite samples in addition to normal release data are evaluated against overall environmental trending data. This evaluation assists in determining isotopic dispersion and deposition patterns within the surrounding environment of PNP.

IV. ASSESSMENT OF PALISADES OPERATION ENVIRONMENTAL IMPACT

In reviewing the 2015 PNP radiological environmental monitoring data, and comparing it to previous operational and pre-operational data, all trending parameters continue to indicate that the operation of PNP has minimal environmental impact. Most isotopic activity is at environmental background levels. Evidence of an overall environmental isotopic buildup attributable to plant effluents remains negligible as well. The positive Cs-137 results detected in crops, broadleaf, and fish samples are attributed to atmospheric weapons testing and Chernobyl accident source term.

V. TABLES

Table 10.4-1 Sampling and Analysis Summary

Medium	Collection Description	Location	Number of Samples Collected	Type of Analysis	Frequency of Analysis
Air	Continuous at ~1 cfm	Stations 4, 5, 8, 9, 10, and 19	312	Gross Beta, I-131	Weekly
Lake Water	1 gallon composite	Lake Intake	12	Gross Beta, Tritium	Monthly
Lake Water - Control	1 gallon composite	Ludington Lake In	12	Gross Beta, Tritium	Monthly
Drinking Water	1 gallon composite	South Haven Municipal (Domestic Water) and South Haven Raw	24	Gross Beta, Tritium	Monthly
TLD	Continuous	Inner Ring, Outer Ring, Controls	91	Gamma dose	Quarterly
Food Products	1 kg grab	4-JS, 3.5 miles SE	2	Gamma isotopic and I-131	At time of harvest
Sediment	1 L grab	Discharge 1/2 mile north and south of plant near site boundary	4	Gamma isotopic	Semiannually
Fish	1 L grab	Discharge and Control	7 Control, 6 indicator	Gamma isotopic	Semiannually
Broad leaf Vegetation	1 kg grab	Plant boundary – S and SSE sectors, Control 9 to 18 miles NNE of plant	15	Gamma isotopic and I-131	Monthly during growing season

a. Only sediment samples 1/2 mile north of plant are required

**Table 10.4-2
Sample Data Summary**

Name of Facility	Palisades Nuclear Plant	Docket No	50-255
Location of Facility (County, State)	Van Buren, Michigan	Reporting Period	Jan 1, 2015 to Dec 31, 2015

Medium or Pathway Sampled (Unit of Measure)	Type/Total Number of Analyses Performed	Lower Limit of Detection	All Indicator Locations Mean (f)b Rangeb	Greatest Mean Name Distance & Direction	Greatest Mean (f)b Rangeb	Control Locations Mean (f)b Rangeb	Number of Reportable Occurrences
Air (pCi/m3)	I-131 / 312	0.07	< MDC	NA	< MDC	< MDC	0
	Gross beta / 311	0.01	0.023 (260/260) 0.008-0.097	19ST 0.443 mi ESE	0.026 (52/52) 0.011-0.097	0.022 (51/51) 0.012-0.042	0
Lake Water (pCi/L)c	Gross beta / 24	4.0	2.61 (7/12) 2.28-3.06	Palisades LKIN	3.06 (1/12) NA	2.36 (3/12) 1.95-2.81	0
	Tritium / 23	2000	< MDC (0/12)	NA	< MDC (0/11)	< MDC (0/11)	0
Drinking Water (pCi/L)c	Gross beta / 36	4.0	2.97 (6/24) 1.95-5.64	South Haven RAW/Domestic	3.23 (4/24) 1.95-5.64	2.36 (3/12) 1.95-2.81	0
	Tritium / 35	2000	< MDC (0/24)	NA	< MDC (0/11)	< MDC (0/11)	0
Inner Ring TLD (Gamma mR)d	Gamma Dose / 56	Sensitivity of 3 mR per vendor	9.5 (44/44) 8.12-10.85	Station # 1 Palisades	10.60 (4/4) 10.22-10.85	10.9 (12/12) 10.00-12.00	0
Outer Ring TLD (Gamma mR)d	Gamma Dose / 47	Sensitivity of 3 mR per vendor	11.2 (35/35) 9.40 – 14.65	Station # 2 5.6 miles S	14.00 (4/4) 12.49 -14.65	10.9 (12/12) 10.00-12.00	0

