PUTTING NEW YORKERS AT RISK

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ABOUT THE AUTHOR

Herschel Specter, President of Micro-Utilities, Inc., holds a BS in Applied Mathematics from the Polytechnic Institute of Brooklyn and a MS from MIT in Nuclear Engineering. He is a Licensed Professional Engineer in the State of New York. He has had a long association with the Indian Point nuclear power plants starting as a member of the Atomic Energy Commission (now the Nuclear Regulatory Commission) where he was the Licensing Project Manager for the original licensing of the Indian Point 3 nuclear plant in the 1970s. In the 1980s the New York Power Authority hired Mr.Specter to manage the defense of Indian Point 3 in a federal adjudicatory trial in the wake of the Three Mile Island nuclear accident in Pennsylvania. Prior to joining NYPA, Mr. Specter served at diplomat rank for 5 years at the International Atomic Energy Agency in Vienna, Austria where he headed up an international effort writing design safety standards for nuclear power plants.

Mr. Specter has been Chairman of two national committees on emergency planning and was a guest lecturer for several years on emergency planning at Harvard's School of Public Health. He led an effort as a consultant to Entergy analyzing emergency responses during a hypothetical terrorist attack on Indian Point. Mr. Specter has presented testimony at the National Academy of Sciences on the Fukushima accident and on other nuclear safety matters and has been a guest speaker at many universities on matters of energy policy. Today he is one of 14 Topic Directors in Our Energy Policy Foundation, a group of about 1500 energy professionals who seek to bring unbiased and comprehensive energy information to our political leaders and members of the public.

Mr. Specter was born in White Plains, NY and lives there now.

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1.0 EXECUTIVE SUMMARY

On January 9, 2017 many were shocked to learn that NY State, Entergy, and Riverkeeper had signed an Agreement to shut down the two operating Indian Point nuclear power plants by 2020 and 2021, respectively. On February 28, 2017, members of NY State's Legislature held a public hearing on this shut down Agreement. Representing the State of New York were Richard Kauffman, the State's "energy czar" and Audrey Zibelman, then head of the Public Service Commission.

These witnesses made three principle claims:

a. The electricity from Indian Point would be replaced by a combination of clean energy and greater energy efficiency achieved through the State's Clean Energy Standard (CES), i.e., there would not be any increase in emissions,

b. The overall reliability of New York's electricity system would be adequate, and

c. The main reason for shutting down Indian Point was a matter of safety.

Within a year all three claims were disproved.

On December 13, 2017 the New York Independent Systems Operator (NYISO) issued a report "Generator Deactivation Assessment Indian Point Energy Center". This NYISO report ruled out the use of renewable energy to replace Indian Point because of severe transmission constraints. *"Due to transmission constraints into the Lower Hudson Valley from upstate (Zones A-F) and Long Island (Zone K), additional resources in any other zone would not effectively resolve the deficiency."* The Indian Point plants will not be replaced by wind energy from upstate New York or proposed wind farms off of Long Island. **Indian Point will be replaced by a fossil fuel, natural gas.**

As to energy efficiency, Riverkeeper's sponsored report by Synapse Energy Economics made it clear that the State's Clean Energy Standard's goals are not being met.*"New York will require an aggressive energy efficiency policy framework in order to secure the improvements needed to obtain either the CES-assumed or the High efficiency assumed scenarios we model in this analysis."* Synapse goes on to say *"The levels of energy efficiency assumed in the CES order have no binding mechanisms, other than the ETIPS approved for each of the utilities. These ETIPs require only a small fraction of the 2,227 GWh annual incremental savings that are assumed in the CES order and reflected in the CES-assumed efficiency scenarios*

modeled herein. No such enforceable mechanism exists for NYSERDA or for the non-jurisdictional entities (NYPA,LIPA, and direct NYISO consumers." Not only are the CES goals not being met, further energy efficiency progress may be difficult. New York already has the lowest energy consumption per person per year in the whole nation. **Indian Point is not going to be replaced by greater energy efficiency.**

As to impacts on NY's overall reliability, the shutdown of the Indian Point plants must be viewed in the context of how this would affect New York City (NYC), the economic engine for NY State. NYC itself is facing a difficult electricity reliability situation. Major portions of NYC's electrical infrastructure are old and need to be replaced. By 2021,the time Indian Point 3 is scheduled to shut down because of this Agreement, about 2800 MW of NYC's electricity supply will be far beyond normal retirement age. By 2026, 41% of NYC's electricity supply, 4000 MW, will be beyond the age where 95% of the power plants using these technologies are retired.

Three new gas power plants under construction, with a total of 1818 MW of capacity, could be a partial answer to NYC's electricity reliability issue. However, they may instead be used to partially make up for the loss of 2060 MW of capacity at Indian Point. This would put NYC in even greater jeopardy. If, however, these same gas plants are used to bolster NYC, the loss of the Indian Point capacity would also precipitate significant reliability issues. **There does not seem to be even enough fossil fueled electricity to simultaneously meet NYC's growing reliability concerns and avoid major reliability issues caused by the loss of Indian Point capacity. An increasing amount of fossil fueled electricity will be needed year by year, beyond that supplied by these three gas plants, just to maintain the minimum level of reliability in the Lower Hudson Valley and NYC area. The sources of these fossil fueled additions have not been identified.**

The safety reasons put forward by NY State and by Riverkeeper to justify shutting down Indian Point are demonstrably false. **These plants are safe and the oft-repeated need to evacuate out to 50 miles in the event of an accident is a fiction.** Such a massive evacuation would be **a 1000 times too large** and a much greater hazard than any radiation effects. Ironically, Riverkeeper's own web site shows that the plants are safe and that no massive evacuation is warranted. This is demonstrated in the Main portion of this report.

This past year has revealed that the energy future of the State of New York is in disarray. The New York Independent Systems Operator, NYISO, is concentrating on

assuring reliability by building fossil fueled (principally gas) capacity. The Public Service Commission, PSC, is focussed on climate change and is concentrating on using energy efficiency and renewable energy to eliminate the use of fossil fuels. These opposite efforts largely cancel each other out, but at considerable expense. For example, one year of replacing Indian Point with natural gas would wipe out four years of GHG reductions from all of the present upstate wind turbines. Further, even if the State's REV program were fully implemented, it would only have a small effect on the release of GHG in NY. Only 18% of the GHG released by NY State comes from the electricity generation sector, the central effort of the REV program. The REV program needs to be greatly expanded so that it can concentrate on the other 82% of the released GHG.

Realistically, New York State is not particularly well suited for renewable energy. NY's wind and solar energy together only produced about 4% of the State's electricity in 2016. New York is not like sunny California nor like the windy Great Plains. Solar electricity in 2016 would only be enough to run the State for a bit more than three hours per year. The upstate wind turbines are not productive almost three quarters of the time. So now the State is turning to off-shore wind power and planning to build 240 to 300 gigantic wind turbines, 8 to 10 MW each, off of Long Island. Off-shore wind power has higher capacity factors than on-shore wind power, but has higher costs. The closest example NY has of large wind turbines are five recently completed 6 MW off-shore wind turbines near Block Island, Rhode Island. These wind turbines are twice the height of the Statue of Liberty and produce electricity at 24.4 cents per kilowatt-hour. 10 MW machines, like the Sea Titan design, have rotor blades that would reach about 725 feet into the air. A number of such huge machines are just coming into operation in Europe and none have been built in the United States. New York has no off-shore wind turbines, let alone huge off-shore wind turbines. The proposed "world's largest wind farm" would be 80 times larger than the expensive Block Island wind farm. Trying to go from zero off-shore wind farm experience to the world's largest off-shore wind farm in just 12 years, at a cost of billions of dollars, seems to be imprudent.

The burdens this January, 2017 Agreement places on New Yorkers must be removed. A second public hearing with Mr. Kauffman and the new head of the PSC, Mr. John Rhodes, should be held on how the Agreement needs to be modified in light of this new information.

2.0 BACKGROUND

A year has passed since New York State signed an Agreement with Entergy and Riverkeeper to shut down Indian Point 2 on April 30, 2020 and Indian Point 3 on April 30, 2021. One of the stated purposes for this interim period of time was for task forces to try to resolve the many questions left unanswered by this Agreement. Towards that end the following list provides insights that are not generally known about the safety of Indian Point and highlights some of the new information that has come forth in this past year:

A. The most important new information was the report issued by NYISO on December 13, 2017. NYISO would use three new gas plants under construction (1818 MW, combined) to partially replace the Indian Point (2060 MW, combined) electricity output. The use of a fossil fuel to replace Indian Point is in direct conflict with promises made by NY State to use non-carbon renewable energy and improved efficiency to replace Indian Point. Replacing the Indian Point plants with gas would release at least 7.6 million metric tons of carbon dioxide each year into the atmosphere. This greenhouse gas would remain in the atmosphere for over 1000 years. It would take all the existing upstate wind turbines four years to offset one year's worth of GHG releases from gas-fired power plants, if used to replace Indian Point.

B. The above NYISO report ruled out the use of renewable energy to replace Indian Point because of severe transmission constraints. To quote the report "Due to transmission constraints into the Lower Hudson Valley from upstate (Zones A-F) and Long Island (Zone K), additional resources in any other zone would not effectively resolve the deficiency." Based on this NYISO conclusion, all Indian Point replacement electricity would have to be generated within the Lower Hudson valley and New York City.

