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PNP 2021-016   Technical Specification 5.6.2

May 12, 2021

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

Subject: 2020 Radiological Environmental Operating Report

               Palisades Nuclear Plant
               Docket 50-255
               Renewed Facility 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, 2020, through December 31, 2020.

If you have any questions regarding this submittal, please contact Mike Soja, Chemistry Manager, at 269-764-2536.

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

Respectfully,

Barbara E Dotson

BED / mrp

Enclosure: Annual Radiological Environmental Operating Report

cc: Administrator, Region III, USNRC
        Project Manager, Palisades, USNRC
        Resident Inspector, Palisades, USNRC

ENCLOSURE

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT
PNP 2021-016

44 Pages Follow

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	YEAR: 2020
Document Number: 2021-016	
Annual Radiological Environmental Operating Report	

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1.0   EXECUTIVE SUMMARY

1.1   <u>Radiological Environmental Monitoring Program</u>

The Annual Radiological Environmental Operating Report presents data obtained through analyses of environmental samples collected for Palisades Radiological Environmental Monitoring Program (REMP) for the period January 1 through December 31, 2020. This report fulfills the requirements of Palisades Technical Specification 5.6.2.

No measurable levels of radiation above baseline levels attributable to Palisades operation were detected in the vicinity of Palisades in 2020. The 2020 REMP thus substantiated the adequacy of source control and effluent monitoring at Palisades with no observed impact of plant operations on the environment.

Palisades established the REMP prior to the station becoming operational to provide data on background radiation and radioactivity normally present in the area. Palisades has continued to monitor the environment by sampling air, water, sediment, broad leaf vegetation, fish, and food products, as well as measuring direct radiation. Palisades also samples milk if milk-producing animals used for human consumption are present within five miles (8 km) of the plant. All analyses have required, nuclide specific, lower limit of detections (LLDs) which must be achieved. The requirements of the REMP are formally described in the offsite dose calculation manual (ODCM), a site specific regulatory document.

The REMP includes sampling indicator and control locations. The REMP utilizes indicator locations near the site to show any increases or buildup of radioactivity that might occur due to station operation and control locations farther away from the site to indicate the presence of only naturally occurring radioactivity. Palisades personnel compare indicator results with control and preoperational results to assess any impact Palisades operation might have had on the surrounding environment.

In 2020, REMP samples were collected for radiological analysis. The results of indicator locations were compared with control locations and previous studies. All 2020 REMP results support the conclusion that the surrounding environment is minimally affected by Palisades' effluents. No activity in any REMP sample from 2020 was attributed to Palisades' effluents.

1.2   <u>Reporting Levels</u>

No samples equaled or exceeded reporting levels.

1.3   <u>Sample Deviations</u>

During 2020, environmental sampling was performed for eight media types (airborne, surface water, drinking water, offsite groundwater, sediment, broad leaf vegetation, fish, and food products) and for direct radiation. All REMP samples were obtained as required by the ODCM in 2020 with the exception of three instances of sample deviations which are further discussed in Attachment 1 Table 8.

1.4   <u>Program Modifications</u>

There were no program modifications during the reporting period.

2.0 INTRODUCTION

2.1 Radiological Environmental Monitoring Program

Palisades established the REMP, as defined in the ODCM, to fulfill 10 CFR Part 50 Appendix I Section IV.B.2. The REMP supplements the radiological effluent monitoring program by verifying that the concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways.

2.2 Pathways Monitored

The airborne, direct radiation, waterborne and ingestion pathways are monitored as required by Palisades ODCM. These requirements are also listed in this report in Table 1 through Table 4.

Section 4.0 of this report provides a discussion of 2020 sampling results and Section 5.0 providing a summary of results for the monitored exposure pathways.

2.3 Land Use Census

Palisades conducts a land use census annually to identify changes in uses of land within five miles of the site that would require modifications to the REMP and the ODCM. The purpose of this census is to identify critical receptor pathways for the purpose of effluent modeling and REMP sampling.

3.0 RADIOLOGICAL ENVIRONMENTAL SAMPLING PROGRAM REQUIREMENTS

Table 1, Exposure Pathway – Airborne

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
RADIOIODINE AND PARTICULATES Six samples total. Four samples from within 6 km (3.7 miles) of the site boundary in different sectors. One sample from the vicinity of a community having the highest calculated annual average ground level deposition factor. One control sample in the least prevalent wind direction (considering practical direction and distance).	• A8 (0.595 miles NE) - onsite near state park • A19 (0.423 miles SSE) - onsite near Bluestar Hwy • A9 (1.525 miles SSW) - offsite near blue star highway • A4 (3.882 miles SE) - offsite in Covert township • A5 (3.590 miles ESE) - offsite in Covert township • A10 (50.765 miles NE) - offsite near Grand Rapids	Continuous sampler operation with sample collection every week, or more frequently if required by dust loading.	I-131 analysis weekly for each filter change. Gross beta radioactivity analysis weekly for each filter change. Gamma isotopic analysis quarterly for a composite of all filters collected. IF filter gross beta is greater than 10 times the yearly mean of the control sample THEN gamma isotopic is performed on the filter.

Table 2, Exposure Pathway – Direct Radiation

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
TLDS 23 routine monitoring stations either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows: One onsite TLD in the vicinity of the plant. An inner ring of stations consisting of one in each overland meteorological sector, one in the general area of the state park camping area in the NE sector, and one in the general area of the site boundary. An outer ring of stations one in each overland meteorological sector within the 12 km range from the site. Three control stations sufficiently far from the plant as to not be affected from the plant.	• TLD-1 (0.213 miles E) - onsite inner ring TLD • TLD-8 (0.602 miles NE)- inner ring TLD • TLD-13 (0.530 miles NNE) - inner ring TLD • TLD-14 (0.551 miles NE)- inner ring TLD • TLD-15 (0.834 miles ENE)- inner ring TLD • TLD-16 (0.804 miles E)- inner ring TLD • TLD-17 (0.572 miles ESE) - inner ring TLD • TLD-18 (0.469 miles SE) - inner ring TLD • TLD-19 (0.443 miles SSE)- inner ring TLD • TLD-20 (0.412 miles S)- inner ring TLD • TLD-21 (0.382 miles SSW) - inner ring TLD	Quarterly	Gamma dose (units of milliRoentgen, abbreviated mR) quarterly

Table 2, Exposure Pathway – Direct Radiation

| Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
	• TLD-2 (5.560 miles SE) - outer ring TLD • TLD-3 (5.684 miles SSE) - outer ring TLD • TLD-4 (3.668 miles S) - outer ring TLD • TLD-5 - (3.475 miles ESE) - outer ring TLD • TLD-6 - (5.314 miles NE) - outer ring TLD • TLD-7 (4.115 miles NNE) - outer ring TLD • TLD-9 (1.670 miles SSW) - outer ring TLD • TLD-23 (3.189 miles ENE) - outer ring TLD • TLD-24 (6.021 miles E) - outer ring TLD • TLD-10 (50.746 miles NE) - control TLD • TLD-11 (39.472 miles E) - control TLD • TLD-12 (27.971 miles SSE) - control TLD	Quarterly	Gamma dose (units of milliRoentgen, abbreviated mR) quarterly

Table 3, Exposure Pathway – Waterborne

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
SURFACE WATER Lake in (plant intake lake water)	Lake in - Lake Michigan intake water used in plant systems. Sample is collected onsite.	Daily samples are used to make a monthly composite sample.	Gamma isotopic, gross beta (not ODCM required), and tritium analysis monthly
DRINKING WATER South Haven drinking water Palisades Park (Pal Park) community drinking water is sampled when in operation (summer months) Domestic water (not ODCM required) is sampled onsite.	City of South Haven drinking water intake structure (5.6 miles NNE of Palisades) Pal Park community drinking water (0.7 miles SSW of Palisades) Domestic water is sampled onsite from any potable water source, typically an eye wash station.	Daily South Haven drinking water samples are used to make a monthly composite sample. 1 grab sample of Palisades Park (Pal Park) community drinking water is sampled monthly when in operation (summer months). Daily samples are used to make a monthly composite.	Gamma isotopic, gross beta, and tritium analysis monthly Gamma isotopic, gross beta (not ODCM required), and tritium analysis monthly when operational Gamma isotopic, gross beta, and tritium analysis monthly
Surface Water and Drinking Water Control Lake water from Ludington Pump-house is analyzed as a control sample for drinking and surface water.	Ludington Control - Lake Michigan intake water from Ludington Pump-house (201 km North of Palisades).	Daily samples are used to make a monthly composite sample.	Gamma isotopic, gross beta, and tritium analysis monthly
OFFSITE GROUNDWATER Palisades Park (Pal Park) commercial water is sampled when in operation (summer months). This sample is not ODCM required.	0.7 miles S of Palisades	1 grab sample is sampled monthly when in operation (summer months)	Gamma isotopic, gross beta, and tritium analysis monthly
SEDIMENT FROM SHORELINE North sediment sample South sediment sample (not ODCM required)	1 sample between the north site boundary and Van Buren State Park beach, approximately 1/2 mile north of the plant discharge. 1 sample from beach near south boundary of site property	Semiannually Semiannually	Gamma isotopic analysis semiannually. Gamma isotopic analysis semiannually.

