

RISING CANCER INCIDENCE NEAR NEW YORK STATE NUCLEAR POWER PLANTS SINCE STARTUP OF REACTORS

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Executive Summary

Six nuclear reactors are currently operating in New York State. Two are at the Indian Point plant in Westchester County (started 1973 and 1976). Four others are on Lake Ontario, including one at the James Fitzpatrick plant in Oswego County (1974); two at the Nine Mile Point plant in Oswego County (1969 and 1987); and one at the R. E. Ginna plant in Wayne County (1970).

All six reactors (other than Nine Mile Point unit 2) are among the oldest of 98 reactors currently operating in the U.S. A tentative agreement signed by New York State would shut down the Indian Point reactors in spring 2020 and spring 2021. A 2016 law allows electric utilities to increase rates \$7.6 billion over 12 years, with virtually all of it going to operators of the upstate nuclear plants.

Nuclear plants routinely release over 100 radioactive chemicals into the environment/food chain – chemicals only created in reactor operations or atomic bomb explosions. Just one federal study of cancer near U.S. plants has been conducted, a review of cancer mortality trends from 1950 to 1984.

This report is the first of trends in cancer cases near New York State nuclear plants, comparing trends in local county(ies) with the state, for five-year periods, from 1976-1980 to 2011-2015.

1. Indian Point. In 1976-1980, cancer incidence in the four counties closest to Indian Point was 20.5% BELOW the state rate. By 1996-2000, the local rate was 4.0% ABOVE the state, and since then has been 1 to 4% ABOVE the state. If the local rate had remained at 20.5% below the state rate over the following 35 years, 56,012 fewer cancer cases would have occurred (“excess” cases).
2. Fitzpatrick and Nine Mile Point. In Oswego County, the 1976-1980 cancer incidence rate was 52.9% BELOW the state rate. By 1986-1990, the county rate had surpassed the state rate (2.0% ABOVE); and in the five-year periods in the 21st century, had risen to 12.3%, 8.7%, and 9.1% ABOVE the state. Total excess cases from 1981-2015 were 10,793.
3. R. E. Ginna. In Wayne County, the 1976-1980 cancer incidence rate was 28.6% BELOW the state rate. By 1986-1990, the county rate had surpassed the state rate (7.5% ABOVE), and has ranged from 3.6% to 6.6% ABOVE since then. Total excess cases from 1981-2015 were 5,020.

These significant and unexpected trends near each of the nuclear plants are not just statistically significant but raise the question of whether radioactive emissions from the reactors have harmed local residents. More studies are warranted, and any discussion of the future of New York nuclear plants must consider public health issues, not just financial ones.

Introduction

In the 1950s, after atomic power was used on human targets in Japan, and the United States and Soviet Union became in a race to develop thousands of nuclear weapons, other uses of the atom were proposed. One of these potential uses was electrical power, that could be generated using uranium-235 atoms. The United States government was enthusiastic about this new technology, which could produce electricity using other methods than the standard (and dirty) coal and oil – as well as assuage fears about nuclear war.

In New York State, numerous proposals for nuclear plants were made. Six of these eventually were built and are still operating (Table 1):

Table 1

<u>Reactor</u>	<u>Site</u>	<u>Proposed</u>	<u>Startup</u>	<u>Shutdown</u>
Indian Point 1	Buchanan NY	1955	1962	1974
Indian Point 2	Buchanan NY	1966	1973	
Indian Point 3	Buchanan NY	1967	1976	
James A. Fitzpatrick	Scriba NY	1968	1974	
Nine Mile Point 1	Scriba NY	1963	1969	
Nine Mile Point 2	Scriba NY	1971	1987	
R.E. Ginna	Ontario NY	1965	1969	
Shoreham	Brookhaven NY	1967	1985	1989

Indian Point units 2 and 3 are located on the Hudson River, just 23 miles north of the New York City border (and 35 miles north of Times Square in Manhattan). Among the reactors on Lake Ontario, Fitzpatrick and Nine Mile Point are in Oswego County, while Ginna is in Wayne County.