C. New York City is facing a severe electrical infrastructure problem as many of its power plants are beyond the point where they would normally be retired. Already some 22% (2100 MW) of NYC's electricity sources are beyond the age where 95% of the plants with this technology are retired. By 2026 this over-aged group increases to 41% (4000 MW). For combustion turbines the 95% retirement age is 46 years and for steam turbines the 95% retirement age is 63 years. Using three gas plants now under construction for a total of 1818 MW is already less than the 2100 MW of present capacity that is over-aged. New York City is the economic engine for New York State. Degraded economic conditions in NYC would have a negative effect throughout the whole

State of New York. **Using these gas plants to partially replace the Indian Point plants instead of bolstering NYC would increase the economic risks to NYC and therefore to NY State.**

D. Because of the severe transmission constraints NYISO has identified, renewable electricity from upstate New York and Long Island will not be available to replace these NYC over-aged power plants. If the three gas plants under construction were used to partially replace over-aged plants in NYC instead of being used to partially replace Indian Point, this would precipitate an immediate shortfall of 100 MW in 2021, the first full year after the retirement of Indian Point 2. The next year, 2022, the first full year after the retirement of Indian Point 3, this shortfall would increase to 200 MW. By 2027 the shortfall would increase to 400 MW to 600 MW. NYISO did not identify specific actions it would take to overcome these shortfalls, nor did it report on what it would do if over-aged NYC gas plants retirements exceeded the 1818 MW simultaneously with the closure of the Indian Point plants. Even meeting this shortfall does not return the State to the present level of reliability with Indian Point operating. **At best, meeting this shortfall brings the State to the lowest acceptable level of reliability.**

E. NY State's REV program is far too small. New York State's 2050 energy goal calls for an 80% reduction in the release of GHG from all sources. **New York State will never meet its 2050 GHG energy goal if it stays on its present path.** Some 82% of the GHG released in 2014 in New York came from the end use sectors of transportation, residential, commercial, industrial, and others. Electric power production was only responsible for 18% of the 2014 GHG release and the REV program through 2030 is focussed on just reducing a fraction of this smaller release. Even if successful, the REV program would hardly move the GHG release "needle".

F. **New York State lacks a comprehensive and coherent energy plan.** NY State, on one hand, it is promoting renewable energy and greater efficiency to combat climate change. On the other hand it is increasing the role of natural gas, a fossil fuel, to provide reliability. These opposite efforts tend to cancel each other out environmentally, but at great expense. A failure by the State to effectively deal with climate change will make the present New York City subway crisis look like a mere inconvenience.

G. Riverkeeper's website inadvertently demonstrated that the Indian Point plants are safe and that a massive evacuation out to 50 miles would be too large by a

factor of about **1000**. The need to evacuate out to 50 miles is a fiction. Evacuation out to two miles with downwind sheltering beyond two miles would be simple and highly effective. If there were a serious accident at Indian Point, **zero** near term off-site radiological health effects would be expected and off-site long term radiation effects, if any, would be **too small to be detected. Typical off-site accident radiation exposures would be similar to what people get every one to two years from normal background radiation plus medical procedures.** Such extremely low radiological consequences are consistent with analyses performed by our National Laboratories and with measured radiation exposures from the Fukushima multi-nuclear reactor accident in Japan.

H. The Indian Point containment buildings are among the strongest structures in the United States and are unlikely to fail from any earthquake in its vicinity. They would be the last buildings standing. Nuclear containment buildings in Japan withstood an earthquake greater than magnitude 9. The direct consequences of large earthquakes far exceed any potential radiological consequences. The direct consequences of the huge earthquake and subsequent tsunami that affected Fukushima was over 18,000 deaths, but there were zero deaths from the limited amount of radioactive material released from the damaged power plants.

I. A report by Synapse Energy Economics, Inc., sponsored by Riverkeeper and the Natural Resources Defense Council[1], has several fundamental errors and can not be used with confidence. Riverkeeper's comments[2] on NYISO's December, 2017 reliability analysis omits the critical transmission constraint statements made by NYISO and repeats a number of the errors contained within the Synapse report.

J. Entergy had announced that it was going to shut down its Palisades plant in Michigan by October, 2018 but has now extended this to April, 2022 after receiving a payment of about $137 million dollars from the Michigan Public Service Commission. Entergy has consistently announced that its reason for closing down Indian Point is financial and that the plants are safe.

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[1] "Clean Energy for New York", Synapse Energy Economics, Inc., Feb.23, 2017

[2] "Checking it twice: Grid operator says that electric system reliable without Indian Point", Riverkeeper 12/15/2017

K. Congresswoman Nita Lowey, Ranking Member of the House Appropriations Committee, introduced legislation, the "Removing Nuclear Waste from Our Communities Act", (H.R. 4442), to expedite the removal of spent fuel rods to interim nuclear waste storage facilities elsewhere in the country. Had this legislation been introduced and enacted years ago it is possible that interim or permanent nuclear waste storage facilities would exist today. Consequently, the complete removal of radioactive material from the Indian Point site is likely to take many years if these plants are shut down on their present schedules.

L. NY State, along with Vermont, Massachusetts, and Connecticut, have been lobbying the Nuclear Regulatory Commission to tighten its financial rules and broaden its cost projections for decommissioning nuclear plants[3]. These states argue that the 60-year decommissioning schedule allowed under NRC's SAFSTOR program should be reduced to 10 years. It has not been explained why the Agreement reached by NY State, Entergy, and Riverkeeper did not require Entergy to complete the decommissioning process in ten years.

3.0 MAIN REPORT

Within New York State itself, the Indian Point nuclear power plants are the only sources of clean electricity within hundreds of miles of New York City (NYC) that simultaneously and safely produce carbon-free electricity, do not release air pollutants, and provide a large, reliable, and dispatchable amount of electricity at a reasonable cost. The Indian Point nuclear power plants are major economic assets which provide both jobs and tax revenues. As such, operating the Indian Point plants is consistent with the economic, health, and environmental goals that would be part of a comprehensive and coherent energy plan. Yet, these are the very same plants that face shutdown in just a few years based on fictitious claims about their safety and their emergency plan.

This report examines four possible energy scenarios to determine their ability to **simultaneously** meet economic, health effects, and environmental objectives.

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[3] "Vt. Fears Covering Nuclear Cost", Mike Faher, VTDIGGER, March 24, 2016

The first scenario review's NYISO's December 13, 2017 response to shutting down Indian Point. This review concentrates on NYISO's analysis of transmission constraints and on meeting State reliability criteria.

The second scenario examines three publications by Riverkeeper. First, there is a report by Synapse Energy Economics, Inc., sponsored by Riverkeeper and the Natural Resources Defense Council[4]. This report, inadvertently, shows that the State's 2050 environmental goal will not be met. Second, there is an analysis of the commentary made by Riverkeeper on NYISO's December 13, 2017 report. Third, there is a rebuttal of Riverkeeper's claims that Indian Point is unsafe because of an inability of off-site emergency actions to adequately respond to a serious accident or for Indian Point to survive a major earthquake initiated at the Ramapo Fault. A figure published by Riverkeeper itself on its own web site depicting a hypothetical accident at Indian Point is used to refute its inadequate emergency response claims.

The third scenario examines the efforts by the Public Service Commission (PSC) to deal with climate change. This third scenario shows that the PSC's efforts to meet the State's 2050 energy goal of an 80% reduction in the release of GHG from all sources are far too small. Results from a scoping study are provided to indicate what would really be needed to meet the 2050 goal.

The fourth scenario concentrates on local issues and what might be done to adjust the Agreement to relieve the burden placed people and governments affected by this ill-advised closure of Indian Point. Other energy-related issues that pose risks to New Yorkers are discussed in the fourth scenario.

3.1 SCENARIO ONE: NYISO's Response to the Indian Point Closure

3.1.1 Introduction

Part of NYISO's mission is to serve the public interest by maintaining and enhancing regional reliability. This has largely been accomplished by adding new gas fired generation. In some cases older coal plants have been refurbished to operate on natural gas. Replacing coal with natural gas supports NYISO's reliability goal and reduces the release of GHG since gas is less carbon intensive than coal per kilowatt-

[4] "Clean Energy for New York", Synapse Energy Economics, Inc., Feb.23, 2017

hour. With coal virtually phased out of New York's electricity supply, further coal-to-gas replacements seem unlikely. NYISO has also replaced older gas plants with more efficient newer gas plants. This bolsters the system's reliability and can yield a very small GHG benefit. However, using gas to replace a nuclear power plant is something NYISO has never dealt with before and is a set back in meeting the climate change challenge.

It will be interesting to see if other State agencies, like the Public Service Commission or the Department of Environmental Conservation or the Governor's Office object to NYISO's planned use of a fossil fuel to replace Indian Point. In justifying subsidies to upstate nuclear power plants the Public Service Commission said[5] "*Given the current economic realities, every baseload MWh of zero-emission power from these units that is lost would be replaced with power generated with significant levels of CO2 and other unwanted air emissions from existing mothballed fossil-fueled units in the State or new gas-fired generation.*" The PSC warning is also true for Indian Point as illustrated by NYISO's plans.