Table 4, Exposure Pathway – Ingestion

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
MILK Samples from milking animals in 3 locations between 5-8km distance 1 sample from milking animals at a control location.	For 2020 goat milk samples were not available to be sampled from the indicator locations. Therefore no control samples were obtained, and broad leaf vegetation was sampled as described below.	Monthly	Gamma isotopic and I-131 monthly
Broad leaf Vegetation Samples of three different kinds of broad leaf vegetation grown nearest each of two different offsite locations of highest predicted annual average ground level deposition and one sample of each of the similar broad leaf vegetation grown 15-30 km distance in the least prevalent wind direction IF milk sample is not performed.	0.7 miles SE from Palisades. 0.4 miles SSE from Palisades. 13.6 miles NNE from Palisades.	Monthly during growing season	Gamma isotopic and I-131 monthly during growing season
FISH Sample 2 species of commercially and/or recreationally important species in the vicinity of the plant discharge area. 1 sample of the same species in areas not influenced by plant discharge.	The indicator sample is obtained from Lake Michigan onsite within a few hundred feet of the main liquid discharge point. The control sample is obtained from Lake Michigan near Ludington MI (201 km North of Palisades).	Semiannually	Gamma isotopic analysis semiannually
FOOD PRODUCTS 1 sample of each of two principal fruit crops (blueberries and apples).	(blueberries) 3.7 to 4.7 miles SE or ESE from Palisades (apples) 3.5 to 3.7 miles E or SE from Palisades	Annually at time of harvest	Gamma isotopic and I-131 annually

Figure 1, Exposure Pathway

Exposure pathways to man
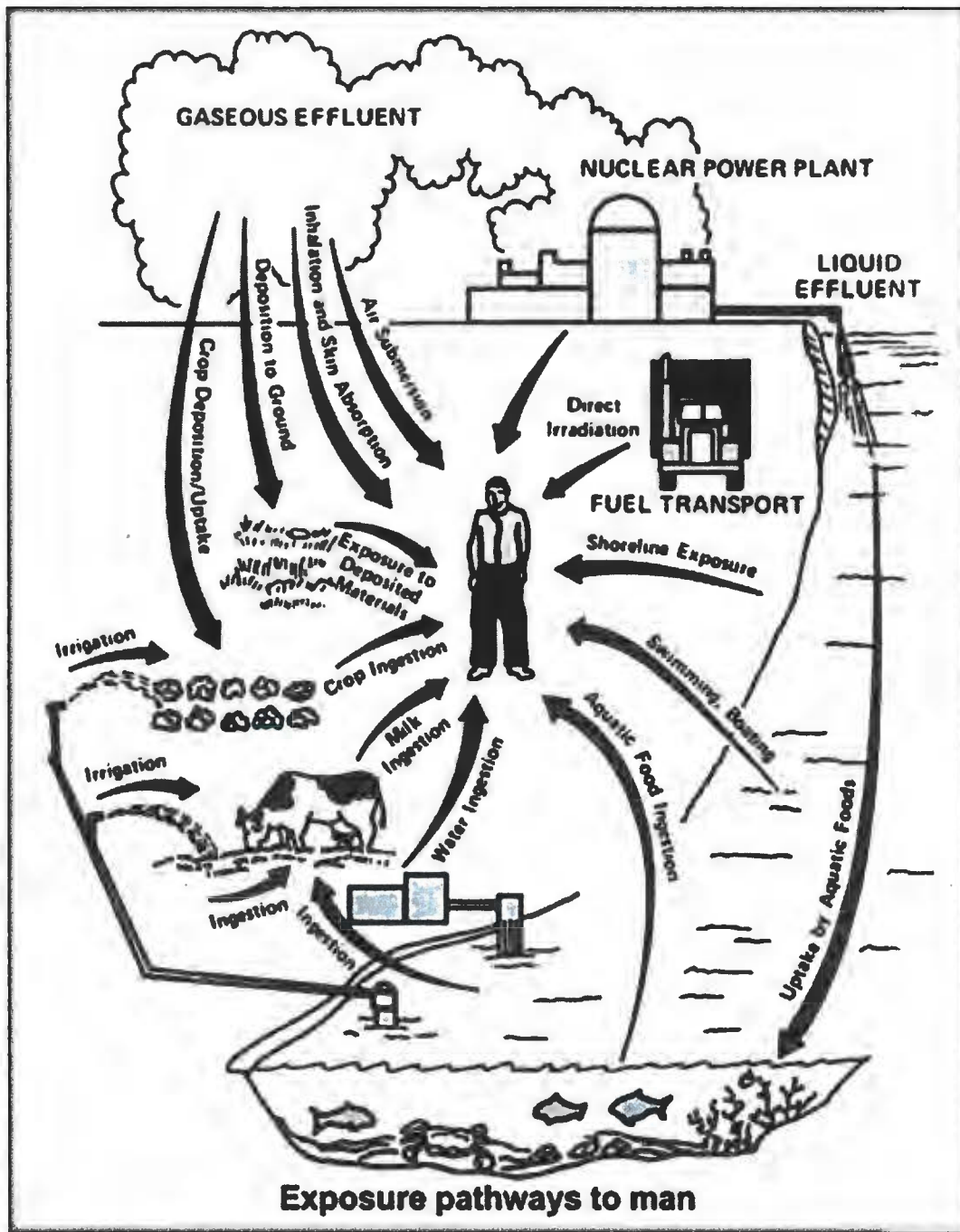
Figure 2, Sample Collection Sites –Near Field
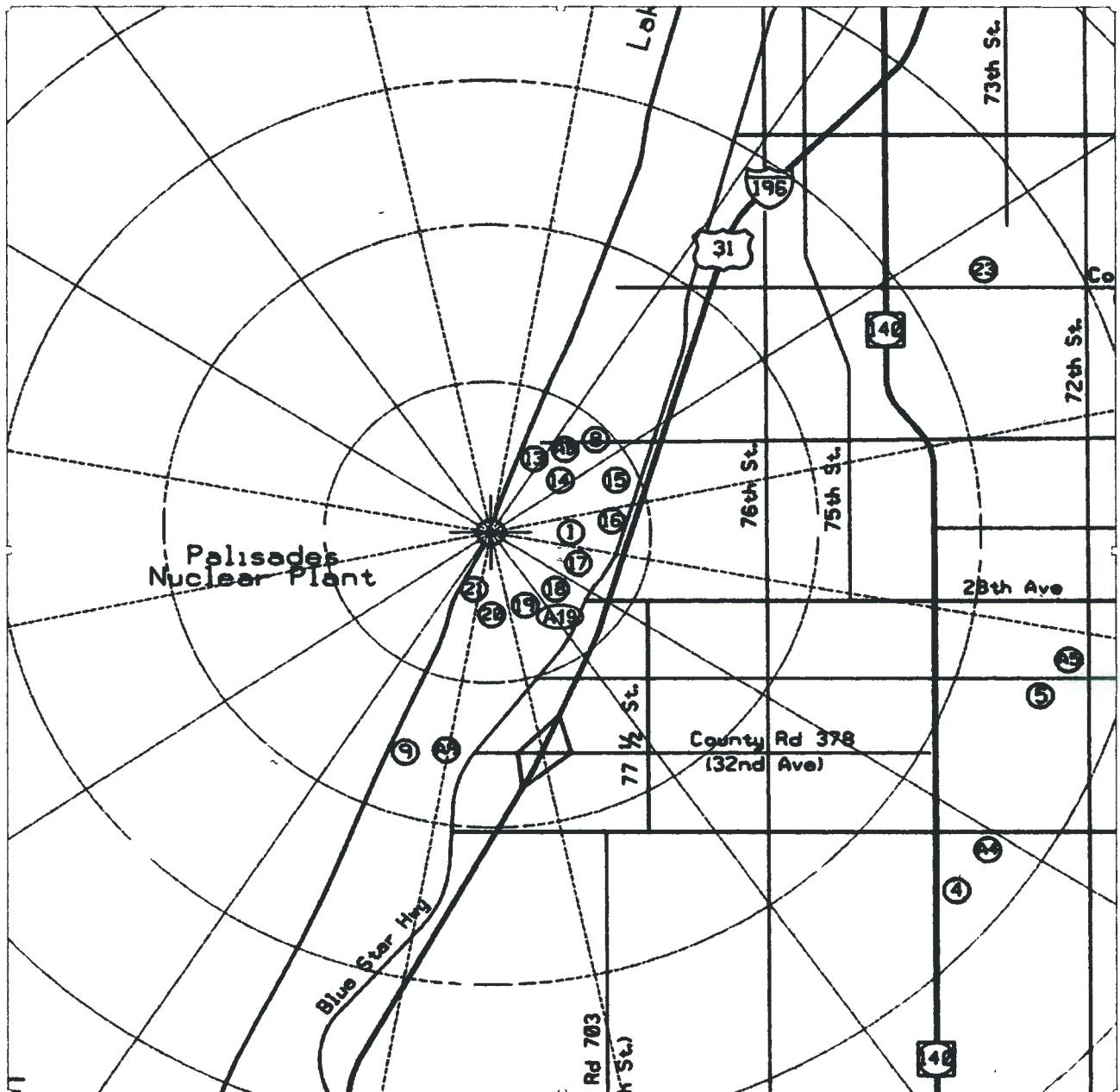
The locations in Figure 2 correspond to the TLD and Air Sampler locations in Table 1 and Table 2.

