NEW YORK STATE OF OPPORTUNITY. Department of Public Service

Three Empire State Plaza, Albany, NY 12223-1350
www.dps.ny.gov

February 3, 2023

VIA EMAIL

Hon. Michelle L. Phillips
Secretary to the Commission
3 Empire State Plaza
Albany, NY 12223-1350

Re: Matter No. 21-01188 – In the Matter of the Indian Point Closure Task Force and Indian Point Decommissioning Oversight Board.

Dear Secretary Phillips:

Please accept for filing in the above-captioned matter, the February 2, 2023 presentation from independent technical expert David Lochbaum regarding radiation monitoring and control at Indian Point. Should you have any questions regarding this filing, please contact me. Thank you.

Respectfully submitted,

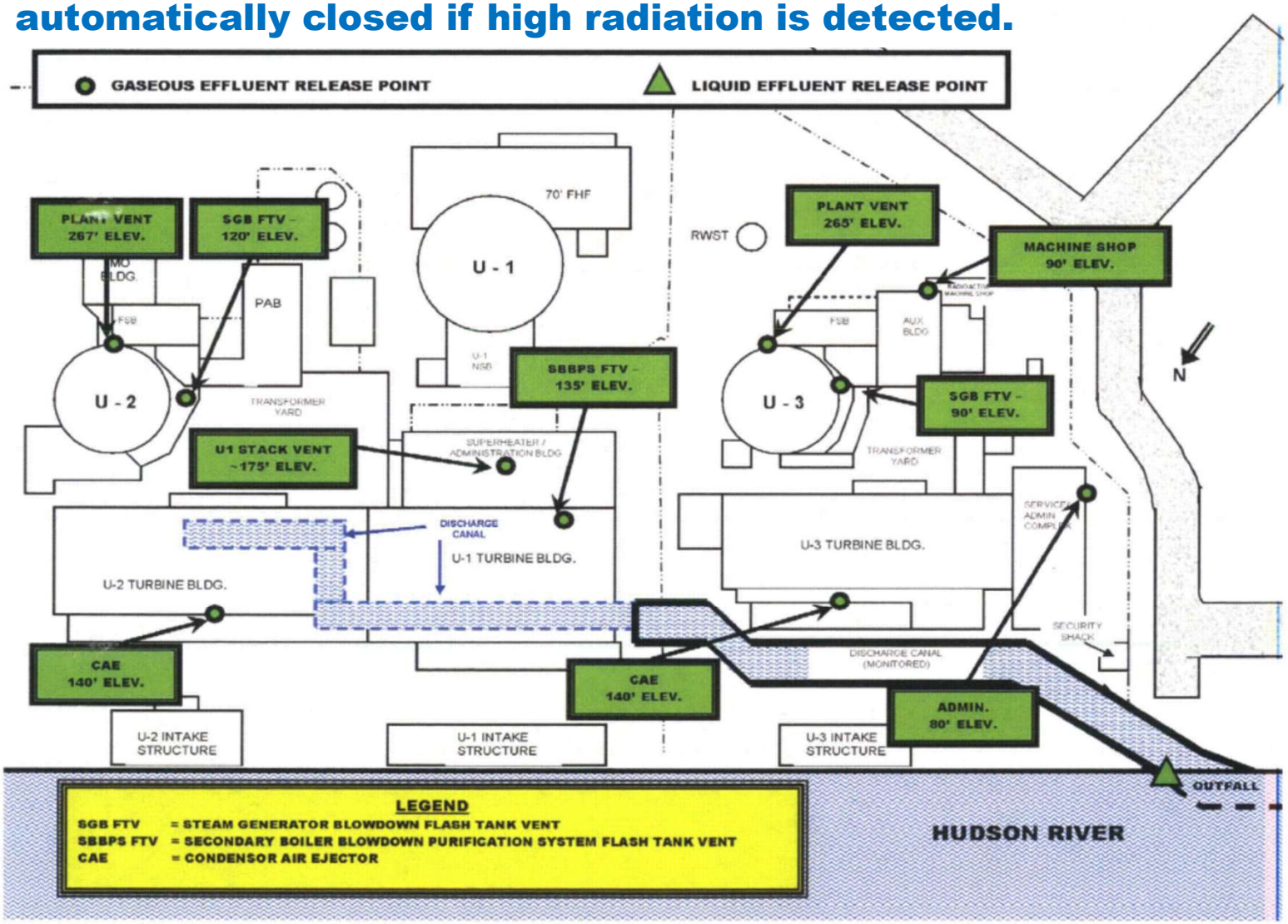
Tom Kaczmarek
Executive Director
Indian Point Closure Task Force
Indian Point Decommissioning Oversight Board

