Nuclear Education

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Indian Point Decommissioning Oversight Board
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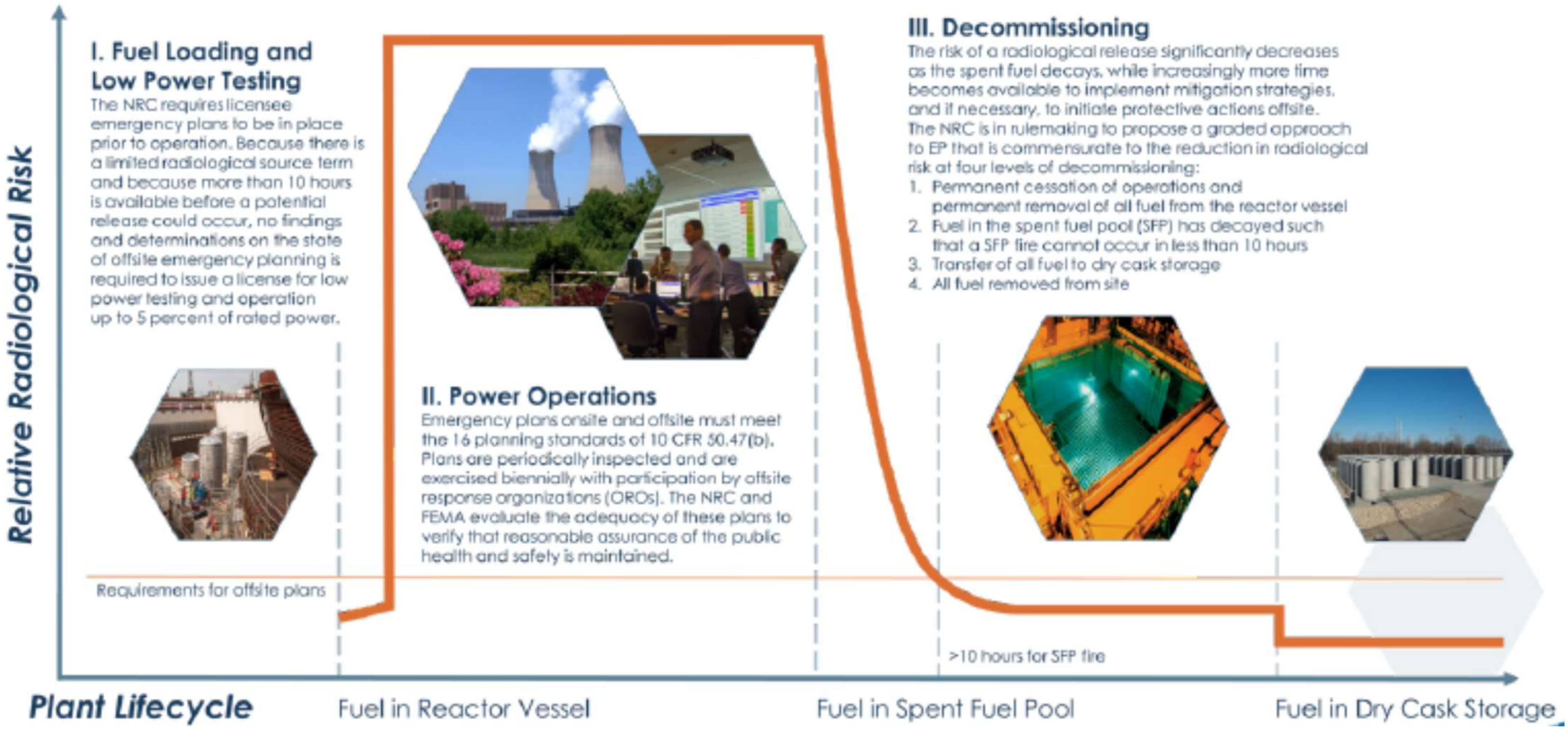
Several terms used in this presentation, like 'scram,' are defined in a glossary appended to these slides.

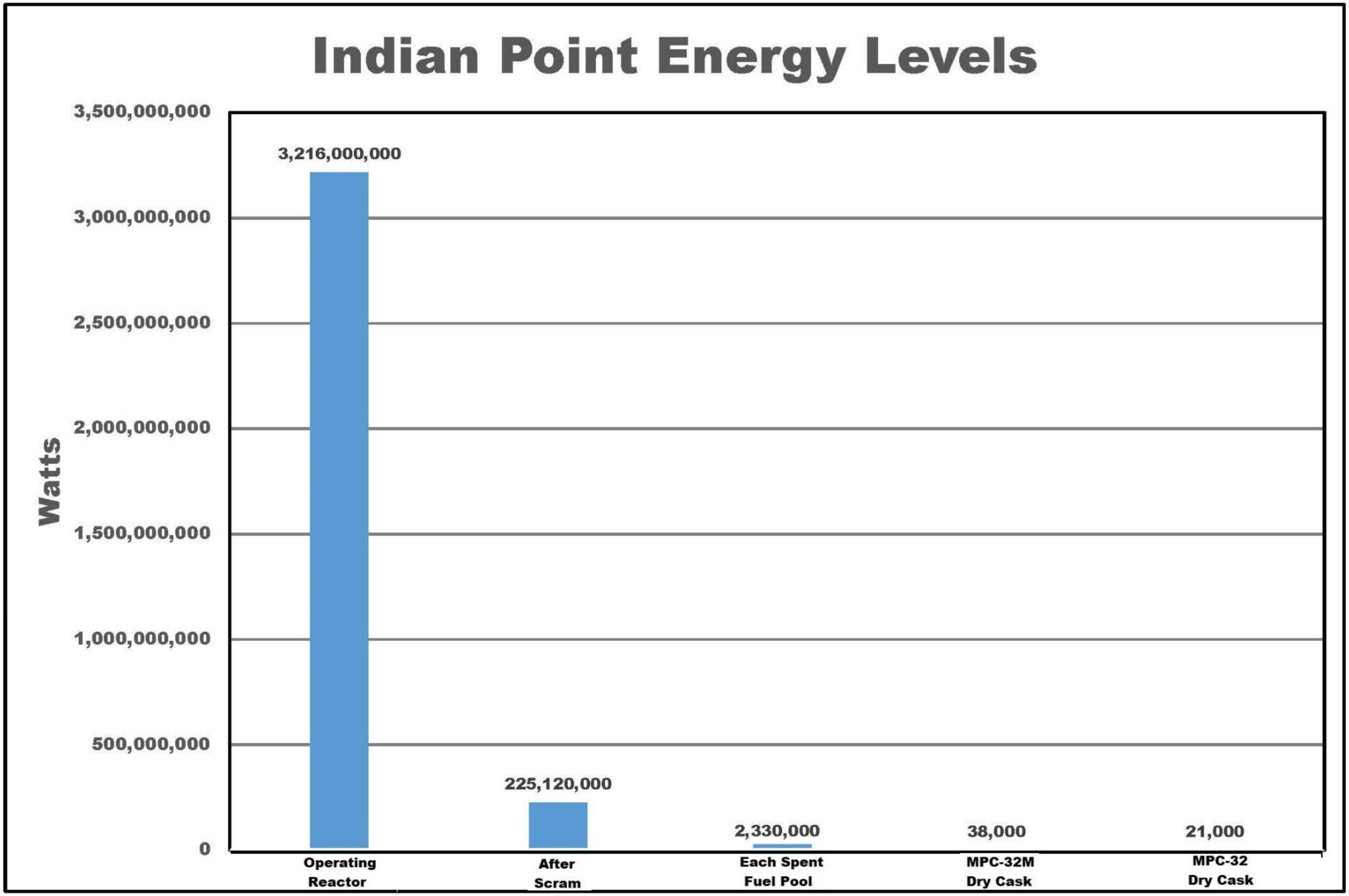
Additional materials on Indian Point decommissioning issues are available online by clicking More Info.

The views expressed here are Dave Lochbaum's and may not reflect views of other DOB Members.

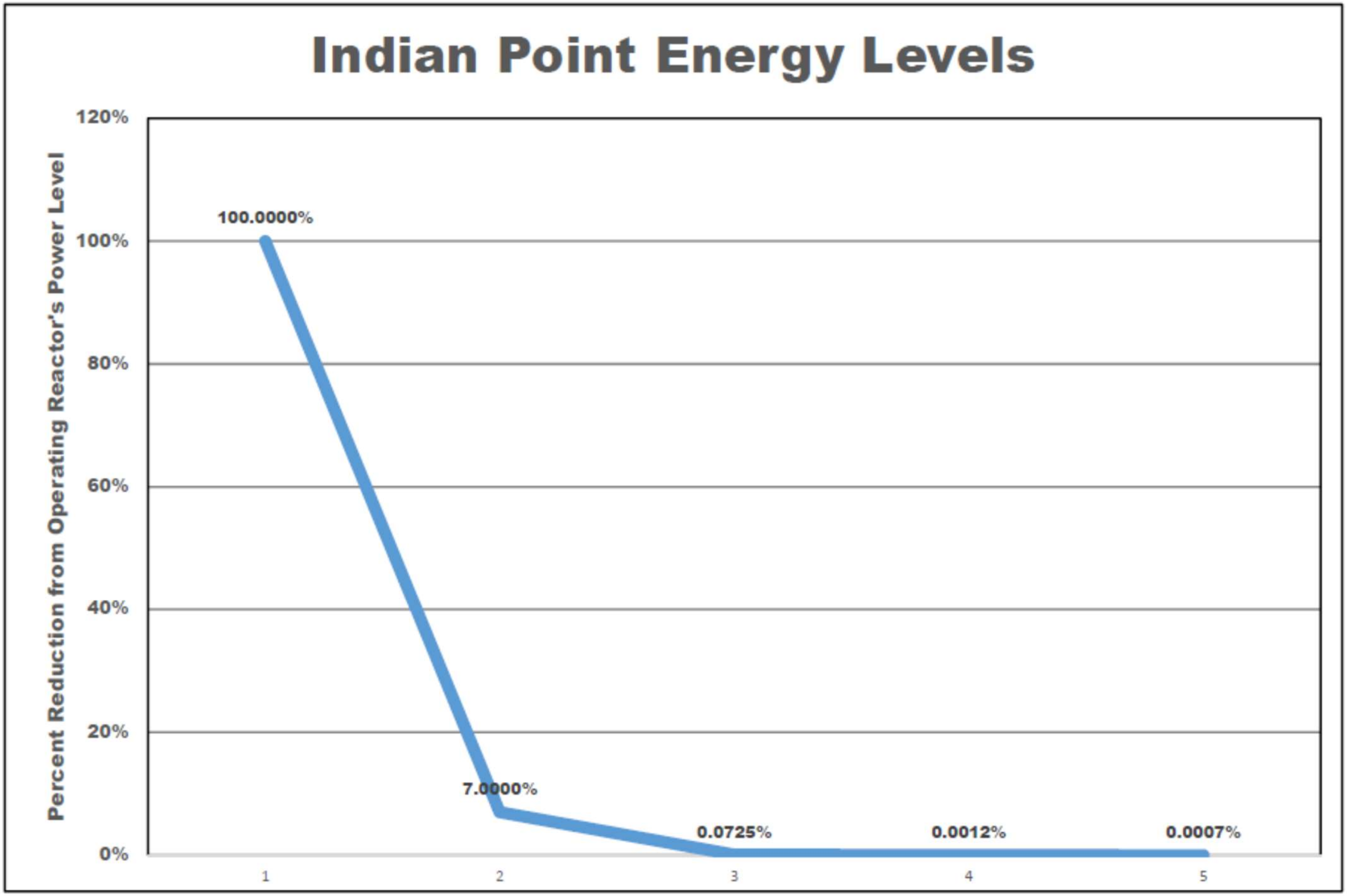


Source: NRC Webinar, "Reactor Decommissioning: A look into Emergency Preparedness and Security Requirements," November 30, 2022. (ML22329A077)