Figure 3, Sample Collection Sites - Far Field
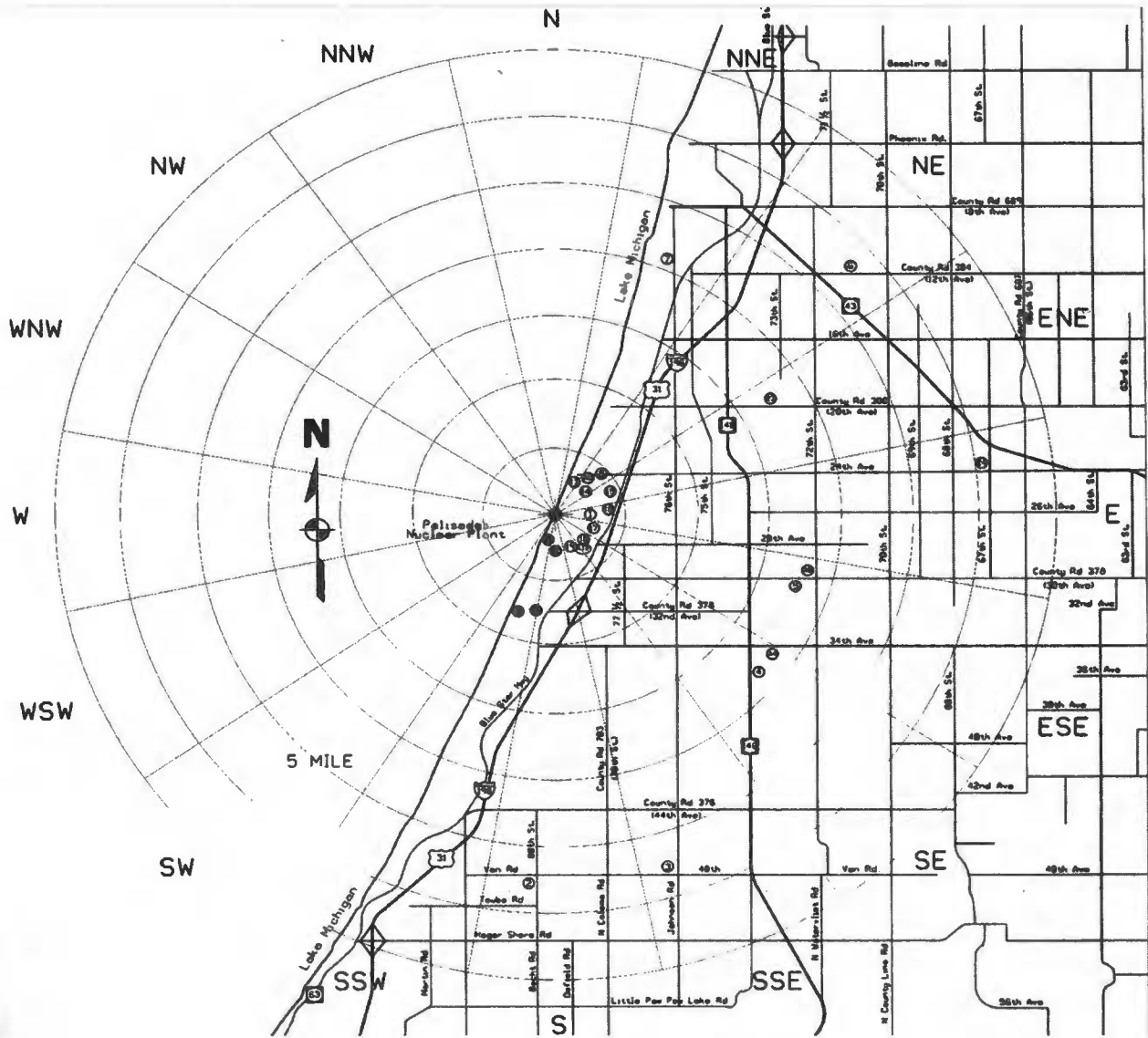
The locations in Figure 3 correspond to the TLD and Air Sampler locations in Table 1 and Table 2.

4.0   INTERPRETATION AND TRENDS OF RESULTS

4.1   Air Particulate and Radioiodine Sample

There were 311 air samples collected and analyzed for gross beta and I-131 during 2020. Air iodine and particulate samples are collected weekly from six air-sampling locations. Air is metered into the sampling unit through a 47-mm air filter (for particulate) and an air iodine cartridge. The filters are in series with one another and housed within the same filter holder. An "as found" and "as left" leak test is performed at each station during each sample collection. Weekly samples were sent to Teledyne Brown Engineering Environmental Services for analysis.

Analysis of the airborne particulate sample data, between the five near-site indicator locations and the control location, indicate no difference between indicator and control locations. The average concentration of gross beta activity among all indicator locations was 2.22E-02 pCi/m^3 and was 2.15E-02 pCi/m^3 for the control location. All I-131 activity results, for both indicator and control locations, were below the minimum detectable activity (MDA). Gamma isotopic analysis is performed quarterly on a quarterly composite of the filter papers. All radionuclides detected (Be-7) were naturally occurring radionuclides which are not attributed to plant effluents.

Palisades' pre-operational environmental study showed naturally occurring gross beta radiation between 0.03 and 3.0 pCi/m^3 with a similar trend between stations onsite, in the surrounding community, and control stations. The activity results from 2020 indicate there is no measurable change between pre-operational airborne gross beta activity and present day airborne gross beta activity.

There was three REMP deviations in 2020 involving air sampling. Two of the deviations involved a failed sampling pump and the third instance involved a tripped power supply. All REMP air sampling pumps are replaced at least once every 2 years to minimize pump failures. These instances are discussed in more detail in Attachment 1 Table 8.

In the absence of plant-related gamma radionuclides, gross beta activity is attributed to naturally occurring radionuclides. The air sample results collected in accordance with the REMP support the conclusions of the effluents monitoring program for 2020. This conclusion is that the surrounding environment is minimally affected by Palisades' effluents. No REMP air samples from 2020 contained measurable radiological materials attributed to Palisades' effluents.

4.2 **Thermoluminescent Dosimetry (TLD) Sample Results**

Palisades reports measured dose as net exposure (subtracting transit reading) normalized to 92 days. TLDs are oriented in an inner ring, outer ring, and control locations. The inner ring consists of 11 TLDs, the outer ring consists of 9 TLDs, and there are 3 control locations. This orientation allows for monitoring all 9 overland compass sectors surrounding Palisades. To assess the effect of direct and shine radiation from Palisades to the environment the inner ring, outer ring, and control TLDs are compared to one another. Additionally, each individual TLD location is compared to a baseline of data which was created from a comprehensive review of data from 2011 through 2016. The high and low values for the baseline are based upon two standard deviations for each data point from 2011 through 2016. If a value is measured outside the baseline additional follow-up investigation is performed to evaluate the cause. During 2020 all TLDs trended normal and no TLDs were outside the baseline. This evaluation identified no noticeable trend that would indicate that the ambient radiation levels are being affected by plant operations. Table 5 shows the consistent trend of average inner ring, outer ring, and control TLDs.

TLD measurements taken as part of Palisades' pre-operational environmental study used different instrumentation which had difficulty in achieving desired sensitivity and accuracy. A more sensitive type of TLD was implemented in 1971 and the present day TLD device used is the industry standard. TLD data has trended consistently throughout the several most recent independent spent fuel storage installation (ISFSI) loading campaigns which indicates these loading campaigns have had no measurable effect on the environment.

Activity from TLD measurements in the environment is attributed to naturally occurring background radiation and not from Palisades' direct or shine radiation.

Table 5, Direct Radiation Annual Summary			
Year	Inner Ring (mR/Qtr)	Outer Ring (mR/Qtr)	Control Location (mR/Qtr)
2013	9.9	11.6	11.7
2014	9.1	10.9	10.7
2015	9.5	11.2	10.9
2016	9.6	11.3	11.2
2017	9.3	11.2	10.9
2018	9.3	11.1	11.0
2019	9.4	11.2	11.0
2020	9.3	11.2	11.1

4.3   Waterborne Sample Results

During 2020 Palisades implemented the REMP in accordance with the ODCM for collection of surface, drinking, and groundwater. For all surface, drinking, and groundwater indicator samples, the same control sample is used as a baseline for comparison. That control sample is referred to as the "Ludington Control" and is collected 201 km north of Palisades. The Ludington Control sample is analyzed monthly and is a composite of daily samples. The Ludington Control sample is analyzed for gamma radionuclide, tritium, and gross beta activity. In 2020 the only radionuclide activity detected in Ludington Control water was naturally occurring isotopes (K-40 and Th-228). Of the twelve Ludington Control samples collected in 2020, five contained detectable gross beta with an average value of 3.08 pCi/L. The gross beta activity is a result of naturally occurring radionuclide and is not attributed to Palisades' effluents.

4.3.1   Surface Water

The indicator surface water samples collected and analyzed for the REMP include "Lake In" water. This sample is Lake Michigan water after it has traveled through the Palisades' intake structure and traveling screens. This sample is collected daily and composited into a monthly sample which is analyzed for gamma radionuclide and tritium onsite. This sample is also analyzed by Teledyne Brown Engineering Environmental Services for gamma, tritium, and gross beta activity. All radionuclide detected (K-40 and Th-228) were naturally occurring and are not attributed to Palisades' effluents. Four out of the twelve monthly samples contained measurable gross beta with the average detectable gross beta activity at 2.78 pCi/L. The gross beta activity is attributed to naturally occurring radionuclide.

Palisades' pre-operational environmental study established a baseline of gross beta activity for the site before Palisades was operational. The study results for surface water showed consistently measurable results for gross beta activity between 11 - 18 (+/- 5) pCi/L.

The surface water sample results collected in accordance with the REMP support the conclusions of the effluents monitoring program for 2020. This conclusion is that the surrounding environment is minimally affected by Palisades' effluents. No REMP surface water samples from 2020 contained measurable radiological materials attributed to Palisades' effluents.

4.3.2   Drinking Water

The indicator drinking water samples collected and analyzed for the REMP include "Domestic Water", "South Haven Drinking Water", and "Palisades Park Community Water". All samples are analyzed for gamma, tritium, and gross beta by Teledyne Brown Engineering Environmental Services.

Domestic Water is collected onsite from a potable water system, typically an eyewash station. This sample is collected daily and composited into a monthly sample which is analyzed for gamma radionuclide and tritium onsite. All radionuclide detected (K-40, and Th-228) were naturally occurring and are not attributed to Palisades' effluents. Four out of the twelve monthly samples contained measurable gross beta activity with the average detectable gross beta activity at 2.90 pCi/L. The gross beta activity is attributed to naturally occurring radionuclide. Domestic water is not required by the ODCM for the REMP. This sample is collected as part of the NRC bulletin 80-10 commitments and is included in this report because the data strengthens the REMP.

South Haven Drinking Water is collected from the City of South Haven Water Treatment facility located in South Haven. All radionuclide detected (K-40) were naturally occurring and are not attributed to Palisades' effluents. Five out of the twelve monthly samples contained measurable gross beta with the average detectable gross beta activity at 2.73 pCi/L. The gross beta activity is attributed to naturally occurring radionuclide.