NYISO[6] stated in its 2017 Power Trends report: "*On January 9, 2017, Entergy and Governor Cuomo announced an agreement to close Indian Point units 2 and 3 by 2020 and 2021, respectively. The NYISO will perform the appropriate reliability impact analysis for this scenario through a Generation Deactivation Assessment as well as the 2018 Reliability Needs Assessment. Using the most up-to-date information of the resource mix, system conditions, and forecasted needs in New York, the NYISO will conduct its studies and provide federal and state policymakers, market participants, investors, and the public with clear information to determine the impact of the Indian Point retirement. If a reliability need is revealed, the NYISO will address the need through market-based solutions or with a regulated solution, if necessary.*" NYISO followed through on this commitment and published a report, described below, on December 13, 2017.

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[5] "Subsidies Proposed for New York's Upstate Nuclear Power Plants", Aaron Larson, Power Magazine, 07/12/2016

[6] NYISO "Power Trends, New York's Evolving Electric Grid 2017", page 22.

3.1.2 Transmission Constraints

The December 13, 2017 NYISO report stated **"Due to transmission constraints into the Lower Hudson Valley from upstate (Zones A-F) and Long Island (Zone K), additional resources in any other zone would not effectively resolve this deficiency."** This sentence by NYISO is profoundly important. One might visualize the lower Hudson area as surrounded by a "wall" through which further transmission of electricity would be difficult. However, the Indian Point power plants are located within this "wall" and the transmission system it uses is already in place. Indian Point, long criticized for its location in a high population density area, is safe, ideally located, and does not face these transmission constraints.

If NYISO's transmission constraints are correct, it means that upstate wind power can not be fully delivered to the Indian Point service area. Upstate New York produces about 60% of the State's electricity but only has about 40% of the State's electricity demand. If transmission constraints prevent upstate wind power from reaching the downstate areas, the 1600 additional planned new upstate wind turbines may be judged to be uneconomical, especially in an age of low natural gas prices. If the electricity produced by upstate wind turbines can not reach into the lower Hudson Valley, are there enough electric loads upstate to justify the construction of these new wind turbines? State energy leaders bemoan the fact that, on an annual basis, about 44% to 46% of the State's electrical capacity is idle. Yet the upstate wind turbines are idle about three quarters of the time because of their low, 26%, capacity factor. New York is not in the Great Plains where wind turbine capacity factors are often over 40%.

Some wind power from Long Island's off-shore wind farm sites might eventually be available to replace a portion of the Indian Point electricity if an underwater cable from a possible wind farm off of the Rockways could bypass the transmission constraint in Zone K that NYISO refers to. At best, this would take years to become a reality and would not be available to deal with impending shortfalls, discussed below. Based on conversions[7] with NYSERDA, the earliest time that 90 MW from off-shore wind power electricity might be generated is at the end of 2022. Therefore the off-shore wind turbines will not be available to replace electricity from the Indian Point plants in 2020 to 2021 time frame.

[7] Matt Vestal, NYSERDA, to Herschel Specter, December 20, 2017

Transmission constraints in New York has long been recognized. In addition to the economic and physical barriers associated with these transmission lines, there is significant public opposition[8] as witnessed when the State's attempted to install an "Energy Highway".

NYISO reported[9] *"In 2016, the Central East interface limited flows of energy from upstate to downstate 53% of the time in the NYISO's Day-Ahead Market, limiting the delivery of clean energy resources to meet downstate energy needs."* The Central East interface is in the westernmost area of the State. Other transmission constraints closer to the Lower Hudson Valley also exist.

In an article published[10] by the New York Times the following was quoted: *"New York is the poster child for congestion"*, said Bill Booth, a senior advisor to the United States Energy Information Administration.

The NY Times article goes on to say:

"*But building new power lines is fiercely unpopular. Residents don't want high voltage lines in their backyards, and local power generators dislike competition from cheaper power brought in from farther away. Even if the lines are below ground, like the ones that bring power to Manhattan from New Jersey through the muck of the Hudson River, securing federal and state permits can take years. One project to bring hydropower from Quebec to New York City under Lake Champlain and the Hudson has been in the works since 2008.*

Despite enhancements, the transmission grid is aging. More than 80% of the lines went active before 1980, and NYISO estimates that almost 5000 miles of high-voltage transmission lines will have to be replaced in the next 30 years at a cost of about $25 billion dollars"

The transmission problems discussed in the above NY Times article are especially important to the planned shutdown of Indian Point. In 2014, according to NYISO[11]

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[8] "Key component of Cuomo's energy highway stalls", Scott Waldman, Politico New York, 02/09/2015

[9] NYISO's Power Trends 2017, Figure 16, page 29

[10] "How New York City Gets its Electricity", Emily Rueb, NY Times, February, 10, 2017

"The Indian Point Plant has two base-load units (2060 MW total) located in Zone H in southeastern New York, an area of the State that is subject to transmission constraints that limit transfers in that area as demonstrated by the reliability violations that arise by 2019 in the base case. Southeastern New York, with the Indian Point plant in service, currently relies on transfers to augment existing capacity. Consequently, load growth or loss of generation capacity in this area would aggravate constraints."

The Federal Energy Regulatory Commission in 2017 had this to say about New York[12] *"The chronic transmission constraints in NYISO are in the southeastern portion of the state, leading in to New York City and Long Island. As a result of their dense populations, New York City and Long Island are the largest consumers of electricity. Consequently, energy flows from the west and the north toward these two large markets, pushing transmission facilities near their operational limits. This results in transmission constraints in several key areas, often resulting in higher prices in the New York City and Long Island markets."*

The difficulty of replacing Indian Point is not a new issue. Several years ago the Indian Point replacement issue centered on maintaining sufficient system reliability. As former PSC Chair Audrey Zibelman[13] said "The potential retirement of IPEC raises significant reliability issues". Although the State has taken actions to deal with reliability challenges due to an Indian Point closure, these actions do not guarantee a clean electricity replacement for Indian Point.

Indian Point is not going to be replaced by renewable electricity.

3.1.3 Reliability Analyses

NYISO's December 13, 2017 reliability study analyzed the period from November 13, 2018 to November 13, 2023 (the Study Period). One major conclusion drawn from this NYISO report is that NYISO reliability criteria could be met through the Study Period, by three gas-fired power plants[14], whose construction is expected to

[11] "2014 Reliability Needs Assessment", NYIOSO, Final Report, September 16, 2014

[12] FERC Electric Power Markets, August 3, 2017

[13] "Indian Point Contingency Plans Move Forward", PSC, 13076/12-E-0503, October 17, 2013

be completed by the time Indian Point 2 is scheduled to close, provided that the Indian Point plants are not closed earlier than their scheduled 2020-2021 closure dates.

What this recent NYISO analysis did not examine is the impact of an Indian Point closure prior to April 30, 2020. This early closure is possible since the Agreement allows Entergy to "*in its sole discretion, temporarily or permanently cease operations of IP2 and/or IP3 at any point in time prior to the dates set forth herein...*". Entergy could close the Indian Point plants before the construction of the gas plants is completed, if it wished to. It would have been useful if the Study Period had been extended to 2027. The longer Study Period might have shown that other major demands would have to be dealt with because of the large number of over-aged power plants in NYC.

The urgency for identifying adequate replacement electricity for Indian Point has been an issue for many years, well before the Agreement was signed. For example, it was clearly stated[15] in 2016 by NYISO *"This scenario simulates the retirement of the Indian Point Energy center by removing 2,060 MW of capacity from Zone H, and finds that significant violations of resource adequacy would occur immediately in 2017."* It should be noted that all three gas plants under construction have a total capacity of 1818 MW while the Indian Point plants have a combined capacity of 2050 MW, a difference of 232 MW. Typical capacity factors for a combined cycle gas plant is 56.3%, while nuclear plants typically have capacity factors around 90%. Unless these new gas plants are operated as base load plants, they would be short 7239 GW-hours per year compared to the usual output of the Indian Point nuclear plants. NYISO did not discuss this potential GW-hour difference in its December, 2017 report. NYISO also did not address the increase in the release of greenhouse gases if this gas replacement option is taken, or how burning more fossil fuels would offset the environmental gains made by NY's REV program.

Solar energy would not be sufficient to make up for the shortfalls identified by NYISO and listed in Table A- 1. The total number of proposed MW in the G, H, I,

[14] Cricket Valley Energy Center (1020 MW) + CPV Valley Energy Center (678 MW) + Bayonne Energy Center II (120 MW) = 1818 MW

[15] NYISO "2016 Reliability Needs Assessment", page v, Final Report, October 18, 2016

and J zones from photovoltaics is 233 MW[16]. At a 15% capacity factor these PV proposed installations might produce about 306 GW-hours per year. This is a far smaller number than the 16,400 GW-hours that Indian Point typically produces each year.

The present NY REV program is an enlarged version of the New York Renewable Portfolio Standard (RPS) announced by the Governor George Pataki in February, 2003. The RPS program committed to 25% of the State's electricity would come from renewable sources in just ten years. After all the years since Pataki's announcement in 2003, the total contribution of solar energy in NY State is tiny; only be enough to meet the State's electricity needs for slightly more than 3 hours per year. New York State is not in the windy Great Plains and it is not like sunny California. NYC announced[17] that 1000 MW of photovoltaics were to be installed by 2030. While all sources of clean electricity are welcome, this 1000 MW would only provide, by 2030, about 2.3% of NYC's present use of electricity.