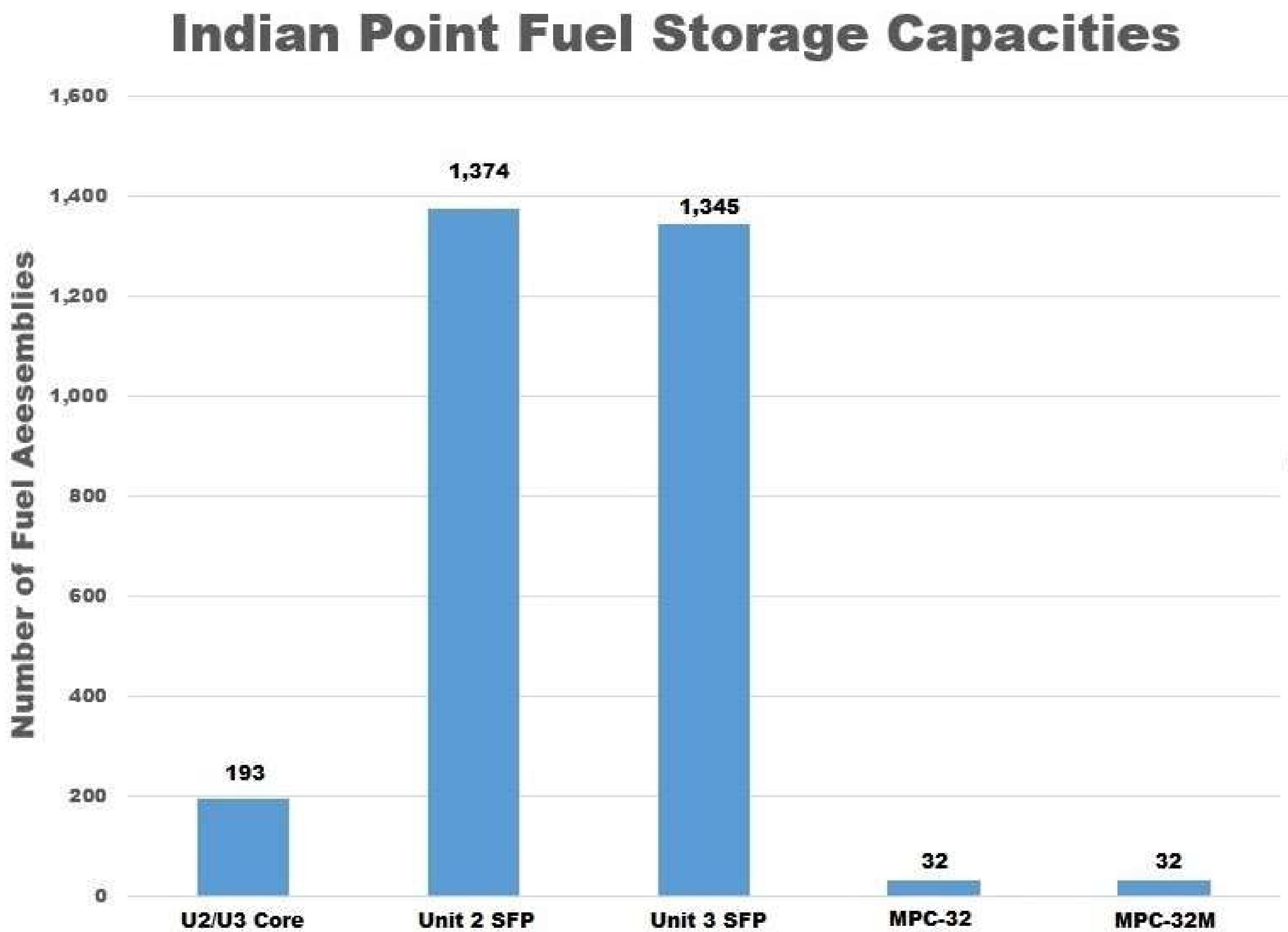
NRC presented this graph showing the relative risks from operating reactors, spent fuel pool storage, and dry cask storage. Risk is the probability of an event times its consequences. Risk drops after operation ceases because the probability of an accident and its consequences both decrease.



The risk of an accident decreases after reactor shutdown because the energy level drops significantly. The lower the energy, the more time is available to intervene and avert disaster.



Seconds after a reactor scram (i.e., rapid shutdown), the energy level drops 93 percent from the operating reactor's energy level. The energy level in a spent fuel pool is 99.9275% lower.



The consequences of an accident depend on the energy level causing damage and the inventory of fuel available to be damaged. The least inventory of fuel is in a dry cask along with the least energy level (and lowest risk).

Radionuclide	0 days	Time After End of Reactor Operation										
		1 day	1 month	3 months	6 months	1 year	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%
Calcium 41	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%	99.7%
Carbon 14	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%	99.9%	99.9%	99.9%	99.8%	98.3%
Silver 108m	100.0%	100.0%	100.0%	100.0%	99.9%	99.8%	99.7%	99.5%	99.3%	99.2%	98.4%	84.7%
Nickel 59	100.0%	100.0%	100.0%	99.9%	99.8%	99.7%	99.3%	99.0%	98.7%	98.3%	96.7%	71.5%
Nickel 63	100.0%	100.0%	99.9%	99.8%	99.7%	99.3%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Yttrium 91	100.0%	98.8%	69.7%	33.8%	11.4%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Strontium 89	100.0%	98.6%	66.2%	29.1%	8.5%	0.7%	0.0%	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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%
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%

Indian Point Unit 1 ended its reactor operation in October 1974, over 48 years ago.

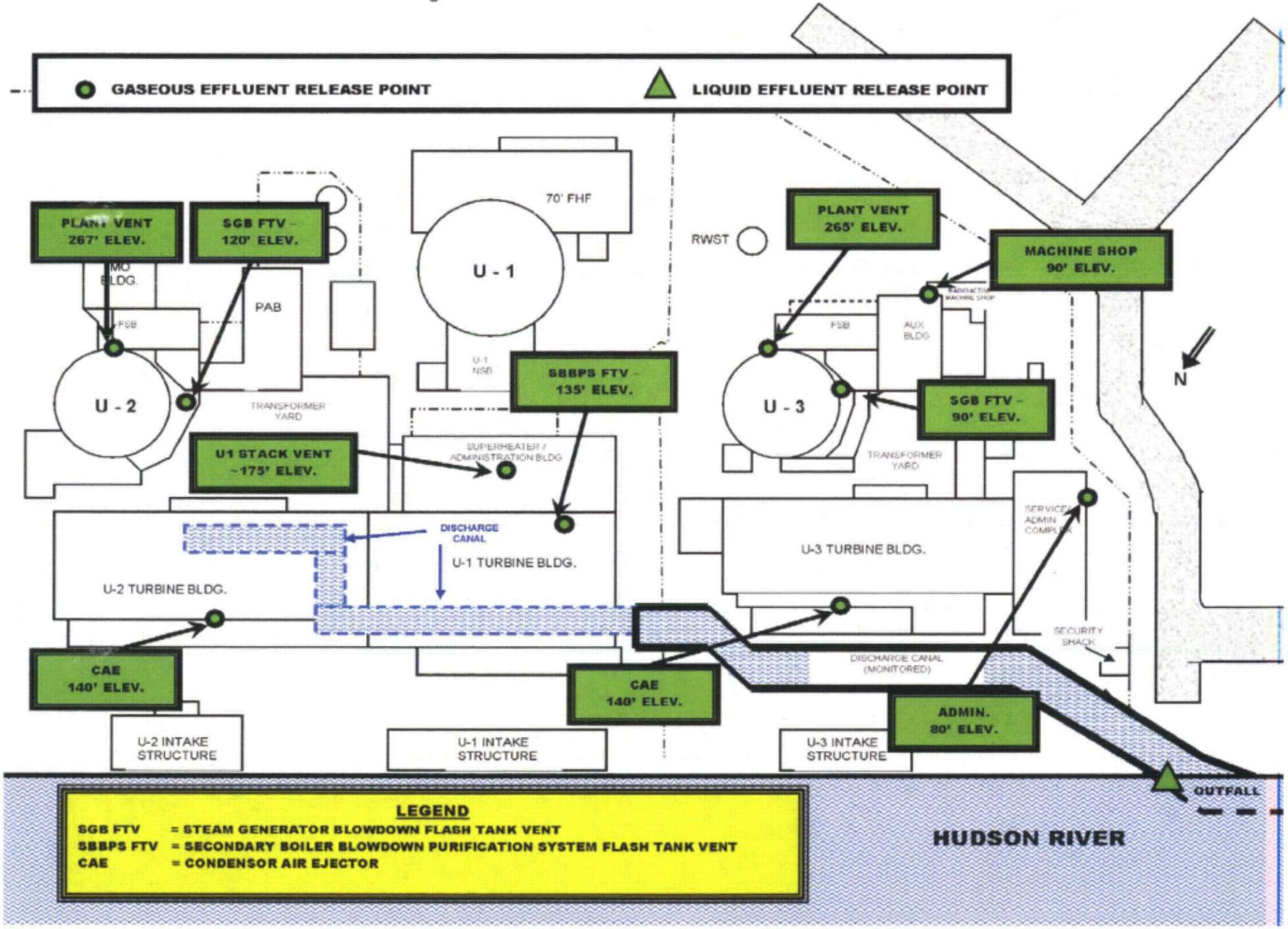
Indian Point Unit 2 ended its reactor operation on April 30 2020, nearly 3 years ago.