Palisades Park Community Water is collected once per month as a grab sample from a community just south of Palisades while the facility is operational (summer months). This sample is analyzed for gamma, tritium, and gross beta activity. No radionuclides were detected via gamma spectroscopy and no tritium was detected in any samples. One out of the six monthly samples contained measurable gross beta activity with an activity of 2.42 pCi/L. The gross beta activity is attributed to naturally occurring radionuclide. Gross beta activity is not required by the ODCM for this sample but is performed for trending purposes and to strengthen the REMP.

Palisades' pre-operational environmental study established a baseline of gross beta activity for the site before Palisades was operational. The study results relied upon as a baseline for drinking water analysis are the same results as with surface water, that being consistent gross beta activity between 11 - 18 (+/- 5) pCi/L.

The drinking water sample results collected, in accordance with the REMP, support the conclusions of the effluents monitoring program for 2020. This conclusion is that the surrounding environment is minimally affected by Palisades' effluents. No REMP drinking water samples from 2020 contained measurable radiological materials attributed to Palisades' effluents.

4.3.3   Groundwater

Palisades implements an extensive groundwater monitoring program in accordance with NEI-0707, "Industry Ground Water Protection Initiative - Final Guidance Document". This program is designed to identify onsite leaks to groundwater to allow for prompt repair or isolation of the leak. The results of the onsite groundwater program are described in the Annual Radioactive Effluent Release Report (ARERR). Palisades samples one offsite groundwater location. This sample is not required by Palisades' ODCM but is procedurally implemented to strengthen the program overall. The REMP groundwater sample is the "Palisades Park Commercial Well Water" sample. This sample is collected once per month as a grab sample from a community just south of Palisades while the facility is operational (summer months). This sample is analyzed for gamma, tritium, and gross beta activity by Teledyne Brown Engineering Environmental Services. No radionuclides were detected via gamma spectroscopy and no tritium was detected in any samples. Four out of the five monthly samples contained measurable gross beta with the average detectable gross beta activity at 4.87 pCi/L. The gross beta activity is attributed to naturally occurring radionuclide.

Palisades' pre-operational environmental study established a baseline of gross beta activity for the site before Palisades was operational. The study results were that five well water samples from Palisades contained gross beta activity above 5 pCi/L with the highest value being 16 pCi/L. Two samples from Covert Park well water contained gross beta activity at 6 and 7 pCi/L.

The groundwater sample results collected in accordance with the REMP support the conclusions of the effluents monitoring program for 2020. This conclusion is that the surrounding environment is minimally affected by Palisades' effluents. No REMP groundwater samples from 2020 contained measurable radiological materials attributed to Palisades' effluents.

4.4   Sediment Sample Results

Sediment samples are collected two times per year north and south of the plant from the beach on Lake Michigan. One sample is collected at the southern edge of the property and a second sample is collected approximately 0.5 miles north of the plant. The sample south of the plant is not required by the ODCM but is collected and analyzed to strengthen the REMP. Both the north and south sediment samples are analyzed for gamma radionuclide. In 2020, the only radionuclides detected were naturally occurring (K-40, Ra-226, Th-228, and Th-232) isotopes which are not attributed to Palisades' effluents. In accordance with the ODCM, no control sample is collected for this sample type.

Soil samples were not specifically part of the Palisades' pre-operational environmental study however a study of Cs-137 found in soil (due to global events such as historical atomic testing and fallout) was performed by Palisades in 2011. Analysis was performed of soil in the surrounding area (Southwest Michigan) which showed Cs-137 concentrations between 1.41E-08 uCi/g and 5.68E-07 uCi/g with an average of 2.68E-07 uCi/g. Considering similar studies performed by other utilities, a conservative (low) background of 1.8E-07 uCi/g Cs-137 in soil is assumed to be due to global fallout.

The sediment sample results collected in accordance with the REMP support the conclusions of the effluents monitoring program for 2020. This conclusion is that the surrounding environment is minimally affected by Palisades' effluents. No REMP sediment samples from 2020 contained measurable radiological materials attributed to Palisades' effluents.

4.5   Ingestion Sample Results

4.5.1   Milk Sample Results

Indicator milk samples were not available to be collected during 2020.

4.5.2   Broad leaf Sample Results

In accordance with Palisades ODCM three different kinds of broad leaf vegetation is sampled from two onsite (indicator) locations and one offsite (control) location due to the fact that milk sampling is not performed. Broad leaf samples are collected once per month during the growing season and analyzed for gamma radionuclides including iodine-131. Naturally occurring radionuclide detected in broad leaf vegetation (Be-7 and K-40) are not attributed to Palisades' effluents. Cs-137 detected in broad leaf vegetation was attributed to historical global atomic testing and biological uptake. Cs-137 was detected at location BV1 (0.4 miles SSE) for four out of the five monthly samples. The average concentration of Cs-137 was 1.22E+02 pCi/kg. Cs-137 was detected in one out five samples at location BVC with the one sample having a result of 102 pCi/kg. It is not abnormal to detect Cs-137 in broad leaf samples. Palisades procedurally implements a conservative administrative action value to perform additional reviews if the activity of broad leaf samples exceeds 146 pCi/kg Cs-137. The absence of Cs-134 and the absence of other radionuclides measured in the plant effluent and coolant systems further support that the Cs-137 detected in broadleaf is not a result of Palisades activity.

The pre-operational environmental study consisted in part of Cs-137 and Sr-90 analysis for crops and milk. These (and broadleaf) sample results are a result of historical global atomic testing and biological uptake. The pre-operational study identified Cs-137 in milk samples ranging from 2 to 70 pCi/L and Sr-90 ranging from 5 to 15 pCi/L. For crop samples, gross gamma activity was generally between 0.11 and 0.22 pCi/g and gross beta activity was generally between 0.72 to 3.31 pCi/g.

The broad leaf sample results collected in accordance with the REMP support the conclusions of the effluents monitoring program for 2020. This conclusion is that the surrounding environment is minimally affected by Palisades' effluents. No REMP broadleaf samples from 2020 contained measurable radiological materials attributed to Palisades' effluents.

4.5.3   Fish Sample Results

Indicator and Control fish samples are collected and analyzed twice per year. The filet of the fish is analyzed for gamma radionuclide. The indicator fish are collected near Palisades lake-out discharge point. At least 2 species of commercial or recreational importance are collected and analyzed. At least one sample of the same species is collected as a control sample. The control fish are collected 201 km north of Palisades near Ludington, MI. In 2020, the only radionuclides detected among all fish samples were naturally occurring radionuclides (K-40) which were not attributed to Palisades' effluents.

Palisades' pre-operational environmental study established a baseline for radiological material in fish. The study established that gross beta activity is generally between 2 and 4 pCi/g and gross gamma activity is generally between 0.04 and 0.4 pCi/g in fish. Cs-137 and Sr-90 were measured in the pre-operational study and were expected to be measured due to known worldwide contamination from historical global atomic testing. Cs-137 detected was generally between 0.10 and 0.25 pCi/g and Sr-90 detected was generally between 0.01 to 0.04 pCi/g in the pre-operational environmental study.

The fish sample results collected in accordance with the REMP support the conclusions of the effluents monitoring program for 2020. This conclusion is that the surrounding environment is minimally affected by Palisades' effluents. No REMP fish water samples from 2020 contained measurable radiological materials attributed to Palisades' effluents.

4.5.4   Food Product Sample Results

Two principal fruit crops are collected once per year and analyzed for gamma radionuclides including Iodine-131 in accordance with the REMP. The two crops sampled in 2020 were blueberries and apples. The results of all sample analysis show that only naturally occurring radionuclides (K-40) were present. In accordance with the ODCM, no control sample is collected for this sample type.

Palisades' pre-operational environmental study performed radiological analysis on a variety of crop samples. Gross gamma activity was generally between 0.11 and 0.22 pCi/g and gross beta activity was generally between 0.72 to 3.31 pCi/g.

The fruit sample results collected in accordance with the REMP support the conclusions of the effluents monitoring program for 2020. This conclusion is that the surrounding environment is minimally affected by Palisades' effluents. No REMP fruit samples from 2020 contained measurable radiological materials attributed to Palisades' effluents.

4.6 Land Use Census Results

The latest land use census (performed in 2020) did not identify any new locations that prompt a change to the REMP or to the atmospheric dispersion or deposition factors used for offsite dose modeling. The sectors in Table 6 include all overland compass sectors.

Table 6, Land Use Census –2020 Nearest Residence Within Five Miles						
Sector	Direction	Residence	Garden	Beef Cattle	Dairy Cow	Goat
2	NNE	1.67	2.52	> 5	> 5	> 5
3	NE	1.14	2.76	> 5	> 5	> 5
4	ENE	1.19	3.96	2.29	> 5	>5
5	E	1.62	2.46	3.51	> 5	3.46
6	ESE	1.35	2.04	2.04	> 5	2.04
7	SE	0.87	2.20	3.88	> 5	3.88
8	SSE	0.80	0.70	> 5	> 5	> 5
9	S	0.51	3.51	> 5	> 5	> 5
10	SSW	0.48	>5	> 5	> 5	> 5

4.7 Interlaboratory Comparison Results

Attachment 3 contains result summary for Interlaboratory Comparison program for Teledyne Brown Engineering.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

1. Table 7, Radiological Environmental Monitoring Program Summary, summarizes data for the 2020 REMP program.

Table 7, Radiological Environmental Monitoring Program Summary							
Sample Type (Units)	Type / Number of Analyses	LLD [Note 1]	Indicator Locations Mean (F)[Note 2] [Range]	Location [Note 3] [Highest Annual Mean]	Mean (F)[Note 2] [Range]	Control Locations Mean (F)[Note 2] [Range]	Number of Non-Routine Results [Note 4]
Air (pCi/m³)	GB / 311	0.01	2.22E-02 (259/259) [8.98E-03 - 4.23E-02]	Station A19 (0.423 miles SSE)	2.39E-02 (52/52) [1.13E-02 - 4.13E-02]	2.15E-02 (52/52) [1.17E-02 - 3.92E-02]	0
	I-131 / 311	0.07	<MDA (0/259)	N/A	N/A	<MDA (0/52)	0
	Cs-134 / 24	0.05	<MDA (0/20)	N/A	N/A	<MDA (0/4)	0
	Cs-137 / 24	0.06	<MDA (0/20)	N/A	N/A	<MDA (0/4)	0
Inner Ring TLDs (mR/Qtr)	Gamma / 56	Sensitivity of 3 mR	9.28 (44/44) [7.75 - 10.82]	Station 1 (onsite 0.213 miles E)	10.43 (4/4) [9.98 - 10.82]	11.14 (12/12) [9.97 - 12.05]	0 0
Outter Ring TLDs (mR/Qtr)	Gamma / 48	Sensitivity of 3 mR	11.17 (36/36) [9.15 - 14.20]	Station 2 (5.560 miles S)	13.82 (4/4) [13.35 - 14.20]	11.14 (12/12) [9.97 - 12.05]	0