NYISO also investigated another scenario where the three gas plants under construction were not used to replace Indian Point. This would be consistent with using these new gas plants to bolster NYC. NYISO calculated, for years 2018 through 2027, a measure called LOLE which is an indicator of the electric system's reliability. The term LOLE stands for Loss of Load Expectation. Any LOLE value larger than 0.100 does not meet NYISO reliability criteria. As can be seen in Table 1, as long as the Indian Point nuclear power plants continued to operate the overall system would have adequate reliability, i.e., a LOLE less than 0.100. In 2021, the first full year after Indian Point 2 is scheduled to close, the LOLE is projected to jump from 0.043 to 0.108 and the whole electrical system would not meet NYISO reliability criteria. Reliability issues worsen in 2022 when the effects of the closure of Indian Point 3 is beginning to be felt. In 2022 the LOLE increases to 0.116. LOLE continues to worsen through the end of this study period at year 2027 where the calculated LOLE is 0.168. It is assumed that the increase in LOLE over time is due to the retirement of gas plants in New York City (NYC); many of which are already beyond the age where 95% of plants of this technology begin to retire. The percent-

[16] "Power Trends 2017", NYISO, Figure 30.

[17] "Climate Week: Solar Power in NYC Nearly Quadrupled Since Mayor de Blasio Took Office and Administration Expands Target", postoffice@cityhall.nyc.gov, September 23, 2016.

age of NYC power plants[18] beyond the 95% retirement age is provided in Table 2. For combustion turbines the 95% retirement age is 46 years and for steam turbines the 95% retirement age is 63 years.

Table 1: Compensatory Megawatts

Year	LOLE	Compensatory MW
2018	0.031	-
2019	0.028	-
2020	0.043	-
2021	0.108	100 MW within zones G,H, I, or J
2022	0.116	200 MW within zones G,H, I, or J
2023	0.123	200 MW within zones G,H, I, or J
2024	0.143	400 MW in G, or 300 in H,I, or J
2025	0.152	500 MW in G, or 400 in H,I, or J
2026	0.167	600 MW in G, or 400 in H,I, or J
2027	0.168	600 MW in G, or 400 in H,I, or J

As shown in Table 1, in order to maintain a LOLE less than 0.100, NYISO calculated the number of MW of additional capacity that would need to be added if Indian point is closed. NYISO calculated a shortfall of 100 MW in 2021 if new capacity is not added and the three gas plants are not counted towards replacing Indian Point. NYISO projects that this shortage would grow to 400 to 600 MW of electricity by 2027 if Indian Point is not replaced by these gas plants. NYISO did not provide a specific plan on how these shortfalls would be dealt with, but did specify that these additions would have to be placed in zones G, H, I, or J. All of these zones are in NYC and the Lower Hudson Valley. These shortfalls would be much larger if the Indian Point plants are shut down by Entergy before April 30, 2020.

Table 1 implies additional information. Prior to the planned shutdown of Indian Point the LOLEs were well below 0.100, indicating a reasonable reserve capacity. Based on the NYISO analysis it would take additional sources of electricity starting in 2021 to maintain the system's reliability. The two Indian Point plants have a com-

[18] Adapted from Figure 9, "Power Trends 2017", NYISO

bined capacity of about 2060 MW. Obviously, adding 100 to 600 MW does not replace 2060 MW. The whole system would not return to LOLE values of around 0.031 as is the case for 2018. It seems to be implied that the addition of 100 MW to 600 MW is to return the LOLE to 0.100. If this is so, then any further loss of capacity or a transmission problem would cause the State's electrical system to be unable to meet its reliability criterion. The probability of a further loss of capacity increases over time, as shown in the right hand column of Table 2. Starting with the closure of Indian Point 2, the gap between the gas plants' capacity and the capacity of the over-aged power plants in NYC widens. As such, the probability of having a LOLE larger than 0.100 increases with time.

In addition to the 1818 MW of gas-fired electricity already identified, two other sources of 336 MW of electric capacity might become available in the next few years. They are the Berrians East Repower project (102 MW) located in Astoria, Queens, NYC and the Linden Cogen Uprate (234 MW) located in Linden, New Jersey directly across from Staten Island. Both use fossil fuels. This 336 MW has advanced to the Facilities Study stage, but would be insufficient to meet a potential shortfall of 642 MW as early as 2021[19]. A number of other electric power plants (Luyster Creek, South Pier Improvement, Liberty Generation, NYC Energy, and the Astoria Generating Unit 4), if built, would take even longer to produce electricity since they don't yet have a Facilities Study in progress. All together they would add 1957 MW.All are fossil fueled power plants.

All this new construction is to use natural gas. This new construction supplements other actions taken by NY State to rely more heavily on natural gas when it refurbished older coal plants to run on gas, specifically the Bowline plant, the Dunkirk plant and the Danskammer plant.

[19] "New York City's Aging Power Plants: Risks, Replacement Options, and the Role of Energy Storage", Pg 14, Stratengen Consulting, LLC, September, 2017

Table 2: MW of NYC Plants Past Their Retirement Age

Year	% of NYC generation beyond its retirement age	Total MW past its retirement age	Potential capacity shortfall if NYC generation past retirement age were removed, MW	NYC MW past retirement age minus 1818 MW from gas plants that might be operable by 2020.
2017	17	1600	0	1600
2018	22	2100	small	2100
2019	22	2100	small	2100
2020	22	2100	small	282
2021	26	2500	642	682
2022	30	2800	989	982
2023	30	2800	1016	982
2024	30	2800	1045	982
2025	30	3200	1462	1382
2026	41	4000	2244	2182

Several things are apparent: (1) The planned addition of 1818 MW from new gas plants which would be used to bolster NYC does not keep up with the number of MW associated the increasing number of NYC power plants that are now or soon will be over-aged. This gap gets worse over time. (2) If Entergy chooses to shut down Indian Point before these gas plants are operational, as allowed by the Agreement, major reliability problems would occur for NYC and surrounding areas. (3) NYISO reliability studies need to be expanded to cover the time period prior to the completion of the new gas plants taking into account both the NYC over-aged power plant situation and the simultaneous Indian Point shut down situation, and (4) Unless something major changes, Indian Point will be replaced by gas.This, unfortunately, is consistent with all nuclear plant closures in recent years in the United States. All closed nuclear plants were largely replaced by fossil fuels, gas and/or oil.

3.1.4 Population Growth

"Population and economic growth will strain the City's energy structure[20]*."* The PlaNYC 2030 report projects an 11% growth in the City's population between 2005 and 2030, from 8.2 million people to 9.1 million people. In a business-as-usual (BAU) approach this could result in a 29% increase in the peak summer load and a 44% increase in electricity consumption over this same time period. This report also predicts NYC will release more carbon dioxide over this same time period even with a carbon tax. NYC plans to take aggressive actions to reduce these BAU figures. Nonetheless, population and economic growth is likely to put further stress on NYC's energy structure.

3.1.5 Additional Demands for Electricity

Between reducing air pollution and dealing with population and economic growth, the resultant greater demands for electricity in NYC and in NY State increases the need for carbon-free electricity. This makes the Indian Point plants even more valuable.

3.1.6 Conclusions

NYC faces major reliabilty risks because of its over-aged electricity supply system. Renewable electricity and heightened efficiency will not remove this challenge because of severe transmission constraints. The only sources of replacement energy for NYC are fossil fueled sources and even these plants do not appear to be sufficient to prevent future electricity shortages. Further, the use of more fossil fueled electricity undermines the State's efforts to deal with climate change. The closure of Indian Point exacerbates NYC's potential electricity shortages which could worsen NYC's ongoing subway crisis. It is clear that new gas plants can't replace both the over-aged gas plants in NYC and also replace Indian Point. In fact, the gas plants' total output is less than the Indian Point capacity and also smaller than the number of MW in NYC that are beyond normal retirement age. NYISO needs to expand its analysis out to 2027 to include possible NYC retirements with the simultaneous closure of the Indian Point plants.

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[20] PlaNYC 2030 "Provide cleaner, more reliable power for every New Yorker by upgrading our energy infrastructure."

3.2 SCENARIO TWO: Three Publications by Riverkeeper

3.2.1 The Synapse Report[21]

The Synapse report, sponsored by Riverkeeper and the Natural Resources Defense Council, emphasizes responding to the immanent closure of Indian Point with emphasis on energy efficiency and renewable energy. Greater use of energy efficiency and renewable energy is essential in dealing with climate change and in maintaining diversity in our electricity supply, but they alone can not solve the problems associated with the Indian Point closure or climate change effects in NY State.

Because there are a number of fundamental flaws in the Synapse report, it does not provide sufficient confidence that Indian Point could be replaced by greater use of renewable energy and improved energy efficiency. Further, the whole concept of replacing Indian Point with renewable energy and greater efficiency is philosophically flawed. The threat of climate change vastly outweighs the risks from operating Indian Point. All progress in increasing the output of renewable energy and in improved efficiency should be directed at reducing the release of GHG. Replacing one clean energy source with another clean energy source makes no sense at all.

3.2.1.1 The Champlain Hudson Power Express (CHPE)

The Synapse report analyzes six different scenarios, two of which are with Indian Point continuing to operate combined with two different levels of energy efficiency throughout the whole NY electrical system. One level of efficiency is based on the full implementation of New York's Clean Energy Standard (CES) and the other is an assumed higher level of efficiency that would exceed the CES.The other four scenarios are the Indian Point retirement cases. Two of these retirement cases are based on efficiencies assumed to be achieved through New York's Clean Energy Standard with and without CHPE and the other two Indian Point retirement analyses are calculated at a higher level of energy efficiency, with and without the influence of CHPE.