	Time After End of Reactor Operation												
Radionuclide	0 days	1 day	1 month	3 months	6 months	1 year	1.5 years	2 years	3 years	4 years	5 years	10 years	100 years
Beryllium 10	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Calcium 41	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%
Niobium 94	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.7%
Carbon 14	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	99.9%	98.8%
Molybdenum 93	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	99.9%	99.9%	99.8%	98.3%
Silver 108m	100.0%	100.0%	100.0%	100.0%	99.9%	99.8%	99.8%	99.7%	99.5%	99.3%	99.2%	98.4%	84.7%
Nickel 59	100.0%	100.0%	100.0%	99.9%	99.8%	99.7%	99.5%	99.3%	99.0%	98.7%	98.3%	96.7%	71.5%
Nickel 63	100.0%	100.0%	99.9%	99.8%	99.7%	99.3%	99.0%	98.6%	97.9%	97.3%	96.6%	93.3%	50.0%
Cesium 137	100.0%	100.0%	99.8%	99.4%	98.9%	97.7%	96.6%	95.5%	93.3%	91.2%	89.1%	79.4%	9.9%
Strontium 90	100.0%	100.0%	99.8%	99.4%	98.8%	97.6%	96.5%	95.3%	93.0%	90.8%	88.7%	78.6%	9.0%
Hydrogen 3	100.0%	100.0%	99.5%	98.6%	97.3%	94.5%	91.9%	89.3%	84.5%	79.8%	75.4%	56.9%	0.4%
Krypton 85	100.0%	100.0%	99.5%	98.4%	96.9%	93.7%	90.7%	87.9%	82.3%	77.2%	72.3%	52.3%	0.2%
Barium 133	100.0%	100.0%	99.5%	98.4%	96.8%	93.6%	90.6%	87.7%	82.1%	76.9%	72.0%	51.8%	0.1%
Cobalt 60	100.0%	100.0%	98.9%	96.8%	93.7%	87.7%	82.1%	76.9%	67.4%	59.1%	51.8%	26.8%	0.0%
Cesium 134	100.0%	99.9%	97.3%	92.2%	85.0%	71.9%	61.0%	51.7%	37.2%	26.7%	19.2%	3.7%	0.0%
Manganese 54	100.0%	99.8%	93.6%	81.9%	67.0%	44.4%	29.6%	19.8%	8.8%	3.9%	1.7%	0.0%	0.0%
Cerium 144	100.0%	99.8%	93.0%	80.3%	64.5%	41.1%	26.4%	16.9%	7.0%	2.9%	1.2%	0.0%	0.0%
Zinc 65	100.0%	99.7%	91.8%	77.4%	60.0%	35.5%	21.1%	12.6%	4.5%	1.6%	0.6%	0.0%	0.0%
Cobalt 58	100.0%	99.0%	74.6%	41.5%	17.2%	2.8%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Yttrium 91	100.0%	98.8%	69.7%	33.8%	11.4%	1.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Strontium 89	100.0%	98.6%	66.2%	29.1%	8.5%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Iron 59	100.0%	98.5%	62.7%	24.6%	6.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Barium 140	100.0%	94.7%	19.7%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Iodine 131	100.0%	91.7%	7.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Xenon 133	100.0%	87.6%	1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Iodine 132	100.0%	80.6%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Tellurium 132	100.0%	80.6%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Molybdenum 99	100.0%	77.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Yttrium 90	100.0%	77.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Lanthanum 140	100.0%	66.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Iodine 133	100.0%	44.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Strontium-91	100.0%	17.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Iodine 135	100.0%	8.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Technetium 99	100.0%	6.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Krypton 88	100.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Manganese 56	100.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Argon 41	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Krypton 87	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Iodine 134	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Tellurium 134	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Bromine 84	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Xenon 135	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Rubidium 88	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Praseodymium 144	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Rubidium 89	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Xenon 138	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

After reactor operation ceases, the production of fission products largely ends and the inventory decreases at a rate based on their half-lives – the amount of needed for half of the original amount to decay. This chart lists radionuclides by descending length of half-life, from longer to shorter.

Indian Point Unit 1 permanently shut down over 47 years ago, Unit 2 about two years ago, and Unit 3 about one year ago. The inventories are significantly depleted compared to the amounts available for release from the damaged Three Mile Island and Fukushima cores.

Each pathway point-of-release is monitored and automatically closed if high radiation is detected.