Table 7, Radiological Environmental Monitoring Program Summary							
Sample Type (Units)	Type / Number of Analyses	LLD [Note 1]	Indicator Locations Mean (F)[Note 2] [Range]	Location [Note 3] [Highest Annual Mean]	Mean (F)[Note 2] [Range]	Control Locations Mean (F)[Note 2] [Range]	Number of Non-Routine Results [Note 4]
Surface Water (pCi/L)	Gross Beta / 24	4.0	2.78 (4 / 12) [2.51 - 3.16]	Lake In (Plant lake intake)	2.78 (4 / 12) [2.51 - 3.16]	3.08 (5 / 12) [2.28 - 3.88]	0
	H-3 / 24	2000	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0
	Mn-54 / 24	15	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0
	Fe-59 / 24	30	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0
	Co-58 / 24	15	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0
	Co-60 / 24	15	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0
	Zn-65 / 24	30	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0
	Zr-95 / 24	15	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0
	Nb-95 / 24	15	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0
	Cs-134 / 24	15	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0
	Cs-137 / 24	18	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0
	Ba-140 / 24	60	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0
	La-140 / 24	15	<MDA (0 / 12)	N/A	N/A	<MDA (0 / 12)	0

Table 7, Radiological Environmental Monitoring Program Summary						
Sample Type (Units)	Type / Number of Analyses	LLD [Note 1]	Indicator Locations Mean (F)[Note 2] [Range]	Location [Note 3] [Highest Annual Mean]	Mean (F)[Note 2] [Range]	Control Locations Mean (F)[Note 2] [Range]	Number of Non-Routine Results [Note 4]
Drinking Water (pCi/L)	Gross Beta / 42	4	2.77 (10 / 30) [2.42 - 3.29]	Domestic Water (onsite)	2.90 (4 / 12) [2.61 - 3.29]	3.08 (5 / 12) [2.28 - 3.88]	0
	H-3 / 42	2000	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
	Mn-54 / 42	15	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
	Fe-59 / 42	30	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
	Co-58 / 42	15	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
	Co-60 / 42	15	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
	Zn-65 / 42	30	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
	Zr-95 / 42	15	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
	Nb-95 / 42	15	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
	Cs-134 / 42	15	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
	Cs-137 / 42	18	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
	Ba-140 / 42	60	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
	La-140 / 42	15	<MDA (0 / 30)	N/A	N/A	<MDA (0 / 12)	0
Fish (pCi/kg)	Mn-54 / 11	130	<MDA (0 / 6)	N/A	N/A	<MDA (0 / 5)	0
	Fe-59 / 11	260	<MDA (0 / 6)	N/A	N/A	<MDA (0 / 5)	0
	Co-58 / 11	130	<MDA (0 / 6)	N/A	N/A	<MDA (0 / 5)	0
	Co-60 / 11	130	<MDA (0 / 6)	N/A	N/A	<MDA (0 / 5)	0
	Zn-65 / 11	260	<MDA (0 / 6)	N/A	N/A	<MDA (0 / 5)	0
	Cs-134 / 11	130	<MDA (0 / 6)	N/A	N/A	<MDA (0 / 5)	0
	Cs-137 / 11	150	<MDA (0 / 6)	N/A	N/A	<MDA (0 / 5)	0

Table 7, Radiological Environmental Monitoring Program Summary							
Sample Type (Units)	Type / Number of Analyses	LLD [Note 1]	Indicator Locations Mean (F)[Note 2] [Range]	Location [Note 3] [Highest Annual Mean]	Mean (F)[Note 2] [Range]	Control Locations Mean (F)[Note 2] [Range]	Number of Non-Routine Results [Note 4]
Food Products (pCi/kg)	I-131 / 2	60	<MDA (0 / 2)	N/A	N/A	Control sample not required	0
	Cs-134 / 2	60	<MDA (0 / 2)	N/A	N/A		0
	Cs-137 / 2	80	<MDA (0 / 2)	N/A	N/A		0
Broad leaf Vegetation (pCi/kg)	I-131 / 15	60	<MDA (0 / 10)	N/A	N/A	<MDA (0 / 5)	0
	Cs-134 / 15	60	<MDA (0 / 10)	N/A	N/A	<MDA (0 / 5)	0
	Cs-137 / 15	80	122 (4 / 10) [103 - 131]	BV1 (onsite 0.4 miles SSE)	122 (4 / 5) [103 - 131]	102 (1 / 5) [N/A]	0
Sediment (pCi/kg)	Cs-134 / 4	150	<MDA (0 / 4)	N/A	N/A	Control sample not required	0
	Cs-137 / 4	180	<MDA (0 / 4)	N/A	N/A		0

Table 7, Radiological Environmental Monitoring Program Summary						
Sample Type (Units)	**Type / Number of Analyses**	**LLD [Note 1]**	**Indicator Locations Mean (F)[Note 2] [Range]**	**Location [Note 3] [Highest Annual Mean]**	**Mean (F)[Note 2] [Range]**	**Control Locations Mean (F)[Note 2] [Range]**	**Number of Non-Routine Results [Note 4]**
Offsite Groundwater (Pal Park Commercial Well) (pCi/L)	Gross Beta / 17	4	4.87 (4 / 5) [4.11 - 5.35]	Pal Park Commercial Well (0.7 miles SSW)	4.87 (4 / 5) [4.11 - 5.35]	3.08 (5 / 12) [2.28 - 3.88]	0
	H-3 / 17	2000	<MDA (0 / 6)	N/A	N/A	N/A	0
	Mn-54 / 17	15	<MDA (0 / 6)	N/A	N/A	N/A	0
	Fe-59 / 17	30	<MDA (0 / 6)	N/A	N/A	N/A	0
	Co-58 / 17	15	<MDA (0 / 6)	N/A	N/A	N/A	0
	Co-60 / 17	15	<MDA (0 / 6)	N/A	N/A	N/A	0
	Zn-65 / 17	30	<MDA (0 / 6)	N/A	N/A	N/A	0
	Zr-95 / 17	15	<MDA (0 / 6)	N/A	N/A	N/A	0
	Nb-95 / 17	15	<MDA (0 / 6)	N/A	N/A	N/A	0
	Cs-134 / 17	15	<MDA (0 / 6)	N/A	N/A	N/A	0
	Cs-137 / 17	18	<MDA (0 / 6)	N/A	N/A	N/A	0
	Ba-140 / 17	60	<MDA (0 / 6)	N/A	N/A	N/A	0
	La-140 / 17	15	<MDA (0 / 6)	N/A	N/A	N/A	0

[Note 1] – LLD = Required lower limit of detection
[Note 2] – Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parenthesis (F).
[Note 3] – Locations are specified (1) by name and (2) compass sector relative to reactor site.
[Note 4] – A reportable occurrence is a situation in which an NRC report was submitted in accordance with the requirements in Palisades ODCM.

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Sample Deviations

Table 8, Sample Deviations Table

Comment No.	Sample Media Affected	Sample Location	Date	Problem	Evaluation / Actions
1	Air Sample	A5	12/21/2020	Sample Pump Failure	During normal weekly sample collection (on 12/21/2020) the sampling pump was found off. Restarting the pump was not successful and therefore the pump was replaced (within one hour of finding the pump off). The sample volume collected was about one third of what was expected indicating that the pump was off for approximately the previous 4 days. The sample volume was sufficient to perform analytical analysis of the filter paper and iodine cartridge. The required lower limit of detection was achieved for this sample.
2	Air Sample	A10	11/30/2020	Sample Pump Failure	During normal weekly sample collection (on 11/30/2020) the sampling pump failed to restart after the new filter paper and iodine cartridge were installed. A new sampling pump was installed approximately 3.5 hours later. The missed sampling time had a minor impact to the total sample volume, and all required lower limit of detection was achieved for this sample.
3	Air Sample	A9	08/17/2020	Loss of Power Supply	During normal weekly sample collection (on 08/17/2020) the GFCI outlet the sampling pump is plugged into was found tripped off. The outlet was reset and the power was restored to the sampling pump. The sample volume was very low for the filter paper and iodine cartridge collected indicating that the pump was not running for approximately 6.5 of the previous 7 days. Therefore, the results of the filter paper and iodine cartridge analysis were not included in this report.