Riverkeeper claims[22] that NYISO has omitted consideration of other viable renewable projects. *"For instance, one promising, already-permitted proposal is for the Champlain Hudson Power Express, a 1000 megawatt transmission line that could*

[21] "Clean Energy for New York", se Energy Economics, Inc., Feb.23, 2017

deliver low-carbon surplus hydropower to New York City". In actuality, this hydropower transmission line project does not have a valid permit to replace Indian Point as Riverkeeper claims. Because of this, half of the retirement scenarios Synapse analyzed are based on a faulty assumption and should be rejected out of hand.

The original Environmental Impact Statement (EIS) for this CHPE project[23] was originally based on replacing fossil fueled electricity generated in Queens, NY. The original Environmental Impact Statement for the Champlain Hudson Power Express (CHPE) project concluded that bringing in 1000 MW of clean hydropower from Canada to replace fossil fueled electric power in Queens would result in reducing 1.5 million tons/year of greenhouse gas emissions (GHG) per year. Additionally, this CHPE EIS estimated reductions of sulfur dioxide releases by 751 tons/year and nitrogen oxides releases by 641 tons/year, while saving ratepayers $405 to $720 million dollars/year.

If the CHPE proposal were directed at replacing a portion of the Indian Point output there would not be any reduction in the amount of GHG released, no reduction in the sulfur dioxide or nitrogen oxides released and likely no cost savings as claimed in the original EIS which was based on the then higher cost natural gas and not on the present price of electricity from Indian Point. The basis for approval of the CHPE EIS disappears if the CHPE were to be a partial replacement for Indian Point. A new EIS would have to be written which would then have to go through the review and approval process.

Importing hydropower from Canada requires a Presidential permit[24], just as the Keystone XL pipeline did. The Department of Energy provided the basis for its decision to grant a Presidential permit in the Federal Register *"DOE's decision to grant this presidential permit is based on consideration of the potential environmental impacts, impacts on the reliability of the U.S. electric power supply system under normal and contingency conditions and the I favorable recommendations of the*

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[22] "Checking it twice: Grid operator says that electric system reliable without Indian Point", Riverkeeper 12/15/2017

[23] "Champlain Hudson Power Express Transmission Line Project Environmental Impact Statement", Department of Energy, August, 2014, page S-3

[24] Federal Register/Vol.79, No.190/Wednesday, October 1, 2014/ Notices, Page 59258

U.S. Department of State and Defense." None of the reviews by DOE, the State Department, or the Department of Defense had anything to do with Indian Point. It is very doubtful if the present or any other federal administration would approve shipping money and jobs out of the country, especially if there is no economic or environmental gain. Re-purposing the original CHPE Environmental Impact Statement to justify using Canadian hydropower to replace Indian Point is not plausible.

Alternative Canadian hydropower projects have not been identified and likely would not be operational by 2021. **Using additional hydropower, if it ever became available, to replace any nuclear power plant, including Indian Point, would be a lost opportunity to reduce the total amount of greenhouse gases released in New York.**

3.2.1.2 Synapse's Use of Efficiency and Peak Power

After eliminating the CHPE retirement cases, the two remaining cases have different assumed levels of energy efficiency, one of which is based on assuming that New York's Clean Energy Standard's (CES) energy efficiency policy is implemented and the other assumes that there is an enhanced or high energy efficiency policy is implemented. The CES assumes that there would be an incremental energy savings of 1.5%/year of retail sales by 2025 (2.2 Terawatt-hours/year by 2025). The aggressive energy efficiency scenario in Synapse doubles this to 3.0%/year of retail sales by 2021 or 4.6 terawatt-hours by 2021.

The different levels of energy efficiency modeled by Synapse present an interesting computer based sensitivity study, but they do not relate to what is actually happening in New York. As Synapse states in its own Conclusions *"New York will require an aggressive energy efficiency policy framework in order to secure the improvements needed to obtain either the CES-assumed or the High efficiency assumed scenarios we model in this analysis."* **Note that even the smaller CES efficiency policy is not being implemented.**

Synapse goes on to say "*Critically, such a policy framework is not currently in place in New York for attaining the levels of energy efficiency contemplated in five of the six scenarios considered in this analysis. Only the IPEC-in-service status quo EE case is likely to reach its assumed levels of energy efficiency without further regulatory support. The levels of energy efficiency assumed in the CES order have no binding mechanisms, other than the ETIPS approved for each of the utilities. These ETIPs require only a small fraction of the 2,227 GWh annual incremental savings*

that are assumed in the CES order and reflected in the CES-assumed efficiency scenarios modeled herein. No such enforceable mechanism exists for NYSERDA or for the non-jurisdictional entities (NYPA,LIPA, and direct NYISO consumers).” In other words, what Synapse modeled is not what is actually happening in NY with regard to energy efficiency. This energy efficiency gap between reality and the Synapse model severely limits the value of the Synapse analyses. **Between the lack of a permit for CHPE and the above energy efficiency gap, the Synapse report can not be used with confidence for decision-making.**

It may be that further major additional efficiency gains can not be achieved, even if a new policy framework is created. The average energy use per person in the United states is about 310 million BTUs per year, while in New York energy use per person is 189 million Btus per person. This places New York in the position of being the lowest energy consumer per person per year in the whole nation. There are multiple reasons for this that are already “baked in”. New York has the third highest electricity price per kilowatt-hour in the nation. This has already encouraged people to install items like LEDs and more energy efficient home appliances. New York City uniquely high rate of public transit makes it one of the most energy efficient cities in the United States. NY State is tied with Alaska as the State with the fewest number of vehicle miles traveled per person. Multi-storey buildings and blocks of row houses, typical of many cities in New York, share internal walls which is usually more energy efficient than individual residences.

The Synapse report should have compared the energy use per person as it actually is in New York against the calculated energy use per person using its high energy efficiency model. It may be that New York already has accomplished much of the energy use reduction calculated by Synapse’s high efficiency model. If there is still a gap between actual energy use per person and the “theoretical” energy use per person in the high efficiency model, then Synapse needs to identify specific energy saving steps that are practical and that a policy framework might call for.

Clearly, until Synapse determines if its high efficiency model is a significant improvement over actual practice in NY State, the Synapse report is a just a paper sensitivity study and not a basis for a very serious action like shutting down Indian Point.

On another matter, the Synapse report often compares actual decreases in peak load to overestimated peak loads and attributes this difference to the impact of greater efficiency. Even if improvements in efficiency were responsible for reducing peak

loads, this has no bearing on shutting down the Indian Point plants which operate as base load plants, not as “peaker” plants.

This Synapse misunderstanding between base loads and peak loads is part of a larger misunderstanding about energy efficiency. Take a hypothetical case where implementing efficiency actions, like purchasing more efficient air conditioners or heat pumps, led to the closure of a fossil fueled power plant because of a decrease in the demand for electricity. One can not take credit for this decrease in electricity use as justification for shutting down Indian Point. **You can not replace the electricity that Indian Point produces that ends up energizing the subways system with electricity one does not make any more.** The electricity that the subways need is a fixed demand. One would have to reactivate the fossil plant that was shut down because of implementing efficiency processes so that replacement electricity for Indian Point could be generated.

A peculiarity in the Synapse modeling is allowing the renewable energy contribution to vary from one scenario to another (See Synapse Tables 3,4, and 5). NY State has a fixed renewable energy program, not one that is varied so that one always achieves the 2030 goal of 50% renewable electricity, as modeled by Synapse. If there were real life situations where renewable energy was more productive than assumed, these additional MWH should be used to reduce GHG releases.

3.2.1.3 Synapse’s Analysis of Transmission Constraints

The Synapse report says almost nothing about a huge issue for replacing Indian Point: The limited ability to transmit electricity from upstate sources to downstate demand centers. Table 2 in the Synapse report notes that the computer model they used, ReEDS, considers upstate and NYC as one zone. If it is just one zone, does this account for the severe transmission constraints that NYISO and others have acknowledged? In Synapse’s Appendix it says that *“ReEDS includes data on the existing fossil fuel facilities in each of the model’s 134 Power Control Areas (PCAs). New York State is represented by two PCAs.*” It is not clear if this statement in the Appendix is consistent with the transmission modeling statement in Synapses’ Table 2.

Riverkeeper should explain to all how the Synapse report compares with the transmission statements made in the December 13, 2017 report by NYISO.

3.2.1.4 Synapse’s Analysis of Gas-fired Plants

Figure 13 of the Synapse report shows new gas build outs starting in 2024 with or without the retirement of Indian Point. Synapse's calculations only went out as far as 2030. These gas build-outs is a result of the ReEDS computer code using gas to meet capacity requirements. As such, they rather resemble NYISO projections shown in Table 1, but at an even larger gas build out than NYISO. Figure 13 includes both CES and high energy efficiency scenarios and in both cases there is a build up of new gas capacity. Additional information can be found in Synapse's Tables A7, A8, A9 and A10. In each case the total gas capacity hardly changes from year 2016 to year 2030.

3.2.1.5 Conclusions Drawn From the Synapse Report

This Riverkeeper sponsored report calculated that, even with improved efficiency and with renewable energy contributions, natural gas continues through 2030 to provide between 29% to 34% of the electricity capacity in New York.

The Synapse report incorrectly giving credit to the CPHE project, gave credit for an unproven higher level of energy efficiency, and was seemingly unaware of the severe transmission constraints later pointed out by NYISO, this Riverkeeper report still showed that significant amounts of gas would be necessary in order to have a reliable electric power system.