Indian Point Unit 3 ended its reactor operation on April 30 2021, nearly 2 years ago.

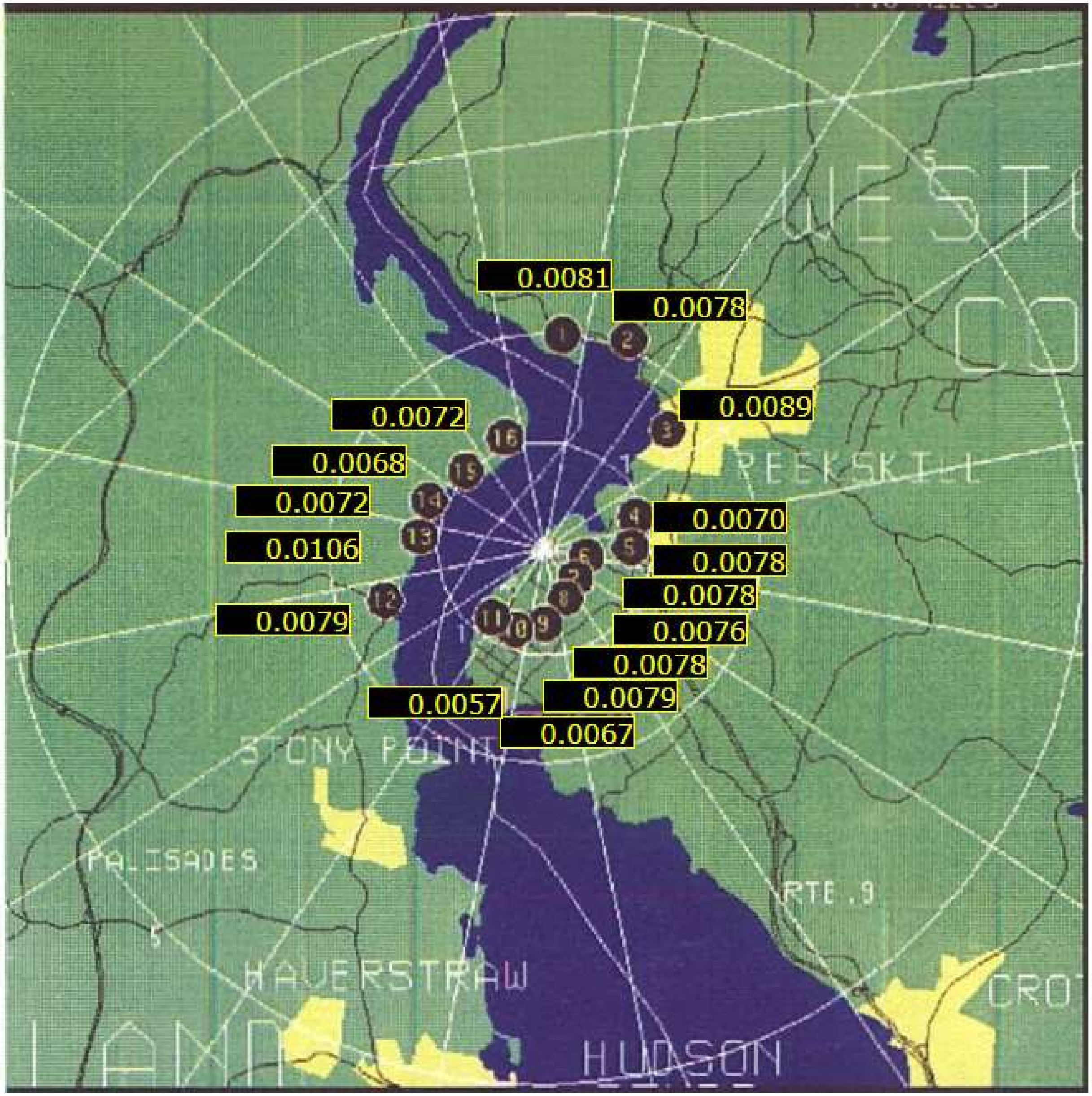
Looking forward, the white cells to the right of each reactor's timeline represent the primary hazards.

An operating reactor has the radionuclide inventory in the first column (0 days). The green-shaded cells at the top reflect radionuclides that have not yet decayed and at the bottom radionuclides that have fully decayed away. The size of a radioactive plume (i.e., the non-shaded cells) decreases every day after permanent shutdown.

Figure D 4.1-2 MAP DEFINING RELEASE POINTS



Radiation detectors that monitor potential pathways for radioactivity being released to the air and water remain in place until decommissioning is completed. If high radiation is detected, dampers or valves close to stop the release.



Offsite Radiation Monitors

Last 15 minutes (MR/HR)

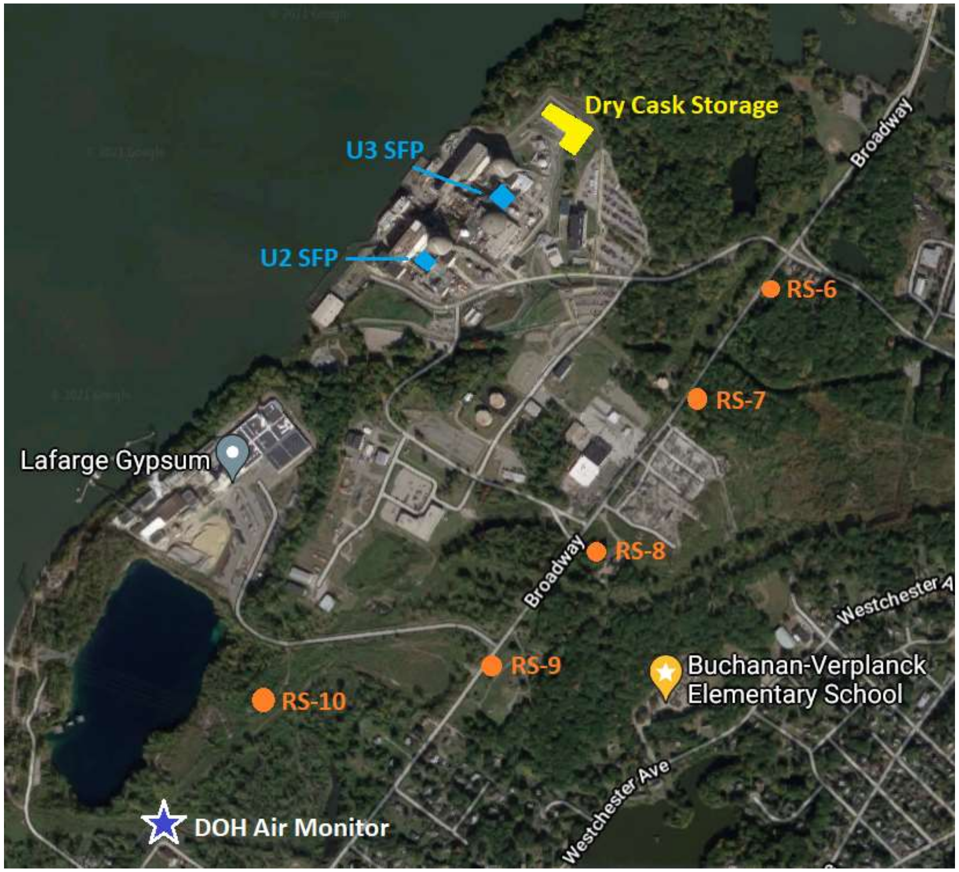
Current Time: 10/27/2021 10:59:40 AM

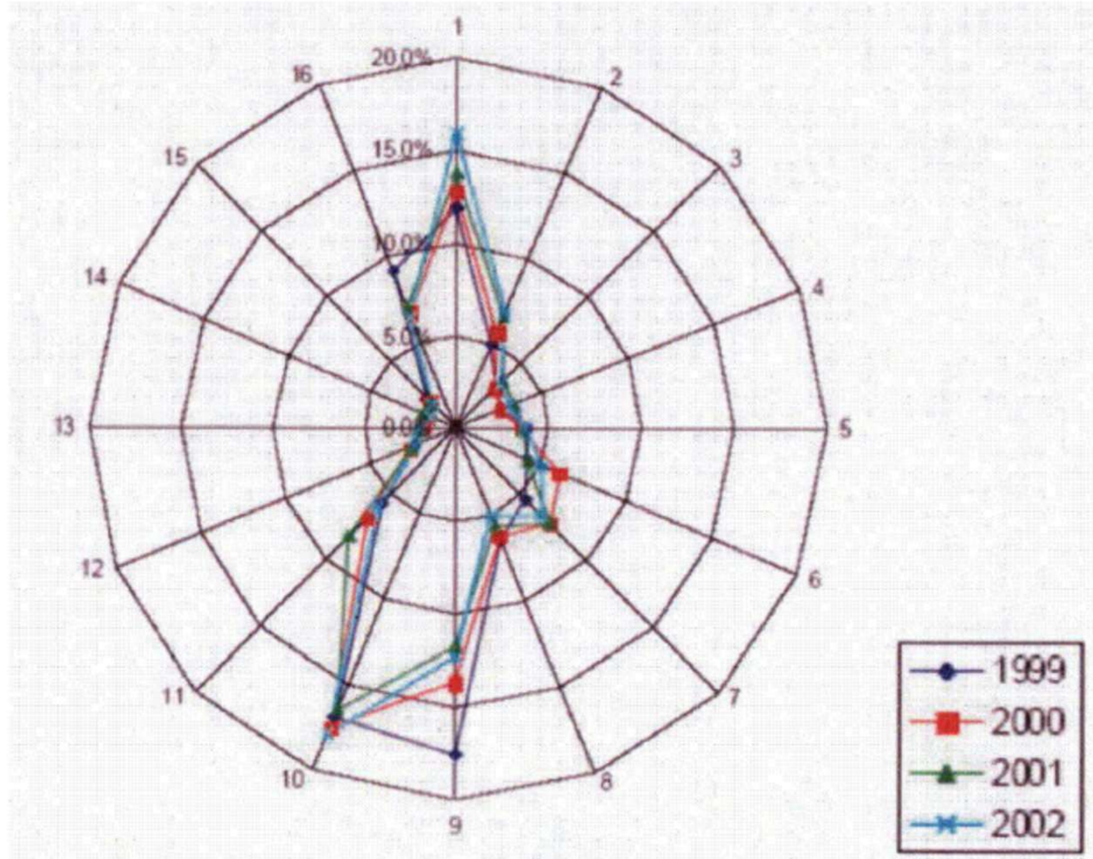
TAGNAME	VALUE	TIMESTAMP
RADMON1.MID	0.0081	10/27/2021 10:57:38 AM
RADMON2.MID	0.0078	10/27/2021 10:57:38 AM
RADMON3.MID	0.0089	10/27/2021 10:57:38 AM
RADMON4.MID	0.0070	10/27/2021 10:57:38 AM
RADMON5.MID	0.0078	10/27/2021 10:57:38 AM
RADMON6.MID	0.0078	10/27/2021 10:57:38 AM
RADMON7.MID	0.0076	10/27/2021 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

Sixteen Reuter Stokes detectors around Indian Point continuously monitor airborne radiation levels at locations ½ to 2½ miles away. Per the State's agreement with Holtec, these detectors will remain operable until all spent fuel is transferred to dry storage. Detectors under the Community Air Monitoring Program will be installed.