Nuclear reactors operate by bombarding uranium-235 atoms with neutrons in the reactor core. This process, known as fission, is identical to nuclear weapons explosions. It is performed in reactors with the presence of large amounts of cooling water, which is converted into steam (and eventually electricity). The cooling water also contains the temperature, preventing the onset of a catastrophic meltdown, such as those at Chernobyl in 1986 and Fukushima in 2011.

The fission process also creates over 100 chemicals not found in nature, but only created when nuclear reactors operate and when a nuclear weapon is detonated. Most of these chemicals are stored on the site as radioactive waste, but some is routinely released into the air and water as a condition of operating reactors.

Once released from reactors, the chemicals enter the food chain (water, milk, plants and animals) and thus enter the human body. Each chemical takes a different pathway once in the body. For example, radioactive iodine seeks out the thyroid gland; strontium seeks out the bone and teeth; and cesium seeks out the soft tissues throughout the body. They decay at different rates. The half-lives of Iodine-131 (8 days), Strontium-90 (29 years), and Plutonium-239 (24,000 years) illustrates this variety (after about 10 half-lives, the chemical is considered disappeared).

These chemicals are all radioactive and cause cancers of different types radiation exposure can cause cancer in any human, but exposures are especially harmful in the developing fetus, infant, and young child. Each of them has an immature immune system to fight radiation’s unhealthy effects, and their cells are dividing rapidly, much more rapidly than adult cells, so damage to one cell will be more widespread in the very young.

Calculating the total amount of radiation released from a reactor is virtually impossible, because of the complexity of measuring each individual chemical in each type of release (air, water, soil, etc.). However, certain data suggest several New York State plants may have been among those that released the most radiation. Table 2 shows the amount of airborne Iodine-131 and particulates from 1970 to 1987; of the 72 U.S. nuclear plants that operated during that time, Nine Mile Point/Fitzpatrick (both in Oswego County) was 5th highest, and Indian Point was 6th highest – even greater than the amount reported at Three Mile Island during the 1979 partial meltdown. (3)

Table 2
 Highest Airborne Emissions, Iodine-131 and Particulates
 Of 72 U.S. Nuclear Power Plants, 1970-1987

<u>Plant</u>	<u>State</u>	<u>Curies Released</u>
1. Dresden	IL	95.58
2. Oyster Creek	NJ	76.80
3. Millstone	CT	32.64
4. Quad Cities	IL	26.79
5. Nine Mile Point/Fitzpatrick	NY	17.95
6. Indian Point	NY	17.46
7. Three Mile Island	PA	14.41
. . .		
R.E. Ginna	NY	0.44

An obvious public health issue posed by nuclear power plants is what, if any, changes in disease rates have occurred in the local area after the startup of the two large reactors in 1973 and 1976.

Methods

Defining a “local” area near nuclear reactors, where residents can be expected to be exposed to the greatest volume of emissions, is an inexact process, as airborne radiation can be propelled in

multiple directions, and the exposures by breathing or by ingesting contaminated food and water, in the county where the plant is located, or those in the nearest counties, specifically:

1. Indian Point. Four counties in New York State (Orange, Putnam, Rockland, and Westchester) flank the plant, and nearly all 1.8 million residents are within 20 miles of Indian Point.
2. Nine Mile Point/Fitzpatrick. Oswego County, with an approximate population of 120,000, is the site of the Nine Mile Point and James Fitzpatrick plants, and thus its residents are at greatest risk of exposure from releases.
3. R.E. Ginna. Wayne County, with an approximate population of 90,000, is the site of R.E. Ginna, and thus the greatest exposures from the plant are to county residents.

The “control” area, in which no exposures or much lower exposures from nuclear plants occur, will be the state of New York, most of whom live over 20 miles from any reactor.

The New York State Cancer Registry has made cancer incidence and mortality data available on its web site. This report will use cancer incidence (cases) rather than cancer mortality (deaths) for analyzing potential Indian Point cancer risk. The effects of environmental toxins are more accurately detected when using incidence data; geographic differences in access to and quality of medical care can affect mortality.