A major conclusion can be drawn from the Synapse report: greater use of renewable energy and improved efficiency, while desirable, are insufficient to deal with climate change. Indian Point and additional sources of carbon-free electricity are needed.

3.2.2 Riverkeeper's Comments on the NYISO Reliability Report

3.2.2.1 Comments by Senior People at Riverkeeper

Paul Gallay and Mike Dulong of Riverkeeper have commented on NYISO's Reliability report. They object to NYISO relying on natural gas to replace Indian Point. Yet Riverkeeper's own Synapse report calls for new natural gas generation power plants as shown in Figure 13 and elsewhere.

Gallay and Dulong also state *"In taking a conservative approach to predicting future energy availability, the NYISO report also omits consideration of other viable renewable projects. For instance, one promising, already permitted proposal is for*

the Champlain Hudson Power Express, a 1000-megawatt transmission line that could deliver low-carbon surplus hydropower from Quebec to New York City."

In spite of what Gallay and Dulong have said, the Champlain Hudson Power Express does not possess a permit to use this hydropower to replace Indian Point. A more attractive use of this Canadian hydropower would be to replace fossil fueled power plants in Queens, NY, where it does have a valid Presidential permit. Yet, even this more environmentally attractive application is not happening. If Riverkeeper is truly interested in reducing the release of GHG, it should work towards using CHPE to replace fossil fueled plants.

Gallay and Dulong repeat the errors in the Synapse report about energy efficiency. The electric loads in New York that are now met by Indian Point will continue regardless of the future of Indian Point. **You can not replace the electricity you need to meet these loads with electricity you no longer make because of efficiency improvements.** Gallay and Dulong might benefit from the following: Assume that 1000 MW of fossil fueled capacity has been shut down in western New York because of large numbers of people using LEDs, more efficient appliances, and the like. Now take Indian Point 2 off line and show how this 1000 MW reduction in electricity supply in western New York turns the motors that run the trains in NYC.

Gallay and Dulong completely ignored the most important statement made by NYISO in its reliability report about the inability of NY's transmission system to bring in upstate renewable electricity or renewable electricity from Long Island. NYISO made that very clear when they identified zones G.H, I, and J [lower Hudson Valley and NYC] as the only practical areas where Indian Point replacement electricity could be made. If Gallay and Dulong disagree with NYISO on their transmission constraint statement, they should explain why.

3.2.2.2 Conclusions About Riverkeeper's Comments

Unless Gallay and Dulong can justify their comments about the NYISO report, these comments are best ignored.

3.2.3 Indian Point Safety

3.2.3.1 Introduction

Two fictions about the safety of Indian Point have been repeated again and again and are now being cited as reasons to shut down Indian Point. One fiction is that in the event of an accident an area out to 50 miles, housing about 20 million people, would have to be evacuated. Since such a massive evacuation seems impossible, opponents to Indian Point claim that Indian Point should be shut down. Such a massive evacuation is unnecessary, unwanted, and dangerous.In reality, only the 20,000 or so people live who within two miles of Indian Point might need be evacuated in an unlikely severe accident, with sheltering of downwind people beyond two miles. The fictional massive evacuation of 20 million people within 50 miles of Indian Point is **about 1000 times too large.** The other fiction is that because of the Ramapo fault Indian Point represents an unacceptable seismic risk.

3.2.3.2 Emergency Response Basics

Based on analyses performed at our National Laboratories and on an actual serious nuclear accident, an accident at Indian Point, should result in **zero** near term off-site radiological health effects and off-site long term radiation effects, if any, **would be too small to be detected**[25]**.** A simple response of evacuating the innermost two miles from the site prior to the release of radioactive material, followed by downwind sheltering would achieve these near zero radiological consequences.

Many hours would be available to take this pre-emptive limited evacuation. At Fukushima, Japan thee was about 12 hours between the start of an accident sequence and a release of radioactive material into the environment. Japan's actual

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[25]These zero to very low radiological consequences were measured by the World Health Organization (WHO) following the Fukushima accident in Japan where three nuclear reactors melted down simultaneously. The U.S. National Academy of Sciences supports these WHO conclusions. Over-evacuation led to about 1600 non-radiological fatalities. If the Japanese had limited their evacuation to two miles, with sheltering beyond two miles, the same zero early radiological consequences would have been achieved and the non-radiological consequences would have been sharply reduced.

emergency response to three simultaneous reactor meltdowns at Fukushima following a greater than magnitude 9 earthquake and a towering tsunami was simple, but highly effective, and essentially eliminated off-site radiological consequences. However, significant non-radiological consequences were experienced from over-evacuation. If the Japanese can virtually eliminate radiological consequences under extreme conditions, there is no reason to believe that New York could not do an even better job in an emergency by not over-evacuating.

The radiological health risks from accidents at nuclear power plants have been intensely studied. These radiological health risks studies are usually divided into two main groups: early effects, such as fatalities and injuries (radiation sickness) which occur within a few months of the accident, and long term effects that might lead to cancer fatalities years later. Very high exposures are required to cause an early fatality. Because of human biology, small decreases in exposure cause very large decreases in the likelihood of causing an early fatality. For example, there is a 50% probability of becoming a near term fatality if a person receives a very high whole body dose of about 300 units of radiation (rads). If, however, the dose were one third smaller, 200 rads, the probability of causing a near term fatality drops to about 0.1%, a 500 fold reduction. As we have all seen, many kinds of plumes spread out as they travel away from their release point. This dilution of the plume concentration is the result of natural forces and do not require any actions by emergency personnel. This natural meteorological dilution process also applies to plumes carrying radioactive material. Further, changing wind directions spread out the plume which also lowers local dose rates. So dose rates generally decrease the further one is from the point of release.The combination of a decreasing radiation level as a plume moves away from its release point, changing wind directions, and the human biology very rapidly decreases the early fatality risk with distance. **The range of the early fatality risk is between zero and one mile from the point of release.** If the release of radioactive material is small, then the range of the early fatality risk is at or closer to zero miles. Modern accident analyses and actual nuclear accidents show that the amount of radioactive material that might enter the environment is far less than was thought before.

For similar reasons, **the range of the early injury risk is between zero and two miles.** Radiation induced early injuries (radiation sickness) include responses like vomiting, diarrhea, and sunburn-like skin effects. Early injuries do not lead to early fatalities.

If there were a nuclear accident at Indian Point there would be plenty of time to carry out this limited two mile evacuation. As stated before, the Fukushima accident took about 12 hours after the accident initiation before there was a release of radioactive material into the environment. Advanced nuclear accident analyses performed at US national laboratories indicate that it would take between 25 and 45 hours[26] for radioactive material to enter the environment for nuclear plants with containment buildings similar to Indian Point's. These 25 to 45 hour time periods are associated with a type of accident where all electric power was lost in the plant, which is what happened at Fukushima. Even if there is a core melt this does not mean that there will be a release of radioactive material into the environment. To have a release to the environment there must also be a loss of containment integrity. Years ago the melt down at the Three Mile Island nuclear plant had an essentially zero release of radioactive material into the environment because the integrity of the containment building was maintained. The containment building at Three Mile Island is the same type as those at Indian Point.

Beyond two miles, i.e., beyond the range of the early health effects, the main radiological objective is to reduce possible long term radiological effects. Here downwind people should take shelter. In addition to the shielding that their shelters would provide, people can take simple actions, completely under their own control, to further reduce their radiation exposure. These protective actions include closing doors and windows, turning off air conditioners, wearing long sleeve shirts, breathing through a wet handkerchief, etc.

The World Health Organization conservatively calculated the long term radiological health effects of the Fukushima accident and concluded that they would be too small to be detectable. The most severe nuclear accident ever occurred at Chernobyl in the Ukraine. No long term fatalities have been detected in the 30 years since the Chernobyl accident[27]. (See Table 3)

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[26]Two other types of analyzed accidents had shorter times, 3.5 and 10 hours, before radioactive material might enter the environment, but these accidents were exceedingly unlikely, less than one chance in a million per year. Even so, there would still be ample time to evacuate the innermost two miles.

Table 3: Radiological Health Consequences from Three Nuclear Accidents

Power Plant	**Number of on-site near term early fatalities**	**Number of off-site near term early fatalities**	**Long term effects**	**Comments**
Three Mile Island (TMI)	0	0	0	TMI had a containment building similar to those at Indian Point. Virtually no radioactive material was released to the environment from this meltdown.
Fukushima	0	0	Too small to be detectable according to the World Health Organization and the National Academy of Sciences.	3 simultaneous meltdowns. Successful emergency radiological response in spite of a greater than magnitude 9 earthquake and a towering tsunami. Over-evacuation led to 1600 non-radiological fatalities.
Chernobyl	28	0	No long term fatalities detected in the 30 years since the Chernobyl accident. Only radiological health effect is increased thyroid cancer incidence in former children in the affected areas of Belarus, Russia, and Ukraine.	(a) 25 near term fatalities came from emergency workers that went on site, 3 fatalities from people in a helicopter that flew through radioactive plume. Zero near term off-site fatalities. (b) Thyroid incidence caused by drinking contaminated milk, 99+% successfully treated. This exposure would not happen in the USA because of food interdiction restrictions.