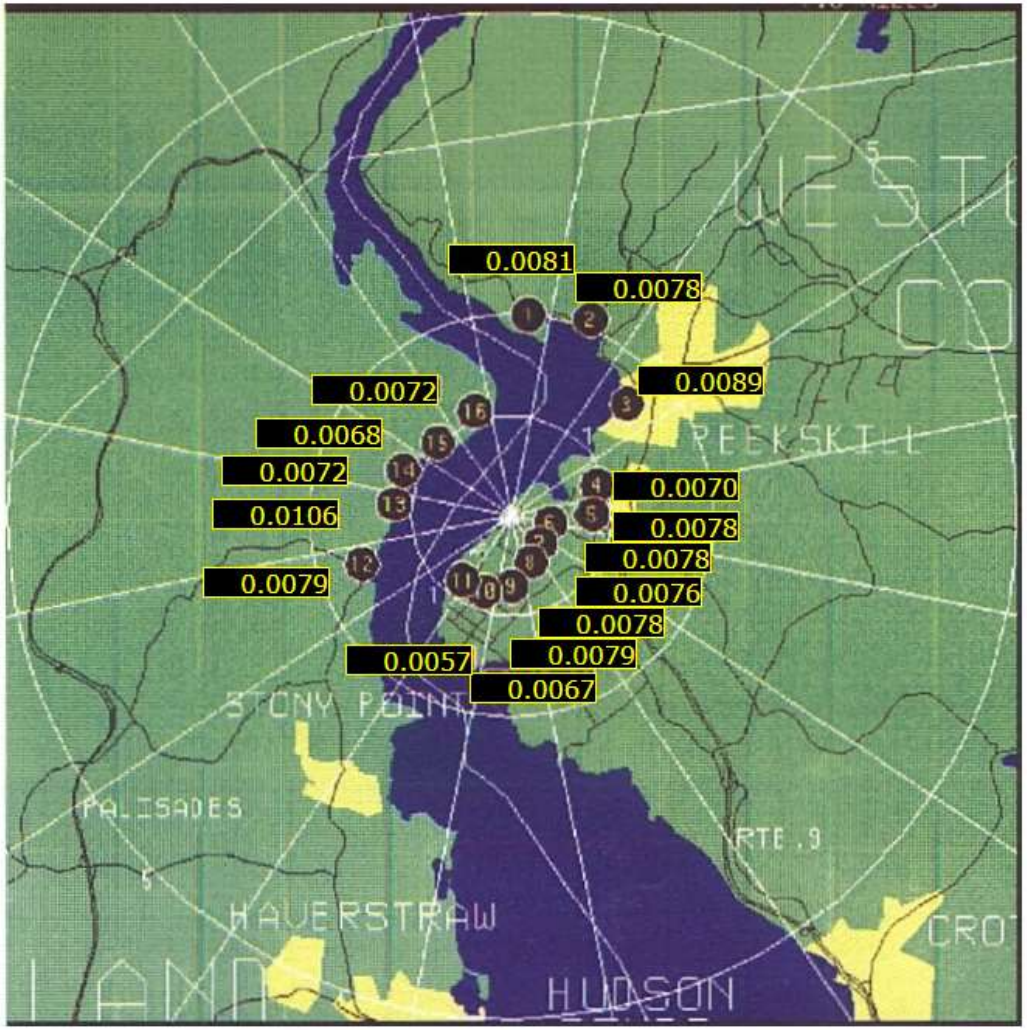


Sixteen Reuter Stokes monitors circle the Indian Point site at distances from 0.40 to 2.1 miles.

The Reuter Stokes monitors send signals continuously to the Meteorological, Radiological & Plant Data Acquisition System (MRPDAS), a computer system.

DPS can access the MRPDAS.

Reuter-Stokes Map



Offsite Radiation Monitors

Last 15 minutes (MR/HR)

Current Time: 10/27/2021 10:59:40 AM

TAGNAME	VALUE	TIMESTAMP
RADMON1.MID	0.0081	10/27/2021 10:57:38 AM
RADMON2.MID	0.0078	10/27/2021 10:57:38 AM
RADMON3.MID	0.0089	10/27/2021 10:57:38 AM
RADMON4.MID	0.0070	10/27/2021 10:57:38 AM
RADMON5.MID	0.0078	10/27/2021 10:57:38 AM
RADMON6.MID	0.0078	10/27/2021 10:57:38 AM
RADMON7.MID	0.0076	10/27/2021 10:57:38 AM
RADMON8.MID	0.0078	10/27/2021 10:57:38 AM
RADMON9.MID	0.0079	10/27/2021 10:57:38 AM
RADMON10.MID	0.0067	10/27/2021 10:55:08 AM
RADMON11.MID	0.0057	10/27/2021 10:57:38 AM
RADMON12.MID	0.0079	10/27/2021 10:57:38 AM
RADMON13.MID	0.0106	10/27/2021 10:57:38 AM
RADMON14.MID	0.0072	10/27/2021 10:57:38 AM
RADMON15.MID	0.0068	10/27/2021 10:57:38 AM
RADMON16.MID	0.0072	10/27/2021 10:57:38 AM

EXAMPLE: MRPDAS METEOROLOGICAL DATA REPORT

TIME	*** MET TOWER DATA (M/S,DEG FROM,F) ***						
HRMN (EST)	SPD10M	SPD60M	DIR10M	DIR60M	DT60	DT122	PC
0700	2.2	3.3	2	15	-1.2	-2.1	D

*** OFFSITE MONITOR DATA ***

MON NO	1	2	3	4	5	6	7	8
SECTOR	N	NNE	NE	ENE	E	ESE	SE	SSE
RAD (MR/HR)	3.4E-03	6.9E-03	6.8E-03	7.0E-03	6.3E-03	7.3E-03	7.9E-03	7.4E-03

MON NO	9	10	11	12	13	14	15	16
SECTOR	S	SSW	SW	WSW	W	WNW	NW	NNW
RAD (MRHR)	8.5E-03	6.0E-03	5.9E-03	8.5E-03	1.1E-02	6.5E-03	7.0E-03	8.4E-03

MRPDAS shows the wind speed (SPD), wind direction (DIR), and differential temperature (DT) measured at 10 meter and 60 meter heights on the site's tower. MRPDAS also shows the radiation levels measured by all 16 Reuter Stokes monitors.

Source: ML20157A128

Entergy

Facility: Indian Point Energy Center	Page 1 of 65
	YEAR: 2019
Indian Point Units 1, 2 and 3	
Docket Nos.: 50-3, 50-247, & 50-286	
Entergy Nuclear Operations, Inc. (Entergy)	
Annual Radioactive Effluent Release Report	

2.0 Batch Releases:

1. Airborne

Table 2.5-1 - Airborne Batch Releases

Unit 1 and 2 Airborne Releases		Qtr 1	Qtr 2	Qtr 3	Qtr 4	2019
Number of Batch Releases		51	52	51	60	215
Total Time Period	(min)	2800	2750	2470	3300	11320
Maximum Time Period	(min)	85	101	85	173	173
Average Time Period	(min)	54.9	52.8	48.4	55	52.8
Minimum Time Period	(min)	20	3	20	12	3

Unit 3 Airborne Releases		Qtr 1	Qtr 2	Qtr 3	Qtr 4	2019
Number of Batch Releases		27	25	17	14	83
Total Time Period	(min)	2040	2400	2480	1850	8770
Maximum Time Period	(min)	168	193	542	223	542
Average Time Period	(min)	75.5	95.9	146	132	106
Minimum Time Period	(min)	5	4	1	1	1

2. Liquid

Table 2.5-2 – Liquid Batch Releases

Unit 1 and 2 Liquid Releases		Qtr 1	Qtr 2	Qtr 3	Qtr 4	2019
Number of Batch Releases		5	13	2	0	20
Total Time Period	(min)	481	1200	139	0	1820
Maximum Time Period	(min)	114	99	69.5	0	114
Average Time Period	(min)	96.2	92.3	96	0	90
Minimum Time Period	(min)	90	65	43	0	43

Unit 3 Liquid Releases		Qtr 1	Qtr 2	Qtr 3	Qtr 4	2019
Number of Batch Releases		40	29	28	5	102
Total Time Period	(min)	4470	3220	3100	555	11345
Maximum Time Period	(min)	119	124	117	115	124
Average Time Period	(min)	112	111	111	111	111
Minimum Time Period	(min)	107	105	107	108	105

Federal regulations require all liquid and gaseous releases of radioactive materials to be monitored and the totals reported to the NRC annually.