The report will use all cancers combined as a basis for assessing any potential link between Indian Point and cancer risk. The registry includes 23 individual cancers, which would be helpful in any follow-up report if indicated.

The registry provides historical data for five-year periods, according to when cases were diagnosed. Moreover, cases are assigned to the county of residence of the person diagnosed at the time of diagnosis. The earliest data is the period 1976-1980, and the latest five-year period is 2011-2015 (as of April 2019).

The registry provides the number of cancer cases for five-year groups, along with the rate (number of cases per 100,000 population). The rates are age-adjusted to the 2000 standard U.S. population, using five-year groups (age 0-4 up to age 80-84, age 85 and over). This adjustment, used as a standard in epidemiological research, ensures an “apples to apples” comparison by period and by geographic area; failure to make such an adjustment would mean that an area with an unusually large percentage of elderly residents (with high cancer rates) would always have higher rates.

For Indian Point, the four-county rate will be a highly accurate estimate, i.e. the sum of the rates of each county weighed by its proportion of the four-county population. These weights include Orange County (21.3%), Putnam County (5.6%), Rockland County (18.4%), and Westchester County (54.8%).

“Excess” numbers of cancer cases will be calculated for each of the three study areas, based on the assumption that the 1976-1980 local/state ratio will be unchanged for each of the seven five-

year periods thereafter. For each period, the actual ratio will be subtracted from the 1976-1980 ratio, then multiplied by the actual cases in the five-year period; each of these seven products will be added to produce 1981-2015 “excess” cases.

Results

Indian Point. The incidence rate of all cancers, by five-year period for the past four decades, for the four counties nearest Indian Point and for New York State, is provided in Table 3.

Table 3

Incidence, All Cancers Combined
 Four New York Counties Closest to Indian Point
 Compared to Total New York State
 By Years of Diagnosis, 1976 – 2015

<u>Year Diagnosed</u>	<u>4 Counties</u>		<u>NY State</u>		<u>% Cancer Rate 4 Co. vs. NYS</u>	<u>Excess Cases*</u>
	<u>Rate</u>	<u>Cases</u>	<u>Rate</u>	<u>Cases</u>		
1976 – 1980	320.8	22,071	403.7	339,008	- 20.5	----
1981 – 1985	365.8	26,376	426.0	367,549	- 14.1	1,691
1986 – 1990	417.3	31,009	440.2	389,622	- 5.2	4,756
1991 – 1995	468.7	36,415	476.2	433,678	- 1.6	6,910
1996 – 2000	513.3	41,888	493.7	466,370	+ 4.4	10,268
2001 – 2005	512.1	44,787	490.6	490,266	+ 4.0	11,162
2006 – 2010	509.0	47,713	498.3	542,058	+ 2.1	10,829
2011 – 2015	481.0	48,966	477.7	539,988	+ 0.7	10,395
Total 1981-2015 (after baseline)		277,154				56,012 (20.2% excess)

Rate = Cases per 100,000 population, adjusted to 2000 standard U.S. population

**Excess Cases = Rate difference x 4-county cases. Example: 1981-1985 excess cases = [(-20.5%) – (14.1%)] x 26,376 = 1691.

The above table shows that in the baseline period 1976-1980, the local cancer incidence rate was -20.5% below the state. For each of the next four five-year periods, the difference declined, until reaching 4.4% above the state in 1996-2000. For each five-year period since then, the area rate has remained slightly above the state (+4.0%, 2.1%, and +0.7%).

In the 35 years after the baseline period (1981-2015), a total of 277,154 cancers were diagnosed among residents of the four counties closest to Indian Point. The shift from a low-cancer to a high-cancer area means **56,012, or 20.2% of cancer cases are considered “excess” cases.** The

extremely large number of cases, both local and state, make all findings in Table 3 statistically significant.

Nine Mile Point/Fitzpatrick. Table 4 shows the changes in cancer incidence rates since 1976-1980 for Oswego County, the location of Nine Mile Point units 1 and 2, along with the James Fitzpatrick nuclear reactor.