RS Monitor #9

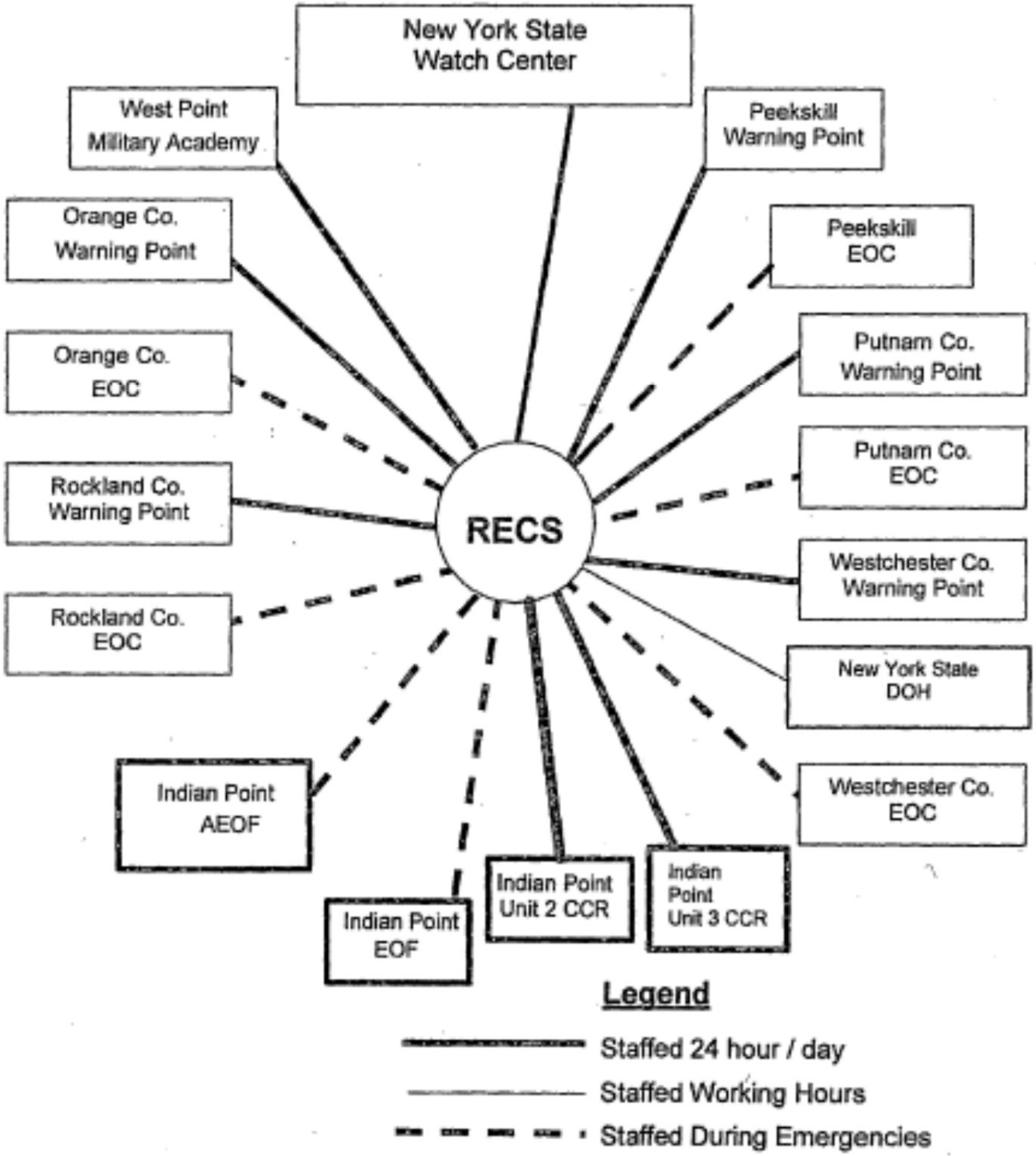
Reuter Stokes (RS) Monitor #9 is mounted on a pole along Broadway near the Buchanan-Verplanck Elementary School.





Source: State of New York Office of the Attorney General comments to NRC on Draft Supplement Environmental Impact Statement for Indian Point, March 4, 2016 (ML17188A338).

The satellite photo on the left shows the elementary school to be southeast of Indian Point. The wind rose on the right shows the wind directions. The prevailing winds are to the north and to the southwest. The wind sometimes blows in the school's direction, but not frequently.



Radiation levels from the Reuter Stokes detectors along with wind speed and direction can be accessed by plant workers and local and state workers.

Holtec will maintain an emergency plan with four emergency classifications: Unusual Event, Alert, Site Area Emergency and General Emergency in increasing order of severity. An example of an Unusual Event would be a radioactivity release to the air or water more than double procedure limits.

The plan includes notification of local and state authorities within 15 minutes.

https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML21144A194

Dust: Existing Monitoring and Safeguards

All dismantling and demolition work is subject to:

- **Local demolition permits requiring dust mitigation**

- **State regulations prohibit air pollution under 6NYCRR part 211.1, which set standards about dust (among other pollutants) that is generated from any action including demolition**

- **Strict workforce safety standards:**

  - **Testing for presence of asbestos, lead, other contaminants before structures are taken down**
  - **Contaminants trigger specific disposal, monitoring and worker safety standards**
  - **Workforce safety standards serve as the first and most accurate line of detection for school and community**

- **Federal regulatory requirements for dust control such as those described in Section 6.1.4 of the Post-Shutdown Decommissioning Activities Report**

Dust: Existing Monitoring and Safeguards

On-site dust control measures and off-site dust complaint reporting and investigation procedures are required through Village demolition permits.

- **Fugitive demolition dust must not leave site.**

Identical/comparable measures to prevent hazards to workers and the public have been or are being used at seven other nuclear plants during decommissioning activities.

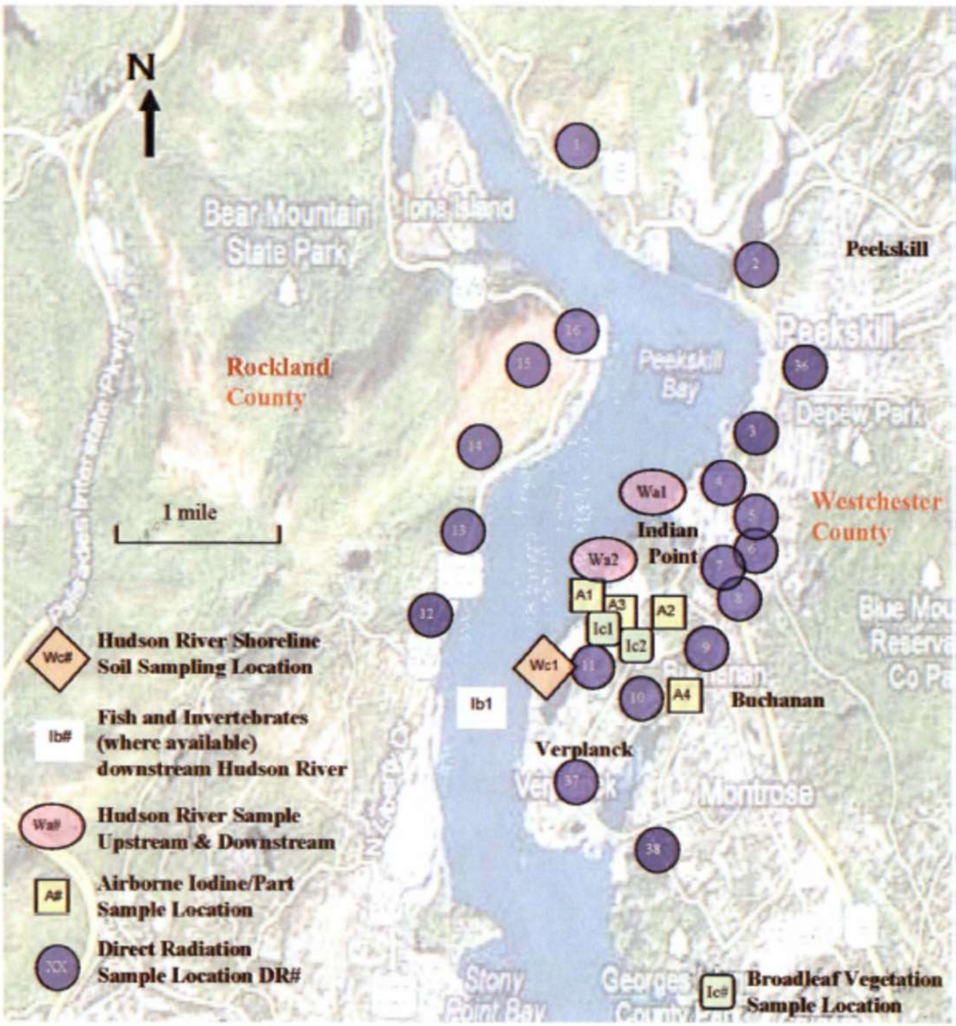
Dust: Additional DOB Actions

DOB secured $500,000 for community monitoring. The Working Group is actively reviewing proposals for environmental consulting services to develop a community air monitoring plan to be in place ahead of the next phases of decommissioning.