[27] Private communication from Professor Mikhail Balonov, Head of Protection Lab, Institute of Radiation Hygiene, St. Petersburg, Russia, April 14, 2017

3.2.3.3 Riverkeeper Proves That Indian Point is Safe, 50 Mile Evacuation a Fiction

After years of opposing Indian Point, Riverkeeper has inadvertently shown that it is safe and that its claim that a 50 mile evacuation is necessary to protect the public is a falsehood. The 50 mile evacuation myth is a "strawman" to be put up and then torn down. Riverkeeper's web site links to "Fukushima on the Hudson" a report written[28] by the Natural Resources Defense Council. Figure 1 comes from this NRDC report.

Figure 1 shows the ultimate non-evacuation response because it assumes that people stand out-of-doors for 48 hours (no sheltering) during the accident, which defies common sense. Under normal conditions people do not stand out-of-doors for 48 continuous hours for any reason. To take such a response would maximize their exposure to radiation if they were in the plume pathway. In fact, people would be better off than this absurd 48 hour, no sheltering response if they just ignored the accident and continued their normal activities. Normal activities includes a large fraction of time being indoors, thereby being sheltered.

In spite of exaggeratring possible radiological consequences with its assumed 48 hour no sheltering response, Figure 1, nonetheless, has some value. Figure 1 shows large areas within the 50 mile radius that are not in the plume pathway or exposed to radiation. **All people outside of the plume pathway need not evacuate and this in itself shows that the often quoted 20 million evacuees figure is false.** People outside of the plume pathway should stay tuned to their political leaders for instructions. If there are wind direction shifts some additional people might be advised to take shelter.

A second benefit of Figure 1 is that it presents a mix of sheltering and evacuation, which has been shown to be superior to a massive all-evacuation response, especially a 50 mile evacuation.

A third benefit of Figure 1 is that it shows that there are no off-site early fatalities. This is correct. Neither the Three Mile Island accident, the Chernobyl accident[29], nor the Fukushima accident caused any off-site early fatalities. (See Table 3).

[28] Nuclear Accident at Indian Point: Consequences and Costs, NRDC, October, 2011

A fourth benefit of Figure 1 is that it shows a small area right next to the Indian Point site that might reach the threshold for radiation sickness (early injuries). Since this radiation sickness area is so limited and so close to the Indian Point site there is no justification for a 50 mile massive evacuation to deal with it. A two mile evacuation prior to the release of radioactive material is recommended here, as was implemented in Japan in the Fukushima accident. This limited evacuation of about 20,000 people, about 5% of Indian Point's Emergency Planning Zone population, should eliminate the possibility of radiation sickness. So a simple improvement over Figure 1 is to evacuate the innermost two miles rather than staying out-of-doors for 48 hours. With this simple improvement all early fatalities and all early injuries (radiation sickness) would be eliminated, only leaving long term effects beyond two miles to be dealt with. This two mile evacuation itself is quite conservative. With a smaller releases of radioactive material into the environment, as calculated with today's advanced accident analysis technology, the ranges of the early fatalities and early injuries shrink towards zero miles.

Although there are points of agreement with Figure 1, there is a significant disagreements in addition to the 48 hour no-sheltering assumption. The most serious error in Figure 1 is the NRDC calculation of the amount of radioactive material that enters the environment (the source term) in its accident analysis. The source term NRDC used is based on a Nuclear Regulatory Commission report[30], NUREG-1465. NUREG-1465 calculates the "in-containment accident source term". As NUREG-1465 states *"The expression "in-containment accident source term" as used in this document, denotes the radioactive material composition and magnitude, as well as the chemical and physical properties of the material* ***within the containment*** *that are available for leakage from the reactor containment"*. (emphasis added) This is in contrast to the "radiological release to the environment source term" identified in NUREG-1465 which is a measure of the amounts of radioactive materials that are calculated to enter the environment. The "radiological release to the environment source term" is used to make off-site consequence analyses. NUREG -1465 clearly separated the radioactive material that would remain inside the containment from the radioactive material that might be released into the outside environment. However, the NRDC took the calculated radioactive materials inside the containment

[29]The Chernobyl accident caused 28 on-site fatalities, zero off-site fatalities.

[30]NUREG-1465, Accident Source Terms for Light-Water Nuclear Power Plants,USNRC, Feb., 1995.

and treated them as if they the radioactive material that would enter the environment. This is incorrect and therefore the NRDC does not have a valid description of what radioactive material might enter the environment. As a result, the dose calculations made by NRDC, which appear in Figure 1, are wrong and the areas calculated to be at 1, 5, 15, and 75 rads are far too large.

The amount of radioactive material that might enter the environment in an accident is significantly smaller than the "in-containment accident source term". First, unless the containment fails there would be no significant radiological release to the environment. An example of this was the Three Mile Island nuclear accident years ago.While there was significant release of radioactive material inside the containment, there was virtually no release to the public because the containment building remained intact. When NUREG-1465 used the term containment leakage it meant that the containment was intact and only very minor amounts of radioactive material would be released via leakage.The containment building at Three Mile Island is quite similar to the containment buildings at Indian Point. Second, inside each Indian Point containment building there are two water spray systems high up inside the dome. Either spray system is capable of reducing the pressure inside the containment while simultaneously washing out radioactive material from the containment air space. Either spray system can be operated from electricity from the electric grid or from the plant's emergency diesels. Even in the unlikely situation where both spray systems did not work, the radioactive material inside the containment air space would continue to decrease over time. There are natural removal processes that do not need any operator action or engineered safety system to work. The natural processes would cause this the airborne radioactive material in the containment's air space to continually decrease. Two examples of the natural removal processes are radioactive material plating out on internal surfaces and iodine and cesium compounds dissolving in the pools of water and wet surfaces created by the accident.

The NRDC assumed that the radioactive material would enter the environment in eight hours after the reactor scrammed. Modern source term analyses[31] for accidents similar to those analyzed by NRDC places the time after scram for radioactive material to begin to enter the environment at 25 to 45 hours for plants with Indian Point type containments. Even using the NRDC eight hour figure and assuming that no engineered safety features like the sprays were operating, there would still be

[31] "State-of-the-Art Reactor Consequence Analyses (SOARCA) Report". NUREG-1935, US Nuclear Regulatory Commission, November, 2012, Table 5

significant reductions in the amount of airborne radioactive material in the containment due to natural removal processes. The NRDC analysis ignored all of these source term reducing processes and the requirement to fail the containment. It appears that the NRDC does not understand the difference between containment leakage and containment loss of integrity.

One can estimate how serious an error the NRDC made in calculating its source term. Based on Table 1 of the NRDC report some 49% of the iodine 131 in the reactor core would enter the environment. This 49% Figure even exceeds the 45% amount assumed years ago in the highly conservative 1982 Siting Study. It also exceeds what was released fro the meltdown of three reactors at Fukushima by 864%. By comparison, modern analysis by the SOARCA program for a containment like that at Indian Point has an iodine release fraction of 0.006 or 0.6%. The iodine release that NRDC used was 82 times larger than what the SOARCA analyses has calculated.

This fundamental error by NRDC should not have happened. All NRDC had to do was to remember the Three Mile Island accident. No release of radioactive material that entered the containment led to a significant release of radioactive material to the environmentalist, because the containment's structural integrity was maintained, i.e. it was a leakage only accident. NUREG-1465 is based on containments that remain structurally intact. Because NRDC misused NUREG-1465, it greatly overstated the amount of radioactive material that entered the environment. The resulting calculated doses in Figure 1 are too high, as are the calculated health and economic consequences, and the sizes of the affected areas.

Because massive evacuations have their own risks and because correcting the NRDC assumptions and calculations would result in much lower dose rates, sheltering downwind is preferred beyond the innermost two miles. Correcting the NRDC source term would also shrink the affected areas, making massive evacuations even less desirable.

Calculated consequences presented by Riverkeeper/NRDC for accidents at Indian Point are incorrect and should be ignored. The claimed basis for shutting down Indian Point because of an inability to evacuate 20 million people out to 50 miles is a serious breach of the truth.

3.2.3.4 Nuclear Accident Exposures Compared to Typical Radiation Exposures

According to reports by the World Health Organization most people in the Fukushima Prefecture received an effective dose between 1 and 10 mSv (Milisieverts)[32] in the first year following the accident. Natural background radiation in the USA, on average, is about 3 mSv per year. However, there has been a significant increase in the radiation the public is receiving from mammograms, bone density tests, computed tomography (CT) scans, and others.

Eleven years ago the NY Times reported[33] *"According to a new study, the per-capita dose from ionizing radiation from clinical imaging exams in the United States increased almost 600% from 1980 to 2006. In the past, natural background radiation was the leading source of human exposure; that has been displaced by diagnostic imaging procedures, the authors said."* One can assume that the use of ionizing radiation in medical diagnostics is higher today than it was in 2007. This implies that the combination of background radiation and medical diagnostic procedures using ionizing radiation could average 6 or more mSv per year. The effective doses from diagnostic CT procedures are typically estimated to be in the range of 1 to 10 mSv, according to an FDA report.

With typical radiation exposures today in the 6 or more mSv range per year, these background plus medical procedures exposures are similar to the exposures received in the Fukushima Prefecture in the first year following the nuclear accident there.

It is expected that, if there were an accident at Indian Point, typical exposures would be similar to those measured at Fukushima, i.e., the accident would result in the same general level of exposure that people get in one to two years of normal background plus medical procedures.The big difference however is that reactor meltdowns are very infrequent while typical background and medical exposures are continuous.