**Table 10.4-2
Sample Data Summary**

Medium or Pathway Sampled (Unit of Measure)	Type/Total Number of Analyses Performed	Lower Limit of Detection	All Indicator Locations Mean (f) ^b Range ^b	Greatest Mean Name Distance & Direction	Greatest Mean (f) ^b Range ^b	Control Locations Mean (f) ^b Range ^b	Number of Reportable Occurrences
Food Crops (pCi/kg wet)	I-131 / 2	60	< MDC (0/2)	NA	< MDC (0/2)	Control sample not required	0
	Cs-134 / 2	60	< MDC (0/2)	NA	< MDC (0/2)	Control sample not required	0
	Cs-137 / 2	80	< MDC (0/2)	NA	< MDC (0/2)	Control sample not required	0
Sediment (pCi/kg dry)	Cs-134 / 4	150	< MDC (0/4)	NA	< MDC (0/4)	Control sample not required	0
	Cs-137 / 4	180	< MDC (0/4)	NA	< MDC (0/4)	Control sample not required	0
Fish (pCi/kg wet)	Mn-54 / 13	130	< MDC (0/6)	NA	< MDC (0/6)	< MDC (0/7)	0
	Fe-59 / 13	260	< MDC (0/6)	NA	< MDC (0/6)	< MDC (0/7)	0
	Co-58 / 13	130	< MDC (0/6)	NA	< MDC (0/6)	< MDC (0/7)	0
	Co-60 / 13	130	< MDC (0/6)	NA	< MDC (0/6)	< MDC (0/7)	0
	Zn-65 / 13	260	< MDC (0/6)	NA	< MDC (0/6)	< MDC (0/7)	0
	Cs-134 / 13	130	< MDC (0/6)	NA	< MDC (0/6)	< MDC (0/7)	0
	Cs-137 / 13	150	< MDC (0/6)	NA	< MDC (0/6)	< MDC (0/7)	0
Broad Leaf Vegetation (pCi/kg wet)	I-131 / 15	60	< MDC (0/10)	NA	< MDC (0/8)	< MDC (0/5)	0
	Cs-134 / 15	60	< MDC (0/10)	NA	< MDC (0/8)	< MDC (0/5)	0
	Cs-137 / 15	80	49.2 (5/10) 43.4-56.2	BV2 0.5 miles SE	56.2 (1/5) NA	< MDC (0/5)	0

a Nominal Lower Limit of Detection (LLD) as defined in table notation c of ODCM Appendix A Table E-3

b Mean and range based on detectable measurements only.

c The Lake Water and the Drinking Water totals in column 2 both account for the use of the same samples from Ludington Control.

d The Inner and Outer TLD totals in column 2 account for the use of the same control TLDs in both areas.

f Fraction of detectable measurements at specific locations is indicated in parenthesis.

Table 10.4-3
Greatest Mean Sampling Location
January 1, 2015 to December 31, 2015

Medium or Pathway Sampled (unit of measurement)	Type of Analysis	Location	High	Low	Mean
Air (pCi/m ³)	I-131	NA	< MDC	< MDC	< MDC
	Gross Beta	19ST	0.097	0.011	0.026
Lake Water (pCi/L)	Gross Beta	Palisades	3.06	2.28	2.61
	Tritium	NA	< MDC	< MDC	< MDC
Drinking Water (pCi/L)	Gross Beta	South Haven Raw/Domestic	5.64	1.95	3.23
	Tritium	NA	< MDC	< MDC	< MDC
Inner Ring TLD (gamma mR)	Quarterly	#1 (Palisades)	10.85	10.22	10.60
Outer Ring TLD (gamma mR)	Quarterly	# 2 5.6 miles S	14.65	12.49	14.00
Crops (pCi/kg wet)	I-131	NA	< MDC	< MDC	< MDC
	Other Gamma	NA	< MDC	< MDC	< MDC
Sediment (pCi/kg dry)	Gamma Emitters	NA	< MDC	< MDC	< MDC
Fish (pCi/gm wet)	Gamma Emitters	Palisades	< MDC	< MDC	< MDC
Broad leaf vegetation (pCi/kg wet)	Gamma Emitters	Site boundary SE	56.2	56.2	56.2