This report covered 2019 when Indian Point Units 2 and 3 operated.

The airborne releases, with the full inventories of long and short half-lived radionuclides present, were a small fraction of the allowable amounts.

Source: https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML20136A402

Entergy

Facility: Indian Point Energy Center	Page 1 of 65
	YEAR: 2019
Indian Point Units 1, 2 and 3	
Docket Nos.: 50-3, 50-247, & 50-286	
Entergy Nuclear Operations, Inc. (Entergy)	
Annual Radioactive Effluent Release Report	

Table 6-1 Summation of Dose Assessments

Year: 2019		Total Body	Max Organ
40 CFR 190 limit ===→	IPEC	25 mrem	75 mrem
Routine Airborne Effluents[1]	Units 1 and 2	1.46E-03	1.46E-03
Routine Liquid Effluents	Units 1 and 2	5.08E-04	7.65E-04
Liquid Releases of C^{14}	Units 1 and 2	1.17E-03	5.83E-03
Airborne Releases of C^{14}	Units 1 and 2	6.51E-02	3.26E-01
Routine Airborne Effluents[1]	Unit 3	3.14E-03	3.14E-03
Routine Liquid Effluents	Unit 3	8.12E-05	2.79E-04
Liquid Releases of C^{14}	Unit 3	1.17E-03	5.83E-03
Airborne Releases of C^{14}	Unit 3	6.18E-02	3.10E-01
Ground Water & Storm Drain Totals	IPEC[2]	5.69E-05	2.30E-04
Direct Shine from areas such as dry cask storage, radwaste storage, SG Mausoleum, etc.	IPEC[3]	3.00E-01	3.00E-01
Indian Point Energy Center Total Dose, per 40 CFR 190	IPEC	4.34E-01	9.54E-01

Note 1: Routine airborne dose in this table is conservatively represented as a sum of Iodine, Particulate, and Tritium dose (excluding C-14, in mrem) with a mrem term added from noble gas gamma air energy (mrad, expressed as mrem). This 'addition' does not represent a real dose and is listed here solely to help demonstrate compliance with 40CFR190. (Doses by type of release and comparison to the specific limits of 10CFR50 Appendix I are summarized on the following pages.)

Note 2: Groundwater curie and dose calculations are provided in Attachment 2.

Note 3: 40CFR190 requires the reporting of total dose, including that of direct shine. Direct shine dose from sources other than dry cask are indistinguishable from background. Direct shine dose is determined from TLDs near the dry cask area and site boundary, compared with REMP TLDs and historical values, and corrected with occupancy factors to determine a bounding, worst case assessment of direct shine dose to a real individual. Details of each year's dose evaluation are available on site.

Federal regulations further require assessment of the radiation dose to the public from the released radioactive materials.

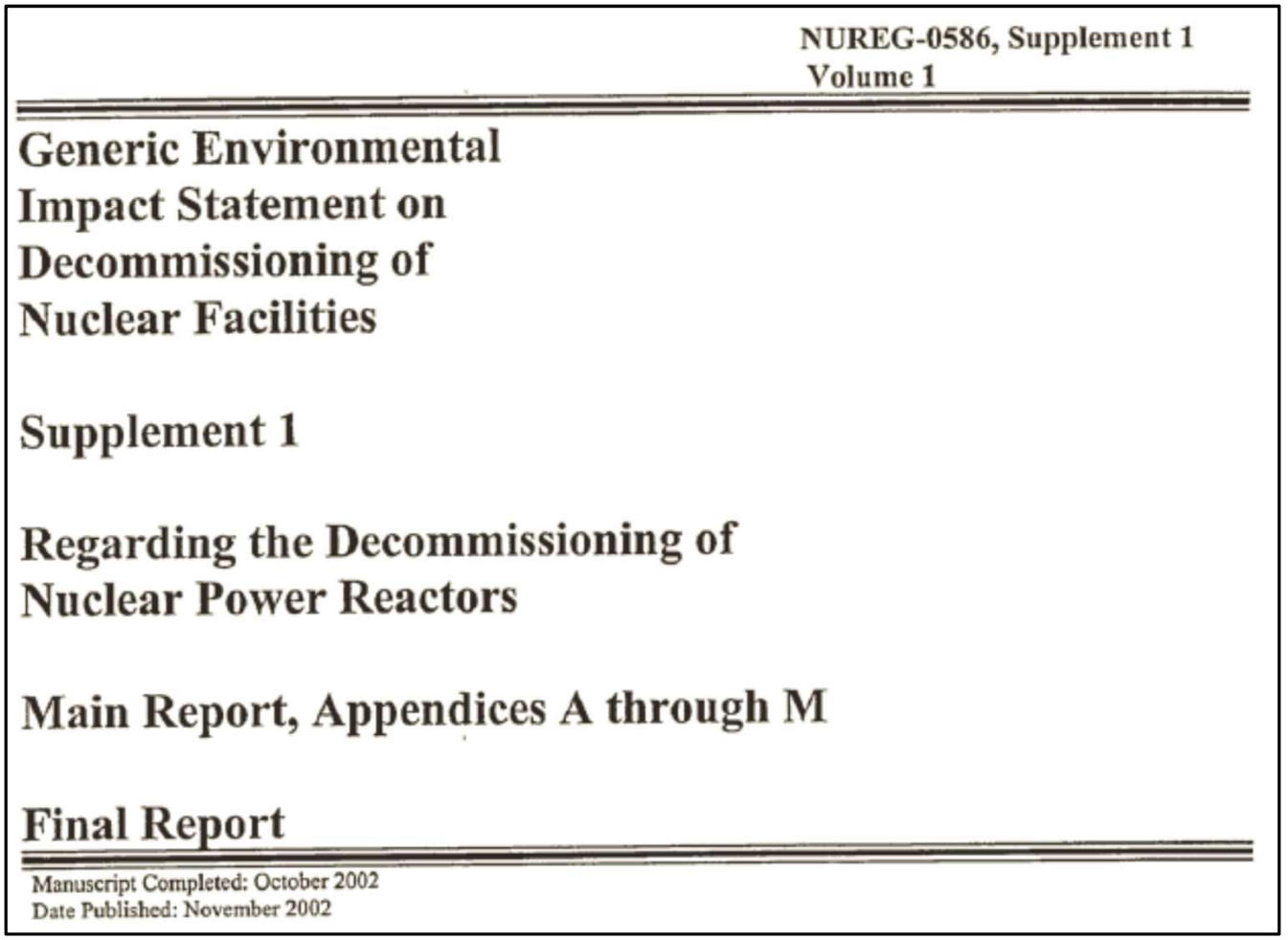
Federal limit on radiation dose to the public is 25 millirem to the body and 75 millirem to the maximum organ.