Monitoring Results Tables

Table 9, Air Gross Beta Data Summary Table

Analysis: Gross Beta				Units: pCi/m³			
Start Date	End Date	Station A4 (Indicator)	Station A5 (Indicator)	Station A8 (Indicator)	Station A9 (Indicator)	Station A19[Note 1] (Indicator)	Station A10[Note 2] (Control)
REQUIRED LLD →		**1.00E-02**	**1.00E-02**	**1.00E-02**	**1.00E-02**	**1.00E-02**	**1.00E-02**
12/30/19	01/07/20	2.11E-02	2.32E-02	2.12E-02	2.39E-02	2.32E-02	2.08E-02
01/07/20	01/13/20	1.59E-02	1.53E-02	1.78E-02	1.56E-02	1.85E-02	1.82E-02
01/13/20	01/20/20	2.97E-02	3.36E-02	3.09E-02	3.22E-02	3.25E-02	1.78E-02
01/20/20	01/27/20	1.86E-02	1.82E-02	1.94E-02	1.75E-02	2.02E-02	1.78E-02
01/27/20	02/04/20	1.16E-02	1.39E-02	9.75E-03	8.98E-03	1.13E-02	1.48E-02
02/04/20	02/10/20	1.54E-02	1.85E-02	1.97E-02	1.92E-02	2.11E-02	1.43E-02
02/10/20	02/18/20	1.68E-02	1.87E-02	1.61E-02	1.70E-02	2.00E-02	2.38E-02
02/18/20	02/24/20	2.97E-02	2.56E-02	3.11E-02	2.67E-02	3.93E-02	2.44E-02
02/24/20	03/02/20	2.01E-02	2.05E-02	2.13E-02	2.02E-02	2.41E-02	1.95E-02
03/02/20	03/09/20	1.83E-02	1.57E-02	1.99E-02	1.73E-02	1.89E-02	1.55E-02
03/09/20	03/16/20	2.03E-02	2.67E-02	2.02E-02	2.49E-02	2.84E-02	2.06E-02
03/16/20	03/23/20	1.82E-02	1.77E-02	2.15E-02	1.65E-02	2.32E-02	2.12E-02
03/23/20	03/30/20	1.95E-02	1.69E-02	1.71E-02	1.92E-02	2.47E-02	1.96E-02
03/30/20	04/06/20	1.56E-02	1.77E-02	1.65E-02	1.52E-02	1.66E-02	1.17E-02
04/06/20	04/13/20	2.08E-02	2.50E-02	2.37E-02	2.02E-02	2.41E-02	2.18E-02
04/13/20	04/20/20	1.94E-02	1.98E-02	2.05E-02	2.12E-02	2.26E-02	1.61E-02
04/20/20	04/27/20	1.68E-02	1.99E-02	1.83E-02	1.77E-02	2.42E-02	1.24E-02
04/27/20	05/04/20	1.10E-02	1.75E-02	1.50E-02	1.47E-02	1.82E-02	1.43E-02
05/04/20	05/11/20	1.18E-02	1.30E-02	9.77E-03	1.27E-02	1.53E-02	1.36E-02
05/11/20	05/18/20	1.74E-02	1.68E-02	1.54E-02	1.45E-02	2.02E-02	2.13E-02
05/18/20	05/26/20	1.72E-02	2.39E-02	2.04E-02	1.95E-02	2.11E-02	1.43E-02
05/26/20	06/01/20	1.44E-02	1.61E-02	2.22E-02	1.25E-02	1.58E-02	1.61E-02
06/01/20	06/08/20	2.30E-02	2.13E-02	3.22E-02	2.26E-02	2.24E-02	1.74E-02
06/08/20	06/15/20	1.52E-02	1.34E-02	1.84E-02	1.57E-02	1.61E-02	1.43E-02
06/15/20	06/22/20	2.01E-02	2.53E-02	2.82E-02	2.42E-02	2.43E-02	2.62E-02
06/22/20	06/29/20	2.35E-02	2.18E-02	2.01E-02	2.17E-02	2.10E-02	2.34E-02

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Monitoring Results Tables

Table 9, Air Gross Beta Data Summary Table

Analysis: Gross Beta						Units: pCi/m^3	
Start Date	End Date	Station A4 (Indicator)	Station A5 (Indicator)	Station A8 (Indicator)	Station A9 (Indicator)	Station A19[Note 1] (Indicator)	Station A10[Note 2] (Control)
06/29/20	07/06/20	2.42E-02	2.99E-02	2.18E-02	2.93E-02	2.49E-02	3.28E-02
07/06/20	07/13/20	2.64E-02	2.89E-02	3.12E-02	3.29E-02	2.89E-02	2.39E-02
07/13/20	07/20/20	1.91E-02	2.58E-02	2.02E-02	2.10E-02	2.17E-02	3.92E-02
07/20/20	07/27/20	1.94E-02	1.93E-02	2.07E-02	2.02E-02	1.86E-02	1.84E-02
07/27/20	08/03/20	1.67E-02	1.83E-02	1.75E-02	1.98E-02	1.97E-02	1.80E-02
08/03/20	08/10/20	2.08E-02	1.89E-02	1.95E-02	1.68E-02	2.12E-02	1.82E-02
08/10/20	08/17/20	1.87E-02	2.00E-02	1.57E-02	[Note 3]	2.15E-02	2.31E-02
08/17/20	08/24/20	2.37E-02	2.34E-02	2.54E-02	2.72E-02	2.65E-02	2.45E-02
08/24/20	08/31/20	2.70E-02	3.50E-02	3.12E-02	2.70E-02	3.20E-02	2.69E-02
08/31/20	09/07/20	2.08E-02	1.80E-02	2.13E-02	1.94E-02	2.30E-02	2.07E-02
09/07/20	09/14/20	1.73E-02	1.63E-02	1.76E-02	1.68E-02	1.85E-02	1.58E-02
09/14/20	09/21/20	2.02E-02	2.47E-02	2.30E-02	2.36E-02	2.11E-02	2.39E-02
09/21/20	09/28/20	3.77E-02	3.38E-02	3.75E-02	3.20E-02	4.06E-02	3.83E-02
09/28/20	10/05/20	1.47E-02	1.17E-02	1.77E-02	1.16E-02	1.67E-02	1.19E-02
10/05/20	10/12/20	2.77E-02	3.36E-02	2.97E-02	2.83E-02	3.04E-02	2.90E-02
10/12/20	10/19/20	1.86E-02	1.90E-02	1.96E-02	1.96E-02	2.68E-02	2.26E-02
10/19/20	10/26/20	1.90E-02	2.11E-02	2.09E-02	1.97E-02	2.30E-02	1.88E-02
10/26/20	11/02/20	2.51E-02	2.30E-02	2.84E-02	2.75E-02	2.79E-02	2.68E-02
11/02/20	11/09/20	3.85E-02	4.23E-02	3.90E-02	3.69E-02	4.13E-02	3.82E-02
11/09/20	11/16/20	3.06E-02	2.98E-02	3.10E-02	2.76E-02	2.81E-02	2.71E-02
11/16/20	11/23/20	2.24E-02	2.22E-02	2.51E-02	2.19E-02	2.45E-02	2.17E-02
11/23/20	12/01/20	2.18E-02	2.03E-02	2.60E-02	2.29E-02	2.67E-02	3.14E-02
12/01/20	12/07/20	2.99E-02	3.36E-02	3.28E-02	2.75E-02	2.51E-02	2.22E-02
12/07/20	12/14/20	3.20E-02	3.39E-02	3.61E-02	3.19E-02	3.28E-02	2.65E-02
12/14/20	12/21/20	3.01E-02	3.18E-02	3.28E-02	2.97E-02	3.58E-02	2.65E-02
12/21/20	12/28/20	1.36E-02	1.78E-02	1.75E-02	1.73E-02	1.98E-02	2.13E-02

[Note 1] – Station with highest annual mean.
[Note 2] – The sample date range is accurate to plus or minus 2 days for station A10
[Note 3] – Reference Attachment 1, Sample Deviations, Table 8, Sample Deviations Table

Monitoring Results Tables

Table 10, Air Radioiodine Data Table Summary

Analysis: I-131				Units: pCi/m³			
Start Date	End Date	Station A4 (Indicator)	Station A5 (Indicator)	Station A8 (Indicator)	Station A9 (Indicator)	Station A19 (Indicator)	Station A10[Note 1] (Control)
REQUIRED LLD →		**7.00E-02**	**7.00E-02**	**7.00E-02**	**7.00E-02**	**7.00E-02**	**7.00E-02**
12/30/19	01/07/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
01/07/20	01/13/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
01/13/20	01/20/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
01/20/20	01/27/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
01/27/20	02/04/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
02/04/20	02/10/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
02/10/20	02/18/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
02/18/20	02/24/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
02/24/20	03/02/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
03/02/20	03/09/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
03/09/20	03/16/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
03/16/20	03/23/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
03/23/20	03/30/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
03/30/20	04/06/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
04/06/20	04/13/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
04/13/20	04/20/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
04/20/20	04/27/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
04/27/20	05/04/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
05/04/20	05/11/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
05/11/20	05/18/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
05/18/20	05/26/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
05/26/20	06/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
06/01/20	06/08/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
06/08/20	06/15/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
06/15/20	06/22/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
06/22/20	06/29/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

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Monitoring Results Tables

Table 10, Air Radioiodine Data Table Summary

Analysis: I-131						Units: pCi/m^3	
Start Date	End Date	Station A4 (Indicator)	Station A5 (Indicator)	Station A8 (Indicator)	Station A9 (Indicator)	Station A19 (Indicator)	Station A10[Note 1] (Control)
06/29/20	07/06/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
07/06/20	07/13/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
07/13/20	07/20/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
07/20/20	07/27/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
07/27/20	08/03/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
08/03/20	08/10/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
08/10/20	08/17/20	<MDA	<MDA	<MDA	[Note 2]	<MDA	<MDA
08/17/20	08/24/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
08/24/20	08/31/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
08/31/20	09/07/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
09/07/20	09/14/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
09/14/20	09/21/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
09/21/20	09/28/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
09/28/20	10/05/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
10/05/20	10/12/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
10/12/20	10/19/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
10/19/20	10/26/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
10/26/20	11/02/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
11/02/20	11/09/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
11/09/20	11/16/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
11/16/20	11/23/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
11/23/20	12/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
12/01/20	12/07/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
12/07/20	12/14/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
12/14/20	12/21/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
12/21/20	12/28/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

[Note 1] – The sample date range is accurate to plus or minus 2 days for station A10
[Note 2] – Reference Attachment 1, Sample Deviations, Table 8, Sample Deviations Table,