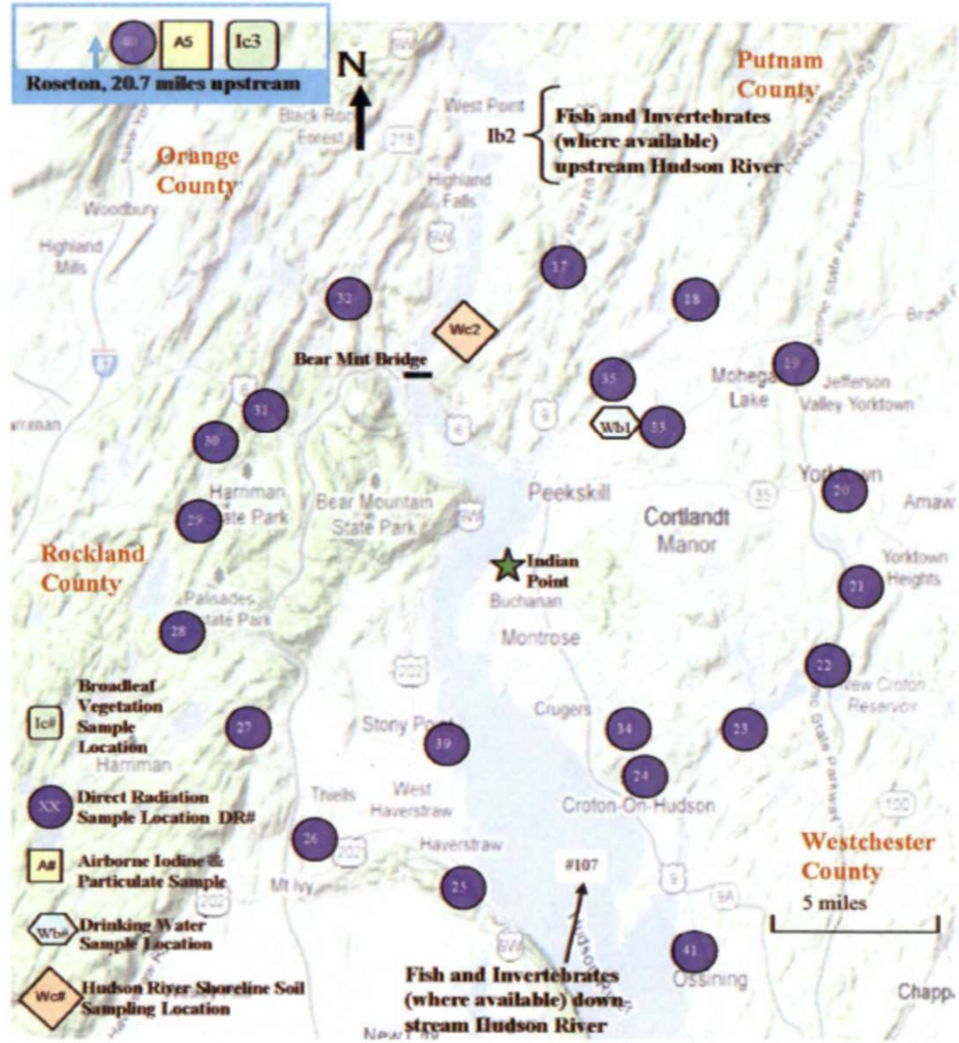
Village will directly incorporate the State standards described in part 211.1 into the demolition permit process.

On-site NYS inspector monitoring work.

SAMPLING LOCATIONS
Within Two Miles of Indian Point



SAMPLING LOCATIONS
Greater than Two Miles from Indian Point



Federal regulations require sampling of shoreline soil, fish, invertebrates, river water, broadleaf vegetation, and air to check for larger releases than permitted or accumulation of released radioactivity. The numerous samples from many locations lessen the chances for a "surprise" buildup of radioactivity.

Source: https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML20136A400

HEALTH.DATA.NY.GOV

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

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

NYS Department of Health monitoring results are available online by clicking HERE.

Radioactive Effluent and Environmental Reports for Indian Point 2 & 3

The "**Groundwater Questionnaire**" describes the state of the groundwater protection program, as of the time the questionnaire was submitted (generally 2007, unless otherwise stated).

The "**Effluent Report**" lists the quantities of radionuclides released from the site in liquid and gaseous effluents for the calendar year. This report is actually the "Annual Radioactive Effluent Release Report" submitted as required by Federal regulations (10 CFR 50.36a).

The "**Environmental Report**" lists the measurements of radioactive materials found in the environment surrounding the power plant. This report is actually the "Annual Radiological Environmental Operating Report" submitted as required by Federal regulations.

- Groundwater Questionnaires

- Results of Ground Water Contamination Investigation

  | 2008 |

- Annual Environmental Protection Plan Report

  |2010 | 2009 | 2008 | 2007 | 2006 | 2005 |

- Radioactive Effluent Reports:

  | 2021 | 2020 | 2019 | 2018 | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 |

  | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 |

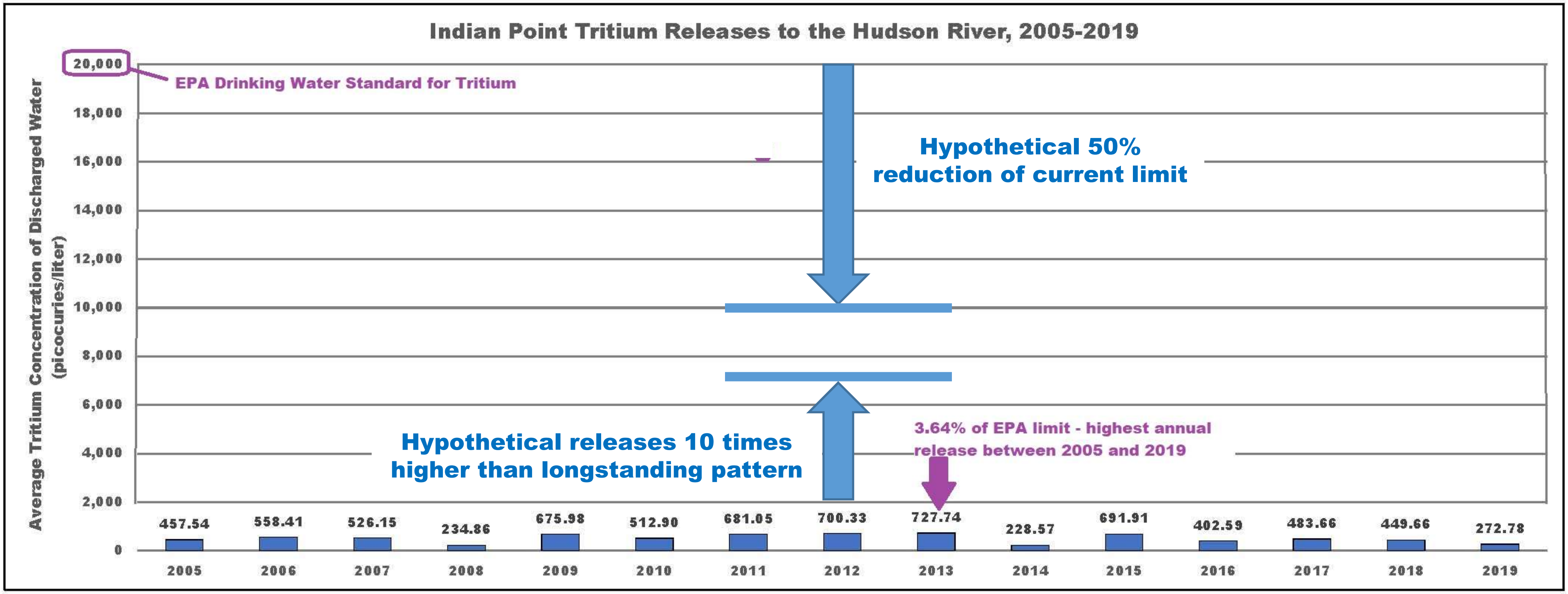
- Environmental Reports:

  | 2021 | 2020 | 2019 | 2018 | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 |

  | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 |

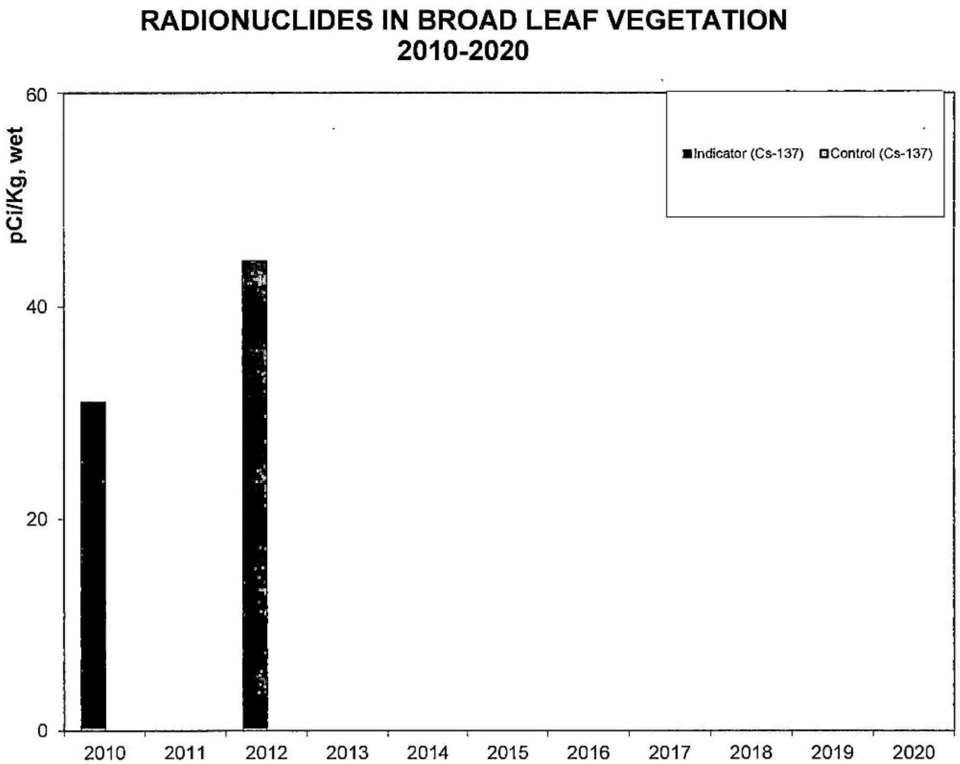
Federal regulations require owners to submit annual reports of radioactivity released to the air and water and results from sampling of soil, water, vegetation and aquatic life. The annual reports since 2005 are posted online by the NRC and can be accessed by clicking HERE.