Table 4

Incidence, All Cancers Combined, Oswego County
Compared to Total New York State
By Years of Diagnosis, 1976 – 2015

<u>Year Diagnosed</u>	<u>Oswego Co.</u>		<u>NY State</u>		<u>% Cancer Rate Co. vs. NYS</u>	<u>Excess Cases*</u>
	<u>Rate</u>	<u>Cases</u>	<u>Rate</u>	<u>Cases</u>		
1976 – 1980	190.0	844	403.7	339,008	- 52.9	----
1981 – 1985	249.8	1175	426.0	367,549	- 41.4	123
1986 – 1990	449.2	2237	440.2	389,622	+ 2.0	1,228
1991 – 1995	473.5	2521	476.2	433,678	- 1.0	1,308
1996 – 2000	509.6	2841	493.7	466,370	+ 3.2	1,593
2001 – 2005	550.8	3290	490.6	490,266	+12.3	2,145
2006 – 2010	542.0	3471	498.3	542,058	+ 8.7	2,138
2011 – 2015	521.3	3643	477.7	539,988	+ 9.1	2,258
Total 1981-2015 (after baseline)		19,178				10,793 (56.3% excess)

Rate = Cases per 100,000 population, adjusted to 2000 standard U.S. population

**Excess Cases = Rate difference x 4-county cases. Example: 1981-1985 excess cases = [(-52.9%) – (41.4%)] x 1,175 = 123.

The above table shows that in the baseline period 1976-1980, the local cancer incidence rate was -52.9% below the state. In the next five-year period, the county rate was just 41.4% below the state, then jumped to 2.0% above the state. In the latest three five-year periods, the county rates were 12.3%, 8.7%, and 9.1% above the state.

In the 35 years after the baseline period (1981-2015), a total of 19,178 cancers were diagnosed among Oswego County residents. The shift from a low-cancer to a high-cancer area means **10,793, or 56.3% of cancer cases are considered “excess” cases**. Again, this total of excess cancers is statistically significant.

R.E. Ginna. Table 5 shows the changes in cancer incidence rates since 1976-1980 for Wayne County, the location of the R.E. Ginna nuclear reactor.

Table 5

Incidence, All Cancers Combined, Wayne County
 Compared to Total New York State
 By Years of Diagnosis, 1976 – 2015

Year Diagnosed	Wayne Co.		NY State		% Cancer Rate Co. vs. NYS	Excess Cases*
	Rate	Cases	Rate	Cases		
1976 – 1980	288.3	1038	403.7	339,008	- 28.6	----
1981 – 1985	334.5	1262	426.0	367,549	- 21.5	90
1986 – 1990	473.0	1877	440.2	389,622	+ 7.5	678
1991 – 1995	496.9	2091	476.2	433,678	+ 4.3	688
1996 – 2000	511.5	2316	493.7	466,370	+ 3.6	746
2001 – 2005	510.5	2502	490.6	490,266	+ 4.1	818
2006 – 2010	524.7	2816	498.3	542,058	+ 5.3	955
2011 – 2015	509.2	2968	477.7	539,988	+ 6.6	1045
Total 1981-2015 (after baseline)		15,832				5,020 (31.7% excess)

Rate = Cases per 100,000 population, adjusted to 2000 standard U.S. population

**Excess Cases = Rate difference x 4-county cases. Example: 1981-1985 excess cases = [(-28.6%) – (21.5%)] x 1,262 = 90.

The above table shows that in the baseline period 1976-1980, the local cancer incidence rate was -28.6% below the state. In the next five-year period, the county rate was just 21.5% below the state, then jumped to 7.5% above the state. In the latest five five-year periods, the county rates ranged between 3.6% and 6.6% above the state.

In the 35 years after the baseline period (1981-2015), a total of 15,832 cancers were diagnosed among Wayne County residents. The shift from a low-cancer to a high-cancer area means **5,020, or 31.7% of cancer cases are considered “excess” cases**. Again, this total of excess cancers is statistically significant.