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Table 11, Air Sample Gamma Isotopic					
Analysis: Gamma Isotopic			**Units: pCi/m³**		
Location	**Start Date**	**End Date**	**Cs-134**	**Cs-137**	**Be-7[Note 1]**
REQUIRED LLD →			0.05	0.06	NA
Station A4	12/30/19	03/30/20	<MDA	<MDA	1.06E-01
Station A4	03/30/20	06/29/20	<MDA	<MDA	1.66E-01
Station A4	06/29/20	09/28/20	<MDA	<MDA	1.46E-01
Station A4	09/28/20	12/28/20	<MDA	<MDA	9.63E-02
Station A5	12/30/19	03/30/20	<MDA	<MDA	1.28E-01
Station A5	03/30/20	06/29/20	<MDA	<MDA	1.61E-01
Station A5	06/29/20	09/28/20	<MDA	<MDA	1.58E-01
Station A5	09/28/20	12/28/20	<MDA	<MDA	7.60E-02
Station A8	12/30/19	03/30/20	<MDA	<MDA	1.01E-01
Station A8	03/30/20	06/29/20	<MDA	<MDA	1.70E-01
Station A8	06/29/20	09/28/20	<MDA	<MDA	1.51E-01
Station A8	09/28/20	12/28/20	<MDA	<MDA	8.15E-02
Station A9	12/30/19	03/30/20	<MDA	<MDA	1.22E-01
Station A9	03/30/20	06/29/20	<MDA	<MDA	1.33E-01
Station A9	06/29/20	09/28/20	<MDA	<MDA	1.42E-01
Station A9	09/28/20	12/28/20	<MDA	<MDA	7.99E-02
Station A19	12/30/19	03/30/20	<MDA	<MDA	1.28E-01
Station A19	03/30/20	06/29/20	<MDA	<MDA	1.62E-01
Station A19	06/29/20	09/28/20	<MDA	<MDA	1.01E-01
Station A19	09/28/20	12/28/20	<MDA	<MDA	1.31E-01
Station A10	12/30/19	03/30/20	<MDA	<MDA	1.05E-01
Station A10	03/30/20	06/29/20	<MDA	<MDA	1.56E-01
Station A10	06/29/20	09/28/20	<MDA	<MDA	1.34E-01
Station A10	09/28/20	12/28/20	<MDA	<MDA	8.17E-02

[Note 1] - This nuclide is naturally occurring and there is no ODCM required LLD.

Table 12, Thermoluminescent Dosimeters – Inner Ring					
Analysis: Gamma Dose			**Units: mR**		
Station	**1st Qtr 2020**	**2nd Qtr 2020**	**3rd Qtr 2020**	**4th Qtr 2020**	**Annual Mean**
1[Note 1]	10.82	9.98	10.59	10.31	10.43
8	10.09	9.15	9.91	10.10	9.81
13	9.40	8.69	9.25	9.55	9.22
14	8.13	7.75	8.20	8.21	8.07

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Table 12, Thermoluminescent Dosimeters – Inner Ring					
Analysis: Gamma Dose			**Units: mR**		
Station	1st Qtr 2020	2nd Qtr 2020	3rd Qtr 2020	4th Qtr 2020	Annual Mean
15	9.21	8.63	8.89	9.33	9.02
16	9.38	8.49	9.11	9.38	9.09
17	8.68	8.25	8.53	8.80	8.57
18	9.97	8.96	9.65	9.97	9.64
19	9.49	8.82	9.30	9.81	9.36
20	9.15	8.84	9.26	10.02	9.32
21	9.66	9.16	9.73	9.71	9.57

[Note 1] – Station with highest annual mean.

Table 13, Thermoluminescent Dosimeters – Outer Ring					
Analysis: Gamma Dose			**Units: mR**		
Station	1st Qtr 2020	2nd Qtr 2020	3rd Qtr 2020	4th Qtr 2020	Annual Mean
2[Note 1]	14.15	13.58	14.20	13.35	13.82
3	11.03	10.47	11.18	11.46	11.04
4	11.85	11.65	12.20	12.33	12.01
5	10.85	10.76	10.94	11.08	10.91
6	10.91	9.95	10.64	10.93	10.61
7	9.15	9.20	9.50	9.77	9.41
9	10.19	9.46	10.31	10.24	10.05
23	11.22	10.55	10.96	11.40	11.03
24	11.51	11.18	11.42	12.70	11.70

[Note 1] – Station with highest annual mean.

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Table 14, Thermoluminescent Dosimeters – Control

	Analysis: Gamma Dose		Units: mR		
Station	1st Qtr [2020]	2nd Qtr [2020]	3rd Qtr [2020]	4th Qtr [2020]	Annual Mean [2020]
10	10.91	9.97	10.59	10.9	10.59
11	11.97	11.26	12.05	12.01	11.82
12	11.08	10.71	11.09	11.19	11.02

Table 15, Surface Water – Gamma Isotopic

		Analysis: Gamma Isotopic				Units: pCi/L								
Location	Start Date	End Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-9S	Cs-134	Cs-137	Ba-140	La-140	K-40	Th-228
REQUIRED LLD →			15	15	30	15	30	15	15	15	18	60	15	[Note 1]	[Note 1]
Lake In	01/01/20	02/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Lake In	02/01/20	03/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Lake In	03/01/20	04/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Lake In	04/01/20	05/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Lake In	05/01/20	06/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Lake In	06/01/20	07/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Lake In	07/01/20	08/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Lake In	08/01/20	09/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	25.18	<MDA
Lake In	09/01/20	10/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Lake In	10/01/20	11/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Lake In	11/01/20	12/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	4.29
Lake In	12/01/20	01/01/21	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	30.25	<MDA
Ludington Control	01/01/20	02/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ludington Control	02/01/20	03/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	28.19	<MDA

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Table 15, Surface Water – Gamma Isotopic															
Analysis: Gamma Isotopic							**Units: pCi/L**								
Location	Start Date	End Date	Mn-S4	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140	K-40	Th-228
Ludington Control	03/01/20	04/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ludington Control	04/01/20	05/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ludington Control	05/01/20	06/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	3.96
Ludington Control	06/01/20	07/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ludington Control	07/01/20	08/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ludington Control	08/01/20	09/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ludington Control	09/01/20	10/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ludington Control	10/01/20	11/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ludington Control	11/01/20	12/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Ludington Control	12/01/20	01/01/21	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	36.47	<MDA

[Note 1] - This nuclide is naturally occurring and there is no ODCM required LLD.

Table 16, Surface Water – Tritium and Gross Beta				
Analysis: Tritium and Gross Beta		**Units: pCi/L**		
Location	Start Date	End Date	Tritium	Gross Beta
REQUIRED LLD →			2000	4.00
Lake In	01/01/20	02/01/20	<MDA	<MDA
Lake In	02/01/20	03/01/20	<MDA	2.65
Lake In	03/01/20	04/01/20	<MDA	<MDA

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Table 16, Surface Water – Tritium and Gross Beta				
Analysis: Tritium and Gross Beta		**Units: pCi/L**		
Location	**Start Date**	**End Date**	**Tritium**	**Gross Beta**
Lake In	04/01/20	05/01/20	<MDA	<MDA
Lake In	05/01/20	06/01/20	<MDA	<MDA
Lake In	06/01/20	07/01/20	<MDA	<MDA
Lake In	07/01/20	08/01/20	<MDA	<MDA
Lake In	08/01/20	09/01/20	<MDA	2.51
Lake In	09/01/20	10/01/20	<MDA	<MDA
Lake In	10/01/20	11/01/20	<MDA	3.16
Lake In	11/01/20	12/01/20	<MDA	<MDA
Lake In	12/01/20	01/01/21	<MDA	2.80
Ludington Control	01/01/20	02/01/20	<MDA	<MDA
Ludington Control	02/01/20	03/01/20	<MDA	<MDA
Ludington Control	03/01/20	04/01/20	<MDA	3.88
Ludington Control	04/01/20	05/01/20	<MDA	<MDA
Ludington Control	05/01/20	06/01/20	<MDA	3.06
Ludington Control	06/01/20	07/01/20	<MDA	<MDA
Ludington Control	07/01/20	08/01/20	<MDA	<MDA
Ludington Control	08/01/20	09/01/20	<MDA	3.87
Ludington Control	09/01/20	10/01/20	<MDA	2.31
Ludington Control	10/01/20	11/01/20	<MDA	2.28
Ludington Control	11/01/20	12/01/20	<MDA	<MDA
Ludington Control	12/01/20	01/01/21	<MDA	<MDA

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Table 17, Drinking Water –Gamma Isotopic															
Analysis: Gamma Isotopic								**Units: pCi/L**							
Location	Start Date	End Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140	K-40	Th-228
REQUIRED LLD →			15	15	30	15	30	15	15	15	18	60	15	[Note 1]	[Note 1]
Domestic Water	01/01/20	02/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Domestic Water	02/01/20	03/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Domestic Water	03/01/20	04/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	21.03	<MDA
Domestic Water	04/01/20	05/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	6.19
Domestic Water	05/01/20	06/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Domestic Water	06/01/20	07/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Domestic Water	07/01/20	08/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Domestic Water	08/01/20	09/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Domestic Water	09/01/20	10/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Domestic Water	10/01/20	11/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	42.00	<MDA
Domestic Water	11/01/20	12/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Domestic Water	12/01/20	01/01/21	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pal Park Community	01/01/20	02/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pal Park Community	02/01/20	03/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pal Park Community	03/01/20	04/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

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Table 17, Drinking Water –Gamma Isotopic																
Analysis: Gamma Isotopic							Units: pCi/L									
Location	Start Date	End Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140	K-40	Th-228
REQUIRED LLD →			15	15	30	15	30	15	15	15	18	60	15	[Note 1]	[Note 1]
Pal Park Community	04/01/20	05/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pal Park Community	05/01/20	06/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pal Park Community	06/01/20	07/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
South Haven	01/01/20	02/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
South Haven	02/01/20	03/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
South Haven	03/01/20	04/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	44.27	<MDA
South Haven	04/01/20	05/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
South Haven	05/01/20	06/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
South Haven	06/01/20	07/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
South Haven	07/01/20	08/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	48.66	<MDA
South Haven	08/01/20	09/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	34.93	<MDA
South Haven	09/01/20	10/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
South Haven	10/01/20	11/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
South Haven	11/01/20	12/01/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
South Haven	12/01/20	01/01/21	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	27.86	<MDA

[Note 1] - This nuclide is naturally occurring and there is no ODCM required LLD.