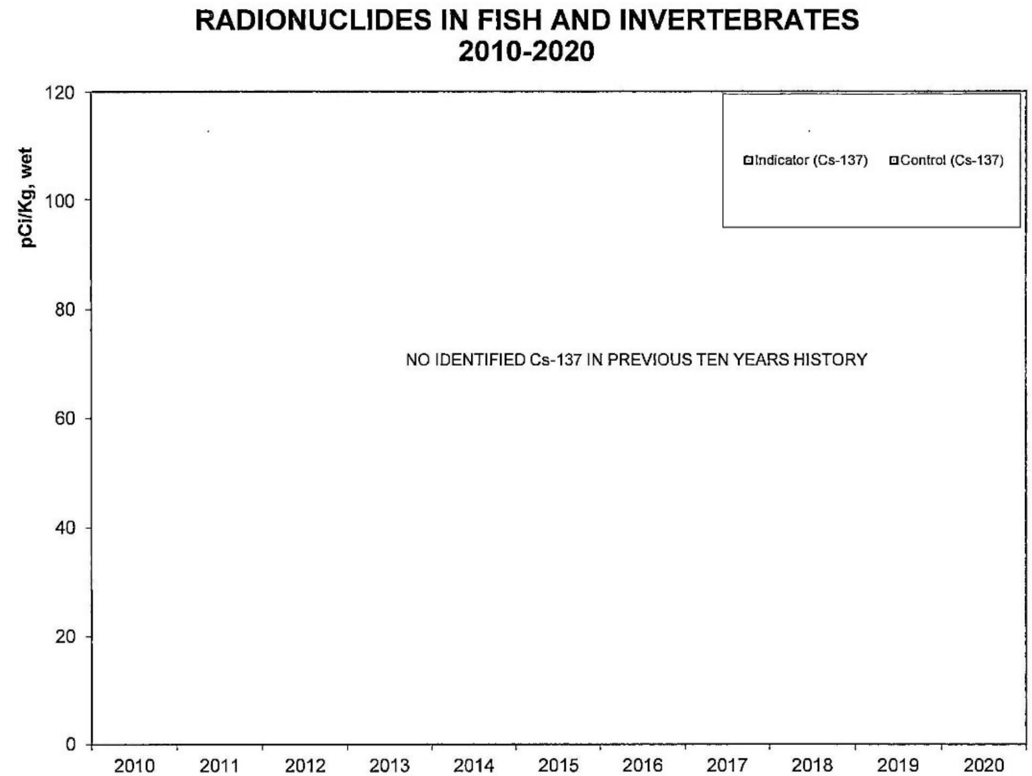
https://www.nrc.gov/reactors/operating/ops-experience/tritium/plant-specific-reports/ip2-3.html



The annual effluent reports between 2005 and 2019 show that tritium releases to the Hudson River have been significantly less than 4% of EPA's drinking water limit.

The huge margin between the limit and the releases means that even if the hypothetical releases were 10 times higher than during this period and if the current limit was reduced by 50%, the tritium releases would still not exceed even the lowered permitted limits. Thus, the ample margin protects against error(s) setting the limit or calculating the amounts of tritium in the discharge flow.





The data shows that releases from Indian Point to the air and water are not increasing (i.e., bio-accumulating) over time.

The historical trend data from the annual environmental reports includes the Cesium-137 concentrations in vegetation and aquatic life samples between 2010 and 2020. There are multiple sources for Cesium-137 (e.g., above-ground nuclear weapons testing, Chernobyl and Fukushima reactor accidents, etc.) Detection of abnormally high amounts of Cesium-137 or detection in unexpected locations would trigger investigations into where it came from and how it got there.

Source: https://www.nrc.gov/docs/ML2116/ML21167A188.pdf

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	

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

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

Federal limit on radiation dose to the public

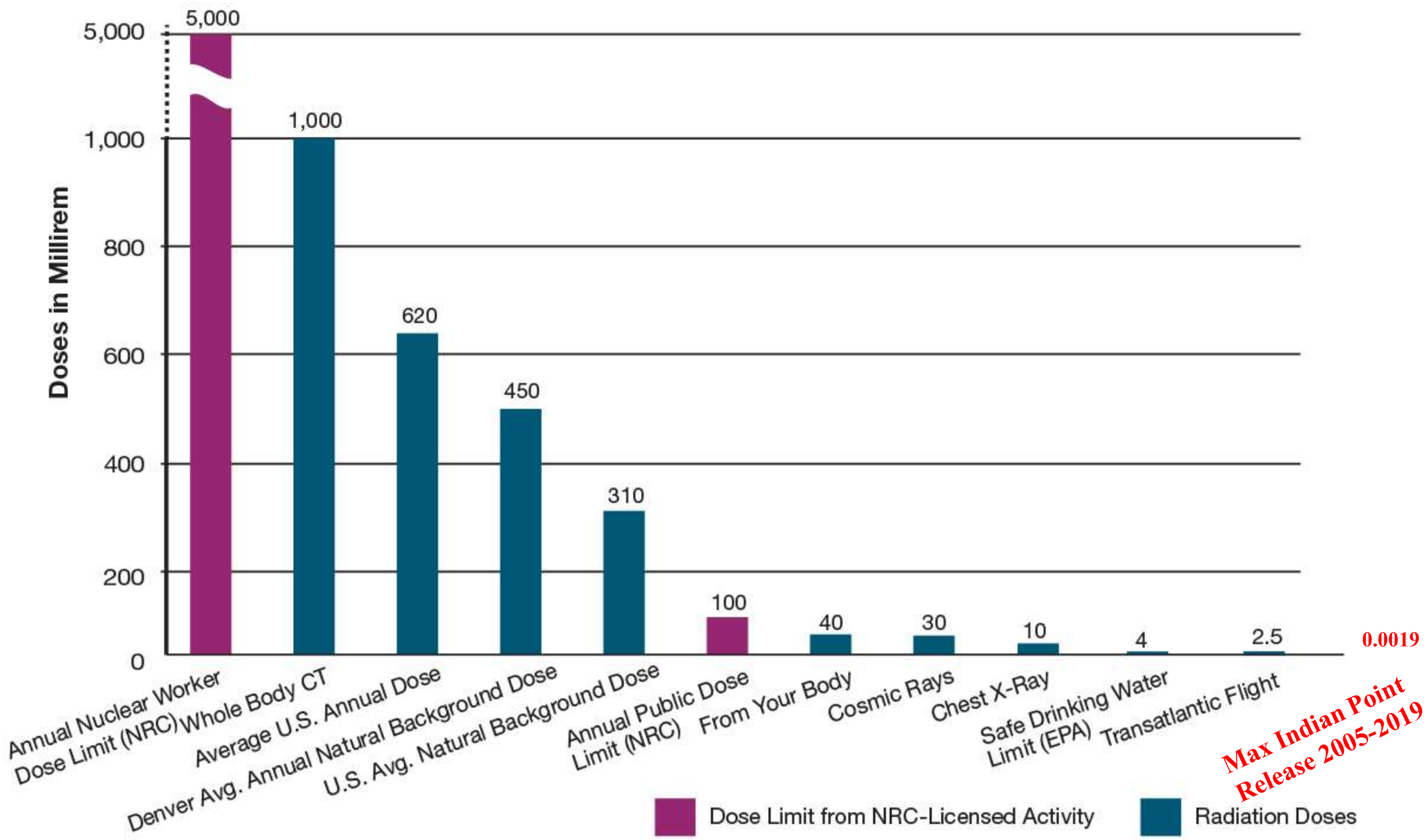
In 2019, radiation total body doses to the public from releases to the water were 0.000508 millirem from Units 1 and 2 and 0.0000812 millirem from Unit 3 for a total of 0.0005892 millirem, 0.00236% of the federal limit of 25.00000 millirem.

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

	Total Whole Body Dose millrem	Total Body Dose Limit (40 CFR 190) millrem	Fraction of Limit
2005	0.001256	25	0.0050%
2006	0.001007	25	0.0040%
2007	0.000855	25	0.0034%
2008	0.000767	25	0.0031%
2009	0.001149	25	0.0046%
2010	0.000688	25	0.0028%
2011	0.000748	25	0.0030%
2012	0.000576	25	0.0023%
2013	0.001375	25	0.0055%
2014	0.0004589	25	0.0018%
2015	0.001247	25	0.0050%
2016	0.001091	25	0.0044%
2017	0.000784	25	0.0031%
2018	**0.001947**	25	**0.0078%**
2019	0.0005892	25	0.0024%

Since 2005, the highest radiation dose to the public from radioactivity releases from Indian Point was less than one hundredth of a percent of the federal limit.

Radiation Doses and Regulatory Limits



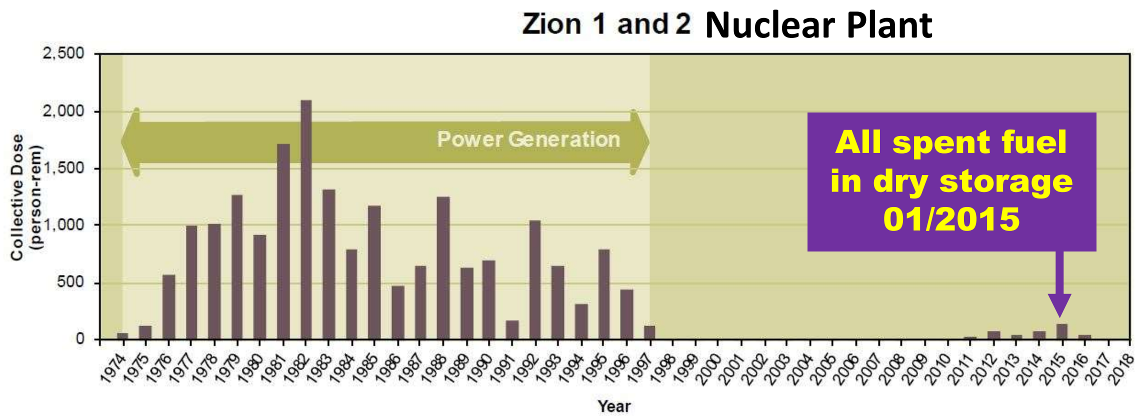
Since 2005, the highest radiation dose to the public from radioactivity releases from Indian Point was 0.001947 millirem. A banana can emit 0.01 millirem or five times the maximum dose from liquid releases from Indian Point.