Discussion

The long-term operation of six large nuclear reactors in New York State and the routine release of radioactive gases and particles into the environment raise the question of what, if any, adverse health consequences have occurred among the local population. Because the 100-plus radioactive chemicals produced in (and released by) reactors are all carcinogenic, it is logical to assess changes in cancer rates over time.

For each area closest to nuclear plants, the same pattern occurred, namely, the local rate was well below the state in the late 1970s, but rose rapidly to levels above the state, where they presently remain. In each area, the number of “excess” cancer cases were calculated, by subtracting the actual county/state ratio for each five-year period from 1981-2015 from the expected (the 1976-1980 ratio). These excess cases were 56,012 in the four counties closest to Indian Point; 10,793 in Oswego County, the site of Nine Mile Point and James Fitzpatrick; and 5,020 in Wayne County, the site of R.E. Ginna.

These data are statistically significant because of the large numbers of cases involved. Perhaps more importantly, the trends suggest a potential connection between exposures to radioactivity from reactors and increasing cancer among local residents. Because these data have not been previously presented, no other potential causes have been considered.

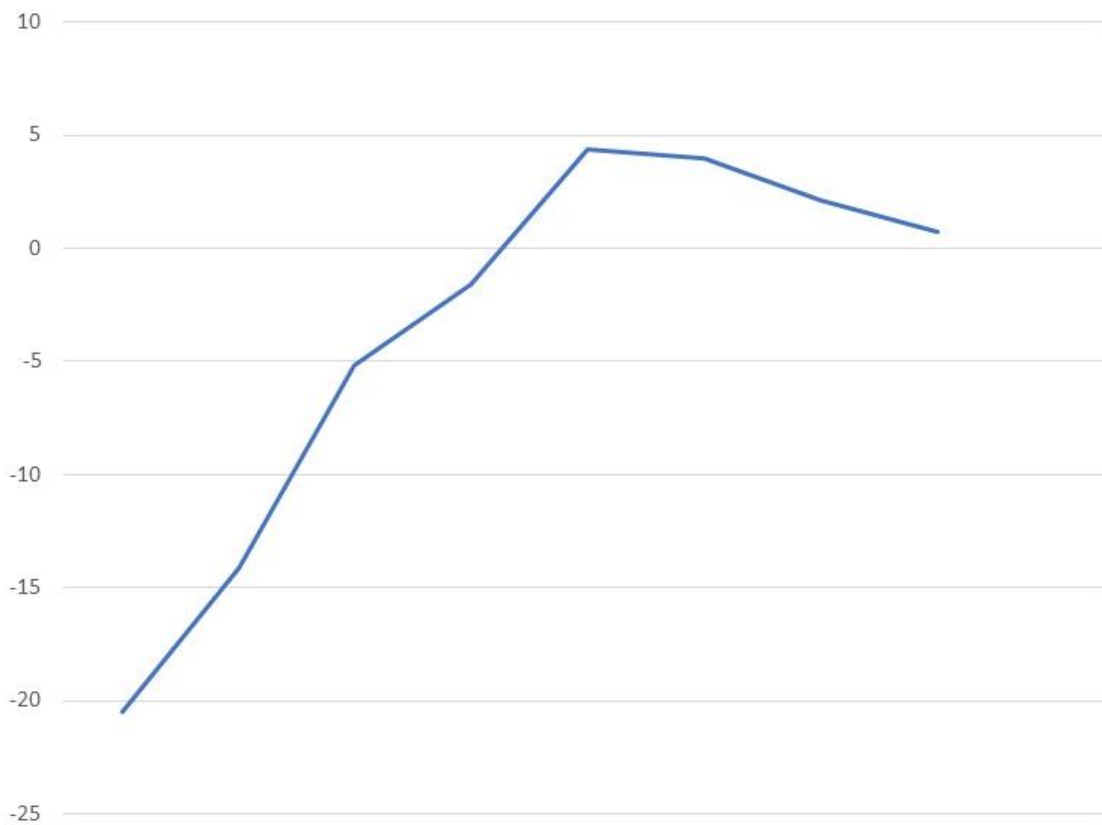
The information in this report underscores the need for additional and more detailed studies of this type, to better understand the cause(s) of the significant increases. Furthermore, any future public policies affecting nuclear plants in New York State must assign highest importance of potential health hazards from routine emissions of radioactivity.