In 2019, radiation doses to the public from all releases to the air and water of 0.434 millirem to the body and 0.954 millirem to the maximum organ were well below the federal limits.

Source: https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML20136A402

Studies, such as this one, show that the theory of reduced energy levels and lessened radioactive material inventories decreasing radiation releases and exposures is valid in practice.

In other words, radioactive releases which are a small fraction of federal limits during reactor operation become an even smaller fraction during decommissioning.



NUREG-0586, Supplement 1
Volume 1

Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities

Supplement 1

Regarding the Decommissioning of Nuclear Power Reactors

Main Report, Appendices A through M

Final Report

Manuscript Completed: October 2002
Date Published: November 2002

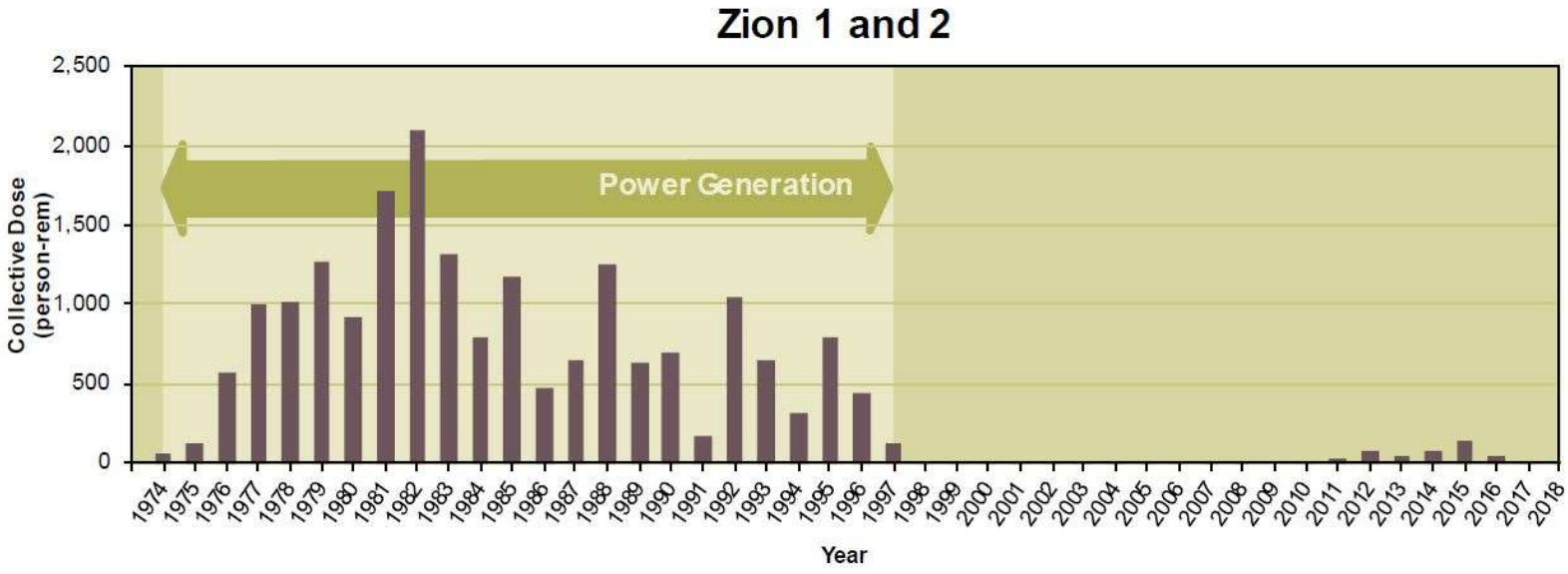
Source: https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML023470304

	Operating PWRs Average (Curies)	Decommissioning PWRs Average (Curies)	Decommissioning/Operating Percent
Total Gaseous Effluents	58.00	21.00	36.2%
Fission and Activation Gases	44.00	16.00	36.4%
Iodines	0.00	0.00	0.0%
Particulates	0.00	0.00	0.0%
Tritium	14.00	13.00	92.9%
Total Liquid Effuents	520.00	0.78	0.2%
Fission and Activation Gases	0.16	0.04	21.9%
Tritium	520.00	0.74	0.1%
Dissolved and Entrained Gases	0.10	0.00	0.0%
Gross Alpha	0.00	0.00	0.0%
Total Gaesous and Liquid Effluents	578.00	21.78	3.8%
Tritium	534.00	13.74	2.6%

The data from Table G-15 of the study shows that the releases of liquid and gaseous radioactive materials, with the exception of airborne tritium, are significantly less at a decommissioning plant than at an operating plant.