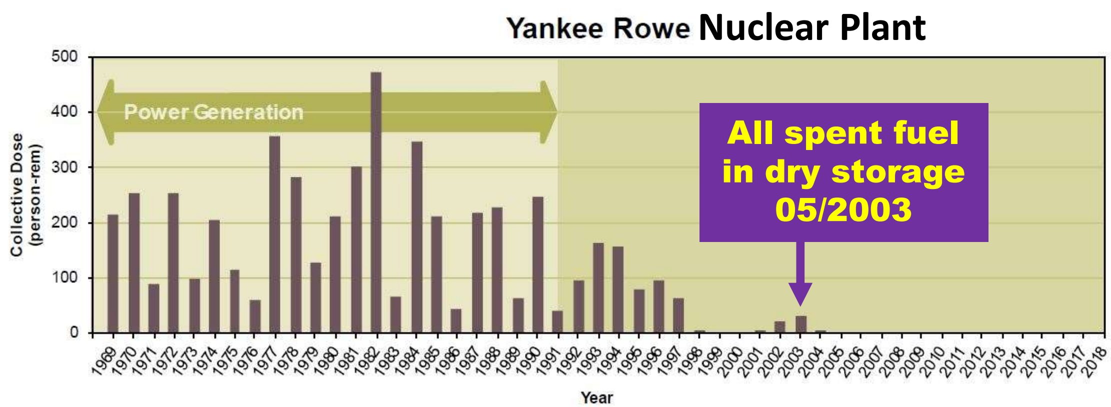
U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

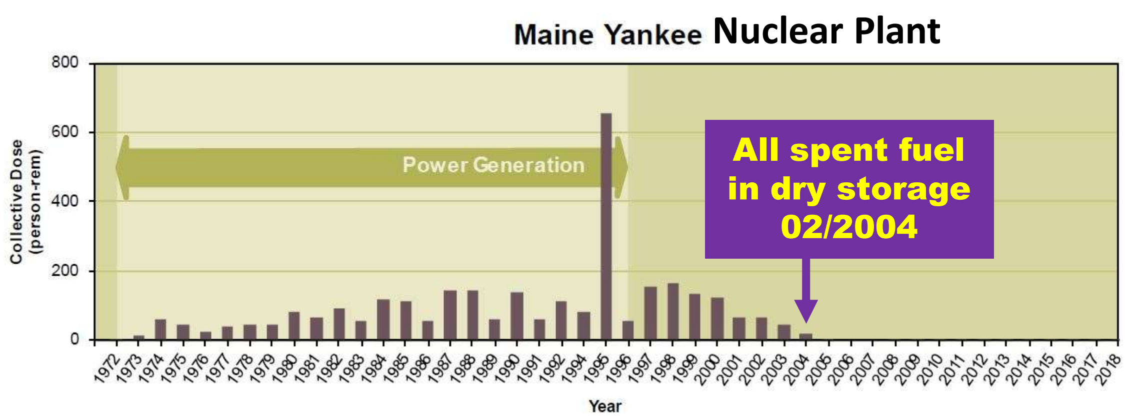
DATA AS OF AUGUST 2020

SOURCE: U.S NUCLEAR REGULATORY COMMISSION NUREG 1350, VOLUME 32, 2020-2021 INFORMATION DIGEST

Banana Source: U.S. EPA





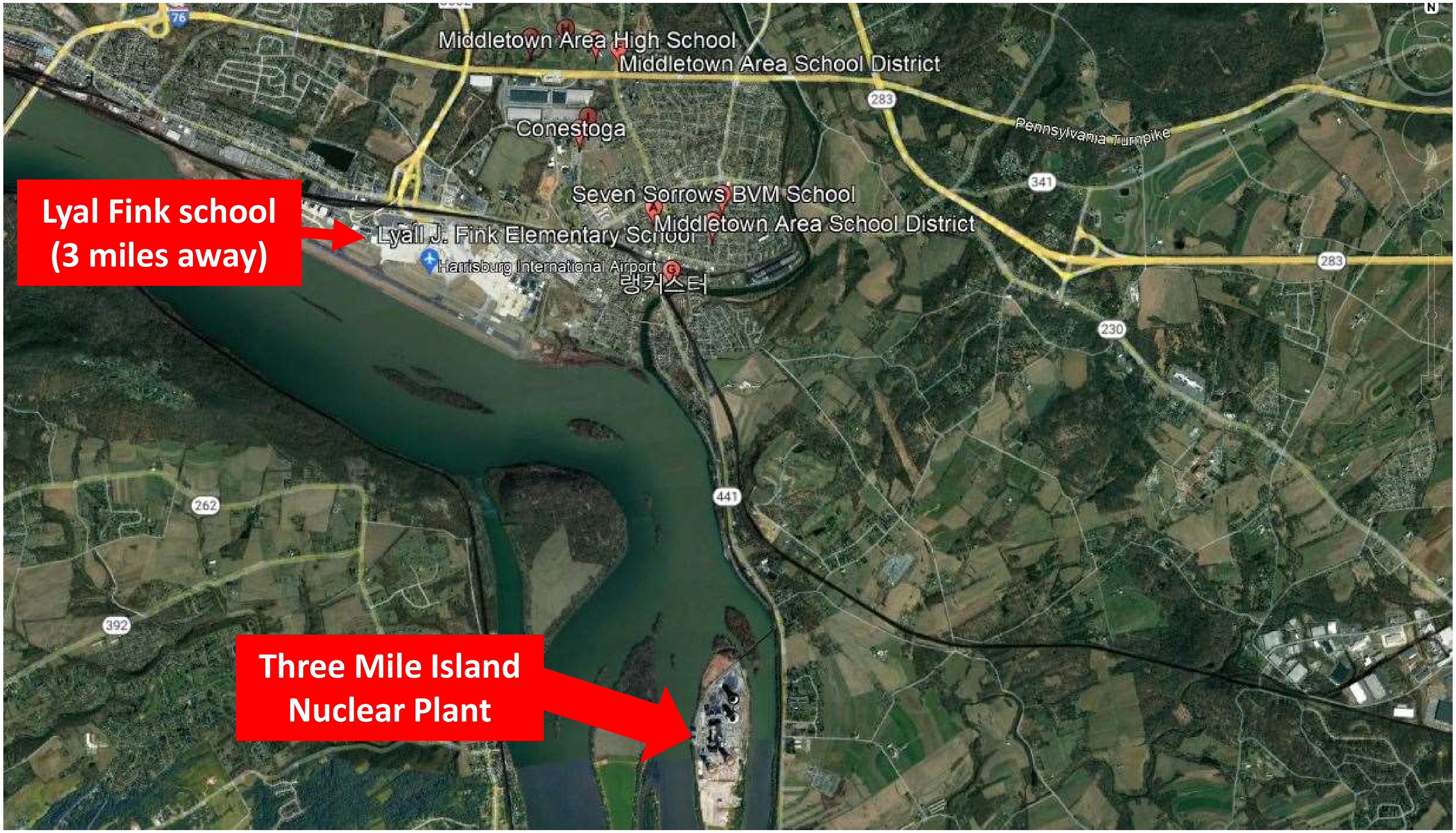


The annual radiation dose to nuclear plant workers significantly dropped when the reactor(s) at the plant ceased operating.

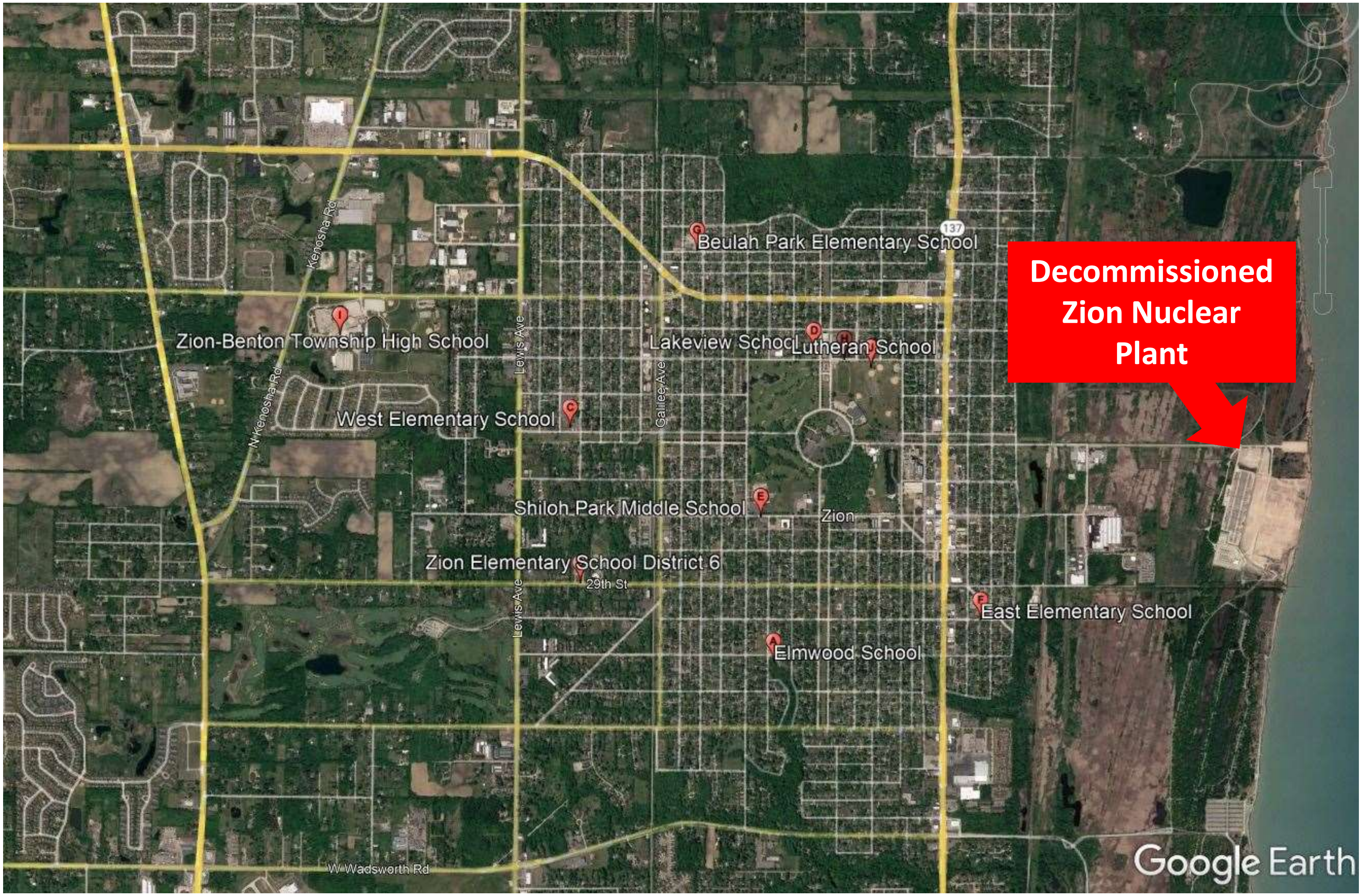
The annual radiation dose to nuclear plant workers dropped essentially to zero once all spent fuel was transferred into dry storage.