An agreement between state government, industry, and advocates to shut the Indian Point reactors is approaching (Spring 2020 and Spring 2021). A 2016 law allowing upstate reactor operators to raise electric bills by \$7.6 billion over 12 years is now in effect. Both policies should strongly consider how much longer to allow operations of the aging reactors situated in areas with rising cancer rates.

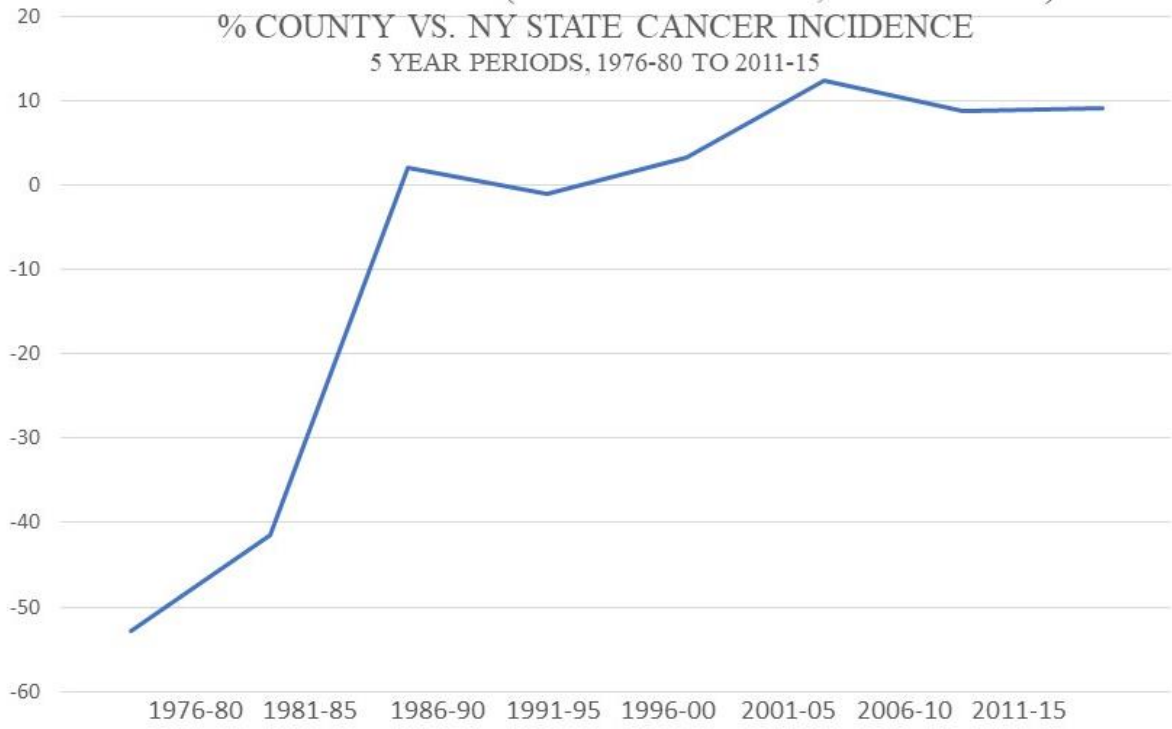
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4 COUNTIES CLOSEST TO INDIAN POINT
% LOCAL VS. NY STATE CANCER INCIDENCE
5 YEAR PERIODS, 1976-1980 TO 2011-2015



OSWEGO COUNTY NY (SITE OF 9 MILE PT., FITZPATRICK)
% COUNTY VS. NY STATE CANCER INCIDENCE
5 YEAR PERIODS, 1976-80 TO 2011-15



WAYNE COUNTY NY (SITE OF R. E. GINNA)
% COUNTY VS. NY STATE CANCER INCIDENCE
5 YEAR PERIODS, 1976-80 TO 2011-15