578 curies released from the average operating Pressurized Water Reactor (PWR, like at Indian Point) dropped to 21.78 curies from the average PWR being decommissioning – a significantly lowered hazard.

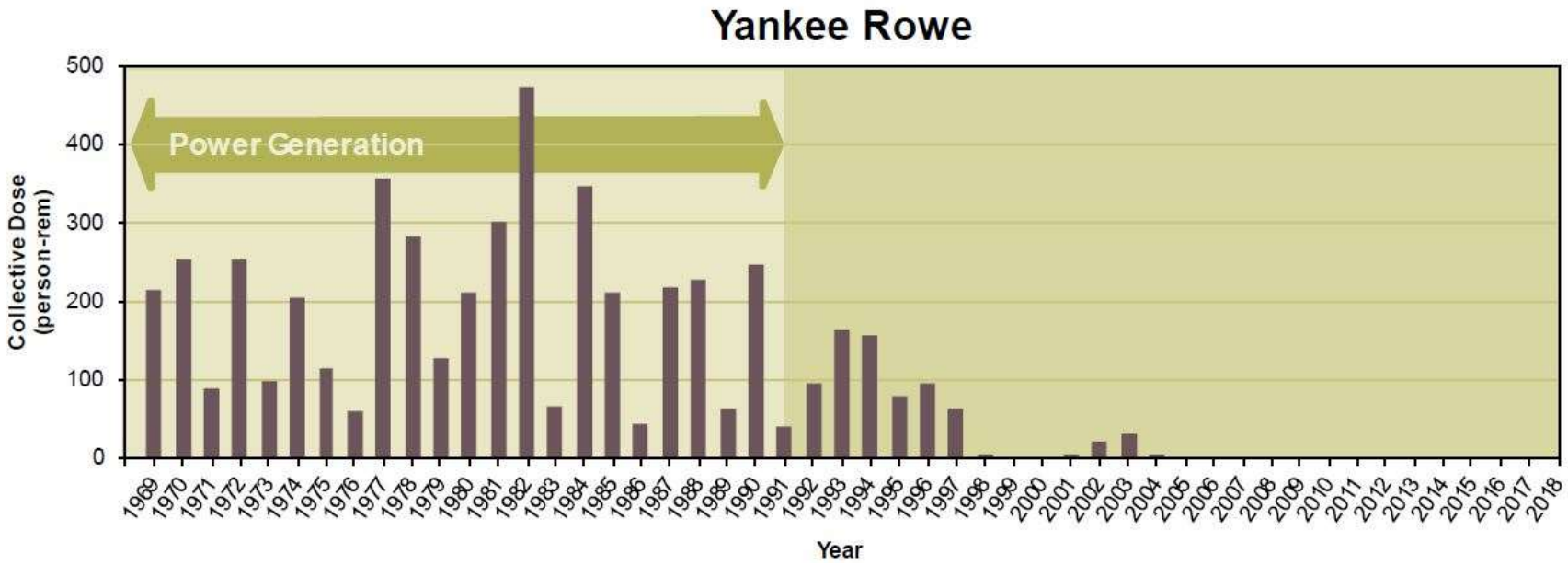
Source: https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML023470304



Zion Units 1 and 2 located in northeastern Illinois had two pressurized water reactors (very similar to Indian point Units 2 and 3 in design, size, age and proximity to large population area) that was permanently shut down on February 21, 1997, and September 19, 1996, respectively.

The transfer of all spent fuel into onsite dry storage was completed in January 2015.

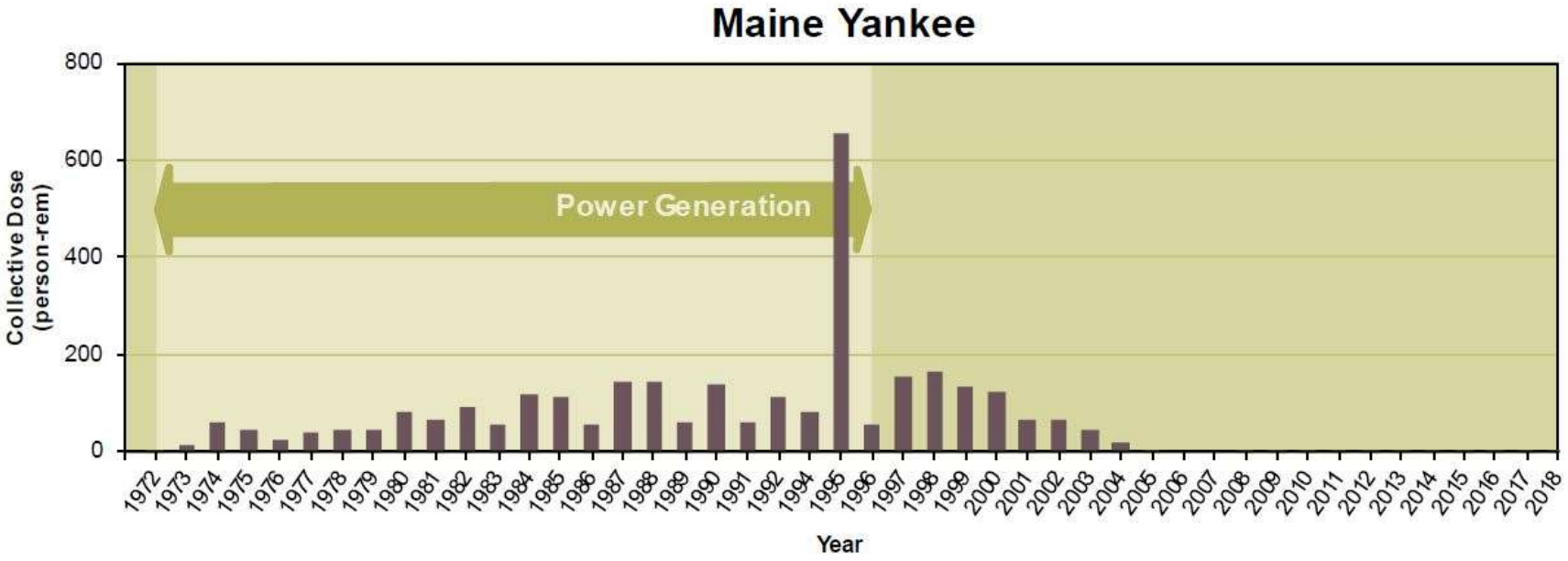
Source: ML20087J424



Yankee Rowe located in northwestern Massachusetts had one pressurized water reactor that was permanently shut down in November 1991.