This reality reflects the NRC's relative risk profile over the life of a nuclear plant and is consistent with, or explained by, the decreasing energy and radionuclide inventories after a reactor permanently shuts down.

Source: [ML20087J424]



The worst accident in US nuclear power plant history caused nearby schools to be closed for about two weeks. But during the ensuing cleanup over the next decade, the schools pursued education as usual. There were at least two air monitoring systems maintained by citizens after during decommissioning. No high readings, other than a handful of very short duration anomalies, were ever detected.



East Elementary School – 1 mile away

Shiloh Park Middle School - 2 miles away

Elmwood School – 2 miles away

Beulah Park Elementary School – 2 miles away

West Elementary School – 2 miles away

The Zion nuclear plant in Illinois was built around the same time as Indian Point Units 2&3 with a very similar design. It has been decommissioned to greenfield (except for the dry storage) with several schools within two miles.

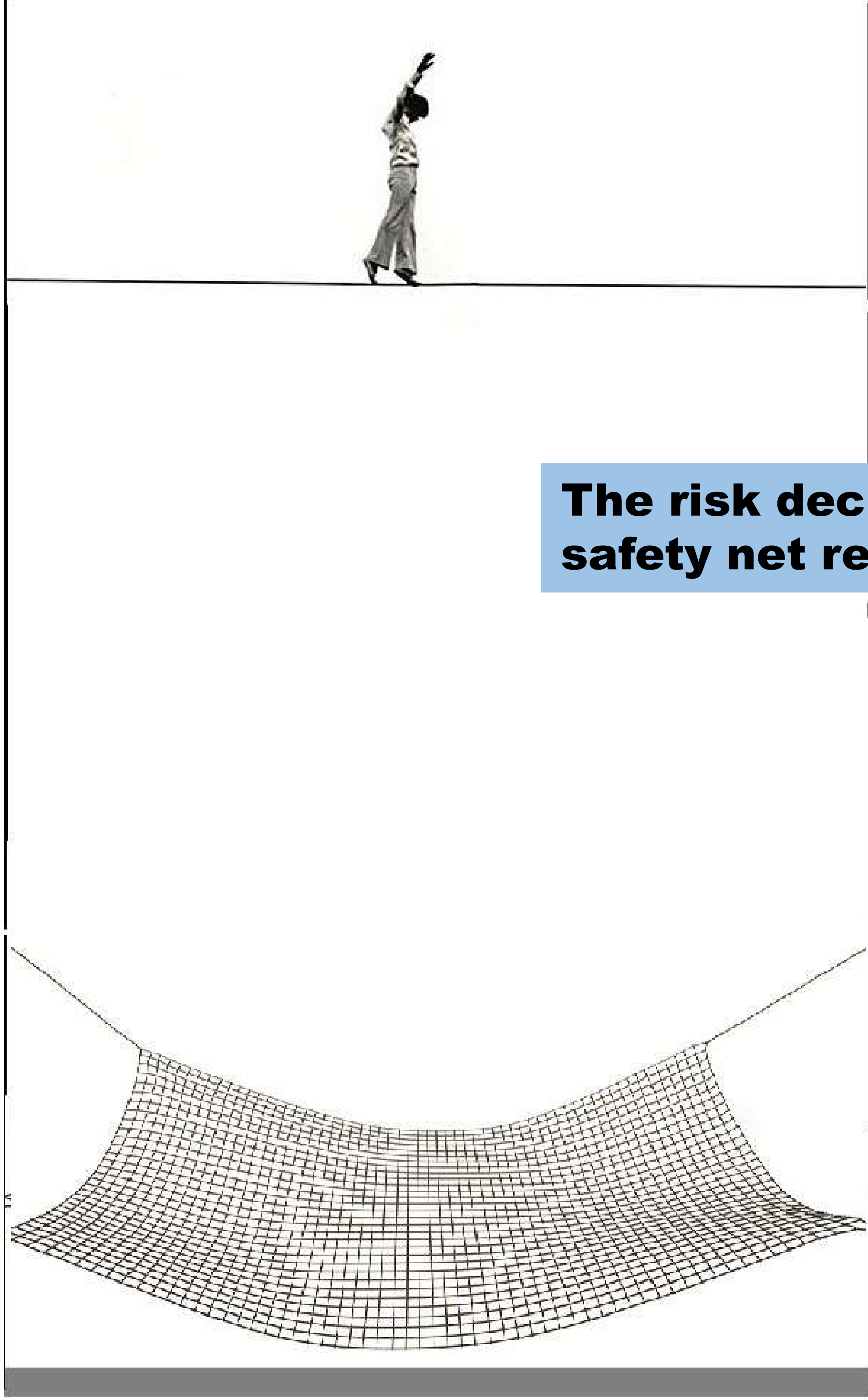
Summary

The energy level and radionuclide inventory is significantly higher when a nuclear reactor operates than after it permanently shuts down. The nuclear risk decreases as a direct result.

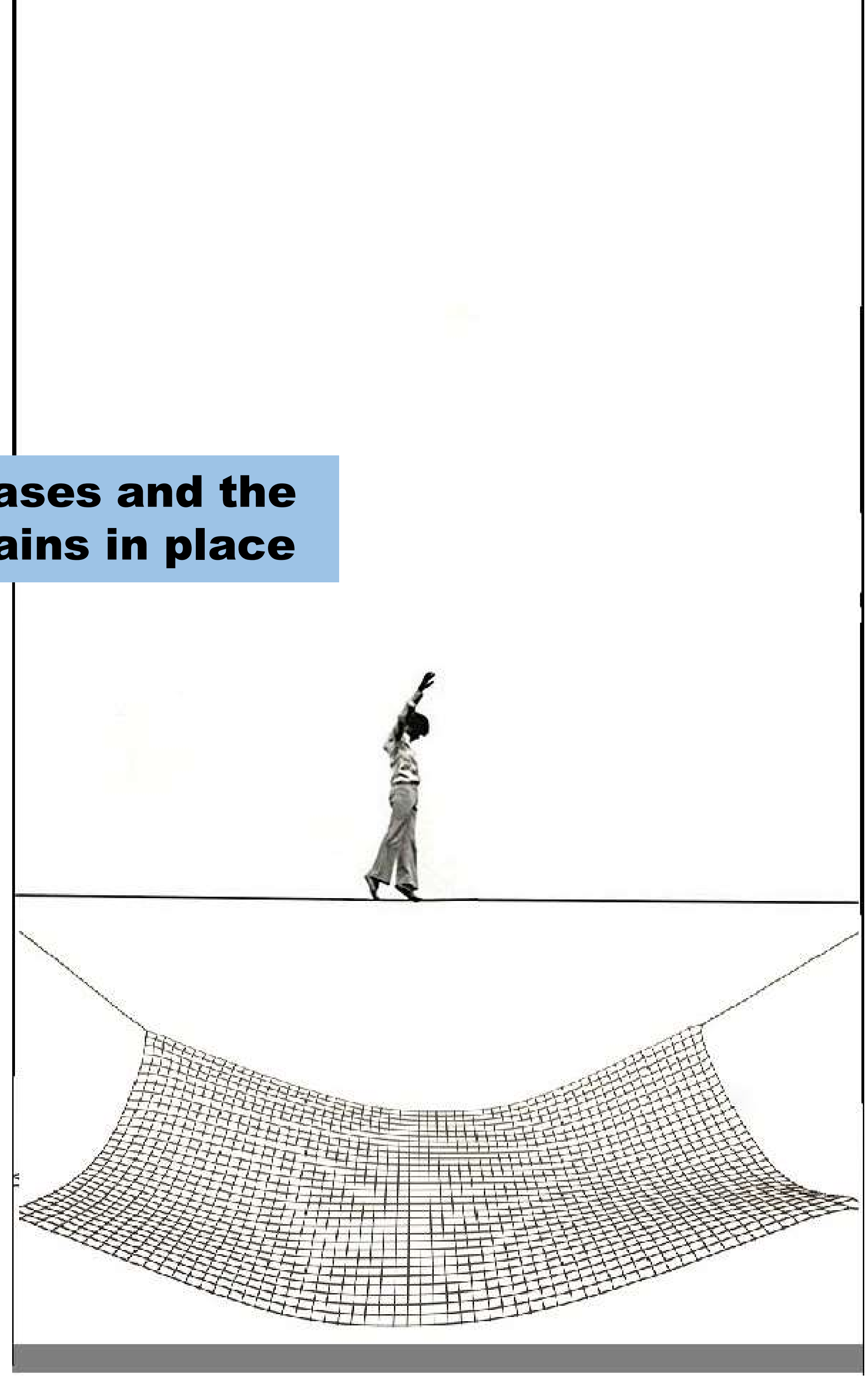
The federal regulations for radioactivity releases to the environment, radiation monitoring, and offsite sampling remain the same during decommissioning as they were during reactor operation.

The margin to the federal limits increase every day after a reactor permanently shuts down.

Operating Reactor Risk



Decommissioning Reactor Risk



The risk decreases and the safety net remains in place

Glossary

Dry cask: A system using a sealed metal canister to hold spent fuel assemblies placed within a concrete cask. Heat conducted through the canister's wall is removed by air flow (i.e., the chimney effect).

Effluent: The release of air or water to the environment from Indian Point systems and structures.

Millirem: A measure of the amount of exposure from radioactive particles and energy waves.

Radionuclide: An unstable atom that seeks stability via the emission (also called decay) of a particle (e.g., alpha, beta, neutron) or energy wave (e.g., gamma ray).

Reactor: The energy source for a nuclear power plant comprising the nuclear fuel (uranium) and associated equipment.

Reactor scram: Also called a trip, a scram is the insertion of control rods into the reactor's core within seconds to terminate the nuclear chain reaction.

Spent fuel pool: A water-filled pit containing fuel assemblies discharged from the reactor core. The spent fuel pool's water is cooled to remove heat generated by the decay of radioactive byproducts in the spent fuel.