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Table 18, Drinking Water – Tritium and Gross Beta				
Analysis: Tritium and Gross Beta			Units: pCi/L	
Location	Start Date	End Date	Tritium	Gross Beta
REQUIRED LLD ➔			2000	4.00
Domestic Water	01/01/20	02/01/20	<MDA	<MDA
Domestic Water	02/01/20	03/01/20	<MDA	3.07
Domestic Water	03/01/20	04/01/20	<MDA	2.61
Domestic Water	04/01/20	05/01/20	<MDA	<MDA
Domestic Water	05/01/20	06/01/20	<MDA	<MDA
Domestic Water	06/01/20	07/01/20	<MDA	<MDA
Domestic Water	07/01/20	08/01/20	<MDA	<MDA
Domestic Water	08/01/20	09/01/20	<MDA	2.62
Domestic Water	09/01/20	10/01/20	<MDA	<MDA
Domestic Water	10/01/20	11/01/20	<MDA	<MDA
Domestic Water	11/01/20	12/01/20	<MDA	<MDA
Domestic Water	12/01/20	01/01/21	<MDA	3.29
Pal Park Community	05/26/20	NA[Note 1]	<MDA	<MDA
Pal Park Community	06/22/20	NA[Note 1]	<MDA	<MDA
Pal Park Community	07/20/20	NA[Note 1]	<MDA	<MDA
Pal Park Community	08/18/20	NA[Note 1]	<MDA	<MDA
Pal Park Community	09/07/20	NA[Note 1]	<MDA	2.42
Pal Park Community	10/08/20	NA[Note 1]	<MDA	<MDA
South Haven	01/01/20	02/01/20	<MDA	<MDA
South Haven	02/01/20	03/01/20	<MDA	2.89
South Haven	03/01/20	04/01/20	<MDA	<MDA

Monitoring Results Tables

Table 18, Drinking Water – Tritium and Gross Beta				
Analysis: Tritium and Gross Beta		**Units: pCi/L**		
Location	Start Date	End Date	Tritium	Gross Beta
South Haven	04/01/20	05/01/20	<MDA	<MDA
South Haven	05/01/20	06/01/20	<MDA	2.62
South Haven	06/01/20	07/01/20	<MDA	<MDA
South Haven	07/01/20	08/01/20	<MDA	<MDA
South Haven	08/01/20	09/01/20	<MDA	2.46
South Haven	09/01/20	10/01/20	<MDA	<MDA
South Haven	10/01/20	11/01/20	<MDA	2.77
South Haven	11/01/20	12/01/20	<MDA	<MDA
South Haven	12/01/20	01/01/21	<MDA	2.91

[Note 1] – This is a grab sample and therefore there is no end date.

Table 19, Sediment							
Analysis: Gamma Isotopic		**Units: pCi/kg**					
Location	Collection Date	Cs-134	Cs-137	K-40	Ra-226	Th-228	Th-232
REQUIRED LLD →		150	180	[Note 1]	[Note 1]	[Note 1]	[Note 1]
North Sediment	06/02/20	<MDA	<MDA	4854	<MDA	266.4	340.8
North Sediment	09/15/20	<MDA	<MDA	3314	<MDA	313.7	<MDA
South Sediment	06/02/20	<MDA	<MDA	3810	884.6	178.1	274.3
South Sediment	09/15/20	<MDA	<MDA	4453	<MDA	89.1	<MDA

[Note 1] – This nuclide is naturally occurring and there is no ODCM required LLD.

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Table 20, Fish									
Analysis: Gamma Isotopic				**Units: pCi/kg**					
Location / species	**Collection Date**	**Mn-54**	**Co-58**	**Fe-59**	**Co-60**	**Zn-65**	**Cs-134**	**Cs-137**	**K-40**
REQUIRED LLD →		130	130	260	130	260	130	150	[Note 1]
Ludington / Redhorse	05/12/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	2187
Ludington / Drum	05/21/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	1688
Ludington / Carp	05/26/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	2792
Ludington / Catfish	08/14/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	3370
Ludington / Walleye	08/14/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	3019
Palisades / Carp	06/09/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	3879
Palisades / Quillback Carp	06/09/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	2097
Palisades / Drum	06/09/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	2773
Palisades / Catfish	08/13/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	2287
Palisades / Quillback Carp	08/13/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	3219
Palisades / smallmouth bass	08/13/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	3701
Palisades / Walleye	08/13/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	4744

[Note 1] – This nuclide is naturally occurring and there is no ODCM required LLD.

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Table 21, Food Products					
Analysis: I-131, Gamma Isotopic		**Units: pCi/kg**			
Sample / Location	**Collection Date**	**I-131**	**Cs-134**	**Cs-137**	**K-40**
REQUIRED LLD →		60	60	80	[Note 1]
Blueberries / Covert MI	07/09/20	<MDA	<MDA	<MDA	1503
Apples / Covert MI	08/20/20	<MDA	<MDA	<MDA	2226

[Note 1] – This nuclide is naturally occurring and there is no ODCM required LLD.

Table 22, Offsite Groundwater - Gamma isotopic											
Analysis: Gamma Isotopic						**Units: pCi/L**					
Location	**Collection Date**	**Mn-54**	**Co-58**	**Fe-59**	**Co-60**	**Zn-65**	**Nb-95**	**Zr-95**	**Cs-134**	**Cs-137**	**Ba-140**	**La-140**
REQUIRED LLD →		15	15	30	15	30	15	15	15	18	60	15
Pal Park Commercial Well	06/22/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pal Park Commercial Well	07/20/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pal Park Commercial Well	08/18/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pal Park Commercial Well	09/07/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
Pal Park Commercial Well	10/08/20	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA

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Table 23, Offsite Groundwater – Tritium and Gross Beta			
Analysis: Tritium and Gross Beta		**Units: pCi/L**	
Location	**Collection Date**	**Tritium**	**Gross Beta**
REQUIRED LLD →		**2000**	**4.00**
Pal Park Commercial Well	6/22/2020	<MDA	4.11
Pal Park Commercial Well	7/20/2020	<MDA	<MDA
Pal Park Commercial Well	8/18/2020	<MDA	5.05
Pal Park Commercial Well	9/7/2020	<MDA	5.35
Pal Park Commercial Well	10/8/2020	<MDA	4.98

Table 24, Broad Leaf Vegetation						
Analysis: I-131, Gamma Isotopic		**Units: pCi/kg**				
Location	**Collection Date**	**I-131**	**Cs-134**	**Cs-137**	**K-40**	**Be-7**
REQUIRED LLD →		**60**	**60**	**80**	**[Note 1]**	**[Note 1]**
Location BV1, 0.4 miles SSE	05/26/20	<MDA	<MDA	<MDA	2381	375.3
Location BV1, 0.4 miles SSE	06/22/20	<MDA	<MDA	123.5	3369	1118
Location BV1, 0.4 miles SSE	07/16/20	<MDA	<MDA	103.4	2352	1705
Location BV1, 0.4 miles SSE	08/18/20	<MDA	<MDA	131.1	2204	2480
Location BV1, 0.4 miles SSE	09/11/20	<MDA	<MDA	128.6	3975	2903
Location BV2, 0.7 miles SSE	05/26/20	<MDA	<MDA	<MDA	3645	609.1
Location BV2, 0.7 miles SSE	06/22/20	<MDA	<MDA	<MDA	5418	840.8

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Monitoring Results Tables

Table 24, Broad Leaf Vegetation						
Analysis: I-131, Gamma Isotopic		**Units: pCi/kg**				
Location	Collection Date	I-131	Cs-134	Cs-137	K-40	Be-7
Location BV2, 0.7 miles SSE	07/16/20	<MDA	<MDA	<MDA	4677	1645
Location BV2, 0.7 miles SSE	08/18/20	<MDA	<MDA	<MDA	4655	3626
Location BV2, 0.7 miles SSE	09/11/20	<MDA	<MDA	<MDA	3133	3104
Location BVC, 13.6 miles SSE	05/26/20	<MDA	<MDA	<MDA	3902	685.2
Location BVC, 13.6 miles SSE	06/22/20	<MDA	<MDA	<MDA	4233	564.2
Location BVC, 13.6 miles SSE	07/16/20	<MDA	<MDA	<MDA	4016	1178
Location BVC, 13.6 miles SSE	08/18/20	<MDA	<MDA	<MDA	3965	2694
Location BVC, 13.6 miles SSE	09/11/20	<MDA	<MDA	102.4	3181	4326

[Note 1] – This nuclide is naturally occurring and there is no ODCM required LLD.

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Interlaboratory Comparison Program Results

1.0   Summary

Teledyne Brown Engineering (TBE) laboratory participates in three overlapping interlaboratory cross check programs, those being, Analytics Environmental Cross Check Program, Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP), and Environmental Resource Associates (ERA). Each program has its own grading criteria for pass or fail. All failures are tracked by TBE with a non-conformance report to determine the cause of the failure.

A total of 28 nuclides associated with six media types (air filter, charcoal, milk, soil, vegetation, and water) were analyzed. From all analyses in 2020 five non-conformance reports (NCR's) were initiated.

NCR 20-19 – One Sr-89 in milk (provided by Analytics) was outside the acceptance criteria.

NCR 20-13 – One air particulate U-234 and U-238 (provided by DOE) were outside acceptance criteria.

NCR 20-20 – One Ni-63 in soil (provide by DOE) was outside acceptance criteria.

NCR 20-17 – One Gross Alpha/Gross Beta in water (provided by ERA) was outside acceptance criteria.

NCR 20-18 – One I-131 in water (provided by ERA) was outside acceptance criteria.

TBE NCR's are reviewed by Palisades and validated that the overall impact to the REMP are acceptable. The interlaboratory comparison program is being adequately implemented by TBE. The interlaboratory program overall is one indicator that the REMP results are accurate.