The transfer of all spent fuel into onsite dry storage was completed in May 2003.

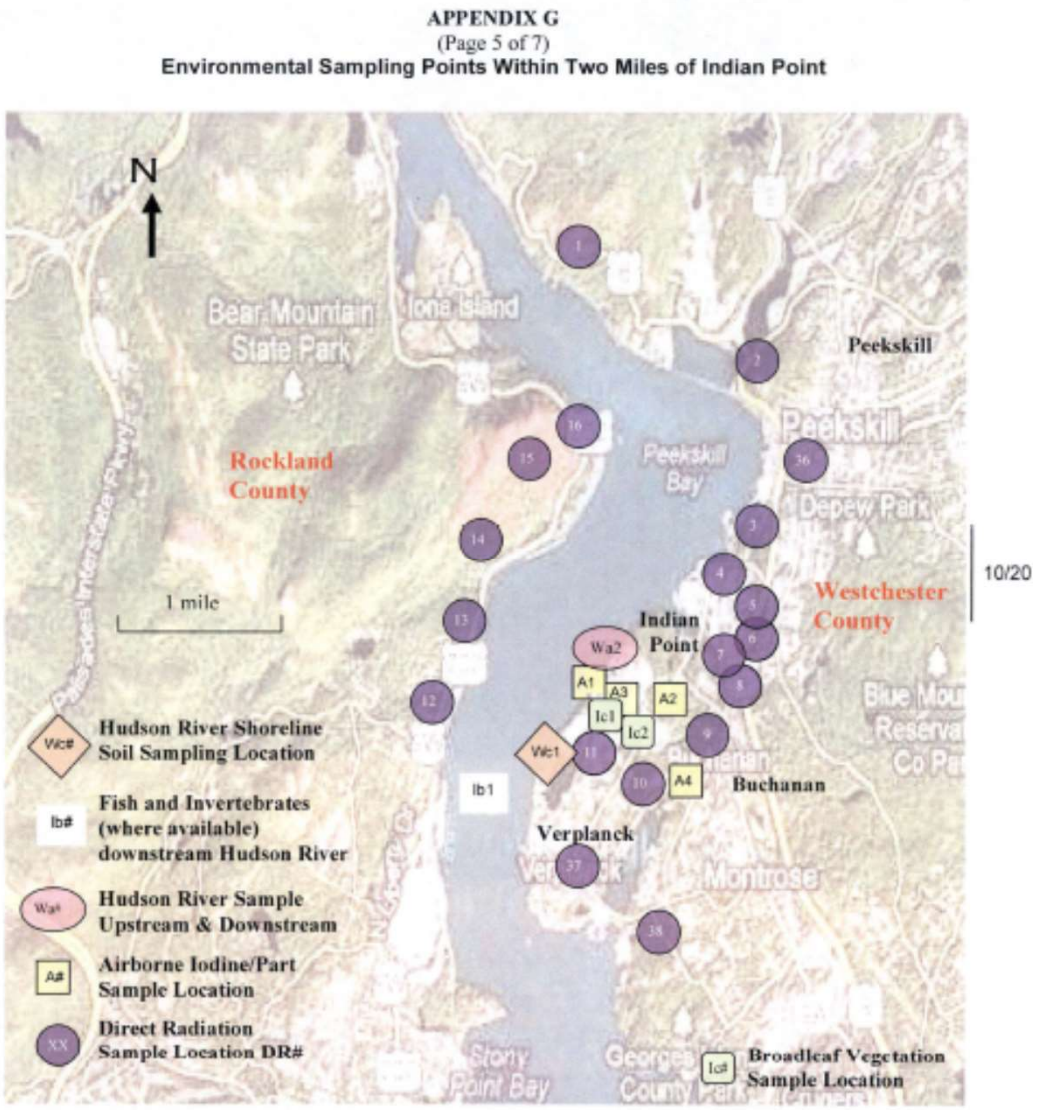
Source: ML20087J424



Maine Yankee located on Maine's coast had one pressurized water reactor that was permanently shut down on December 6, 1996.

The transfer of all spent fuel into onsite dry storage was completed in February 2004.

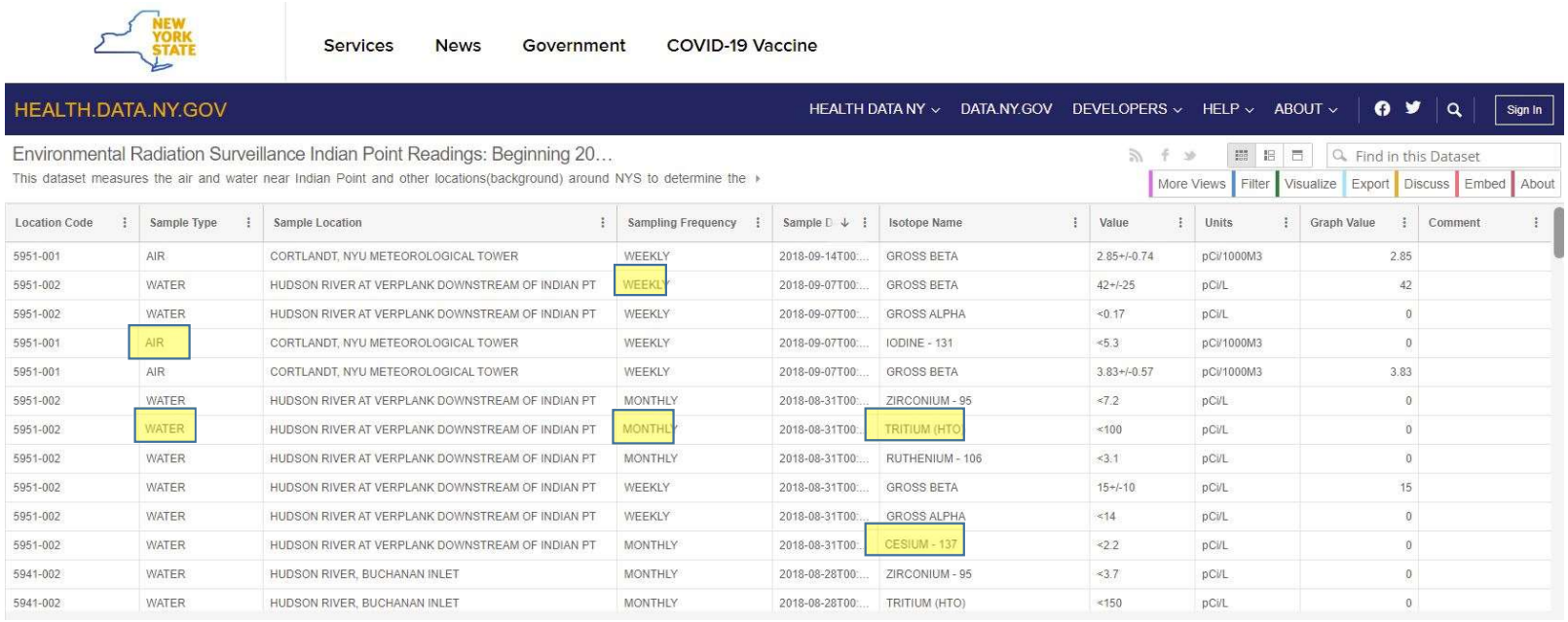
Source: ML20087J424



Per federal regulations that remain in effect until the license is terminated after decommissioning, Indian Point's owner periodically samples air, soil and water at numerous offsite locations for radiation levels.

Sampling backs up the point-of-release monitoring and also checks whether allowable point-of-release discharges bio-accumulate to cause unintended harm.

https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML21168A060



Location Code	Sample Type	Sample Location	Sampling Frequency	Sample D	Isotope Name	Value	Units	Graph Value	Comment
5951-001	AIR	CORTLANDT, NYU METEOROLOGICAL TOWER	WEEKLY	2018-09-14T00:...	GROSS BETA	2.85+/-0.74	pCi/1000M3	2.85	
5951-002	WATER	HUDSON RIVER AT VERPLANK DOWNSTREAM OF INDIAN PT	WEEKLY	2018-09-07T00:...	GROSS BETA	42+/-25	pCi/L	42	
5951-002	WATER	HUDSON RIVER AT VERPLANK DOWNSTREAM OF INDIAN PT	WEEKLY	2018-09-07T00:...	GROSS ALPHA	<0.17	pCi/L	0	
5951-001	AIR	CORTLANDT, NYU METEOROLOGICAL TOWER	WEEKLY	2018-09-07T00:...	IODINE - 131	<5.3	pCi/1000M3	0	
5951-001	AIR	CORTLANDT, NYU METEOROLOGICAL TOWER	WEEKLY	2018-09-07T00:...	GROSS BETA	3.83+/-0.57	pCi/1000M3	3.83	
5951-002	WATER	HUDSON RIVER AT VERPLANK DOWNSTREAM OF INDIAN PT	MONTHLY	2018-08-31T00:...	ZIRCONIUM - 95	<7.2	pCi/L	0	
5951-002	WATER	HUDSON RIVER AT VERPLANK DOWNSTREAM OF INDIAN PT	MONTHLY	2018-08-31T00:...	TRITIUM (HTO)	<100	pCi/L	0	
5951-002	WATER	HUDSON RIVER AT VERPLANK DOWNSTREAM OF INDIAN PT	MONTHLY	2018-08-31T00:...	RUTHENIUM - 106	<3.1	pCi/L	0	
5951-002	WATER	HUDSON RIVER AT VERPLANK DOWNSTREAM OF INDIAN PT	WEEKLY	2018-08-31T00:...	GROSS BETA	15+/-10	pCi/L	15	
5951-002	WATER	HUDSON RIVER AT VERPLANK DOWNSTREAM OF INDIAN PT	WEEKLY	2018-08-31T00:...	GROSS ALPHA	<14	pCi/L	0	
5951-002	WATER	HUDSON RIVER AT VERPLANK DOWNSTREAM OF INDIAN PT	MONTHLY	2018-08-31T00:...	CESIUM - 137	<2.2	pCi/L	0	
5941-002	WATER	HUDSON RIVER, BUCHANAN INLET	MONTHLY	2018-08-28T00:...	ZIRCONIUM - 95	<3.7	pCi/L	0	
5941-002	WATER	HUDSON RIVER, BUCHANAN INLET	MONTHLY	2018-08-28T00:...	TRITIUM (HTO)	<150	pCi/L	0	

New York State also routinely samples the air and water around Indian Point at weekly and monthly intervals checking for radionuclide emissions such as tritium, cesium, and ruthenium.

This is an additional, independent check to determine whether releases of radioactivity to the air and water from Indian Point are potentially harmful.

https://health.data.ny.gov/Health/Environmental-Radiation-Surveillance-Indian-Point-/ms7x-sfpf/data