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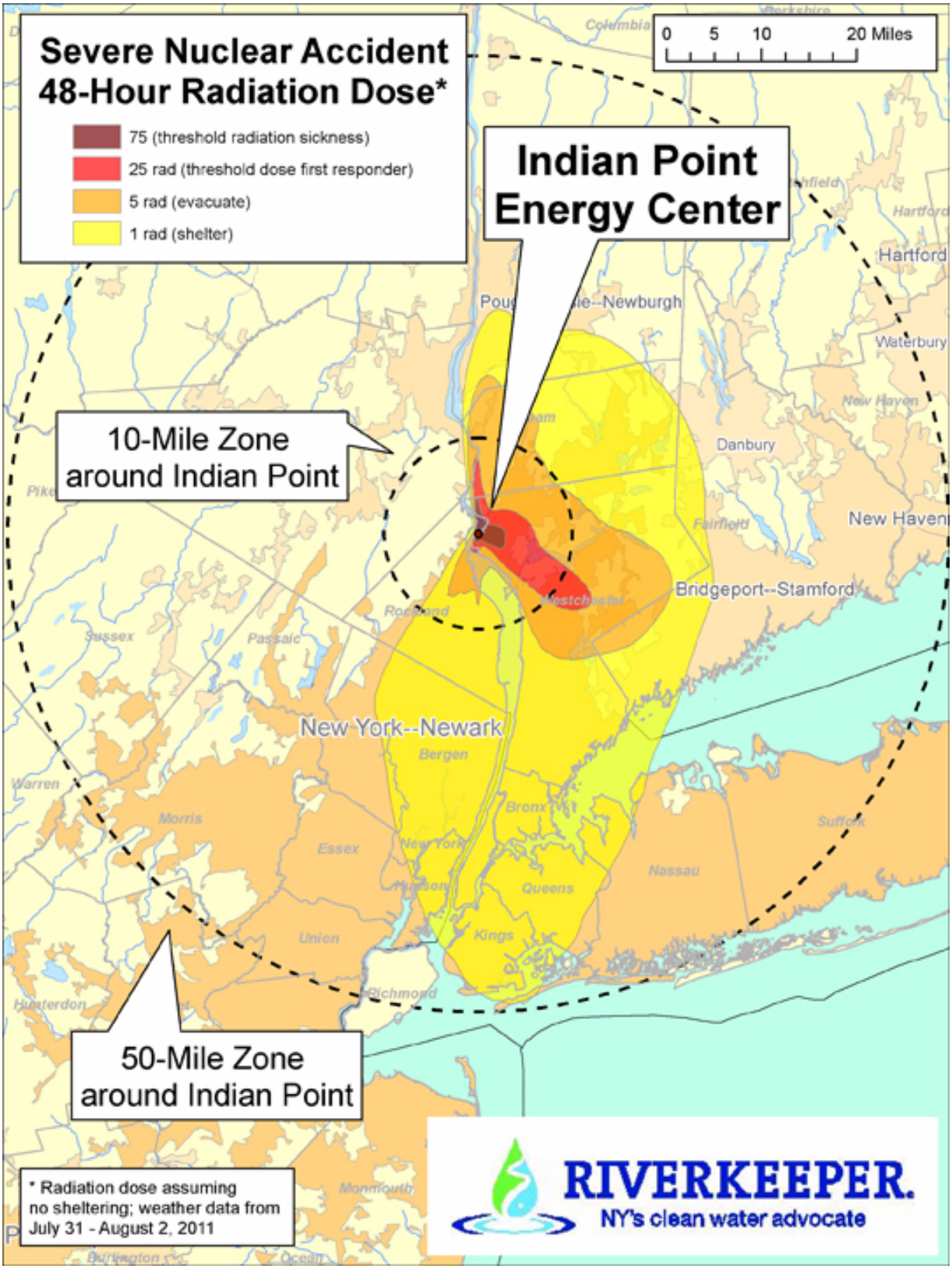
[32] "Lessons Learned from the Fukushima Nuclear Accident for Improving Safety of U.S. Nuclear Plants", National Academy of Sciences, page 203.

[33] "With Rise in Radiation Exposure, Experts Urge Caution on tests", Roni Rabin, NY Times, June 19,2007

FIGURE 1 Riverkeeper's No Sheltering 48-Hour Radiation Dose



3.2.3.5 The Ramapo Fault

It is claimed that a major seismic event in the Indian Point area is more probable than thought before. However, some seismologists urge caution stating there have been exaggerated claims about earthquake predictions[34].

As seismologist Alan Kafka[35], now deceased, said *"As we demonstrated in 1985, the existence of a "Ramapo Seismic Zone" (RSZ) is very difficult to disentangle from the fact that many of the seismic stations are located in the vicinity of the hypothesized seismic zone, which results in a seismicity map that is biased towards highlighting that zone. If the seismic data for the New York City area is reanalyzed to minimize this bias, the existence of the proposed seismic zone is not so clear, and the distribution of epicenters lends itself to many possible conjectures of hypothetical fault zones, all of which are based on circumstantial evidence. None of these hypotheses can be considered "concrete evidence" that the site of the Indian Point nuclear power plant is necessarily any more seismicly active than many sites in the study area."*

Since there is disagreement among seismologists about the importance of the Ramapo fault perhaps a useful way to deal with this issue is to put it in perspective. The Indian Point plant is designed to handle between a Richter 6.0 and 7.0 earthquake. The definition of the design basis earthquake is that the plant can be brought to a safe shutdown configuration without damage should such a magnitude earthquake strike the plant. Let us then examine the kind of damage to the general public if a seismic event between Richter 6 to 7 were to strike the area around Indian Point, recognizing that such an event would not lead to reactor core damage at Indian Point. Lynn Sykes and John Armbruster, two seismologists based at Columbia University's Lamont-Doherty Earth Observatory compiled a catalog of all 383 known earthquakes from 1677 to 2007 in a 15,000 square mile area around New York City. During this time period three magnitude 5 earthquakes occurred, in 1737, in 1783, and again in 1884. While earthquakes of this size are strong enough to cause dam-

[34] "Exaggerated Claims About Earthquake Predictions", Alan Kafka and John Ebel, EOS Transactions of the American Geophysical Union, Volume 88, Number 1, January 2007

[35] "Faults and Earthquakes in the Greater NY City Area", Alan Kafka, Weston Observatory, Department of Earth and Environmental Sciences, Boston College.

age to the general public, they would be well below the design basis earthquake at Indian Point. As to the category 5 earthquake in 1864, centered under the seabed between Brooklyn and Sandy Hook, it toppled chimneys across the city and New Jersey. With the great increase in population since 1864, the consequences would be expected to be far greater. *"Today, with so many more buildings and people, a magnitude 5 centered below the city would be extremely attention-getting" said Armbruster. We'd see billions in damage, with some brick building failing. People would probably be killed.*[36]*"* If Indian Point has a design basis earthquake capability of about magnitude 6.5 it would be able to withstand an earthquake about 32 times larger than the one that Mr. Armbruster says would cause billions of dollars worth of damage and could kill people.

What if there were a magnitude 7 earthquake? It is estimated that an earthquake of this magnitude in the New York City area occurs about once every 3,400 years, which equals a probability of about 1.5% over the next 50 years *"The New York Consortium for Earthquake Loss Mitigation put the cost of quakes this size in the Metro New York area at $39 billion dollars to $197 billion dollars. A separate 2001 analysis for northern New Jersey's Bergen County estimates that a magnitude 7 would destroy 14,000 buildings and damage 180,000 in that area alone.*[37]*"* Clearly, the damages today, 18 years later than this 2001 study, would be even greater.

Given the large damage estimated by this earlier study of Bergen County, New Jersey it raises questions like what might happen if a magnitude 7 earthquake struck Westchester County. Would schools and homes collapse? Would Kensico Dam fail sending a huge flood into White Plains? Would Metro-North train tracks and stations be torn up? Would Bear Mountain Bridge fall into the Hudson River? What about the Sing Sing prison or the Montrose Veterans hospital? Would power lines be knocked out, would gas pipelines leak and start a fire or explosion, would water supplies served by the old Croton Aqueduct lines fail, would sewer systems fail, and so forth? Would the Riverkeeper headquarters collapse since it is only a few miles downwind from Indian Point?

Is it possible that the Indian Point plants could be among the last structures standing if there was a severe earthquake? The Indian Point plants, as said before, were built

[36] "Earthquake risk to New York City and Indian Point", Science Blogging, August 21, 2008, page 2.

[37] Ibid, page 3

to withstand a Richter 6 to 7 earthquake and safely shut down. However, these containment structures have a great deal of margin beyond their design basis levels. For example, the Indian Point containment's design pressure is about 62 pounds per square inch absolute. Yet detailed studies have shown that these containments would not begin to leak until there was an overpressure of 141 pounds per square inch absolute. All the safety systems at Indian Point have additional capability beyond their design values because of the margins built into them.

Two examples exist that illustrate the very large earthquake margins that US nuclear power containments have beyond their design basis numbers. First, there was a beyond the design basis earthquake of magnitude 5.8 at the North Anna nuclear power plants in Virginia. These plants safely withstood this beyond the design basis earthquake with hardly any damage. The containment buildings at North Anna are the same general design as those at Indian Point. The accident at Fukushima provides additional insights into containment buildings at nuclear power plants having capabilities beyond their design bases. The Fukushima plants withstood an earthquake over a magnitude nine, more than a 100 times larger than a magnitude 7 earthquake. The emergency diesels at Fukushima turned on as they were supposed to when the electric grid failed from the earthquake. They operated properly for about one half an hour until the towering tsunami struck the site, knocking out a key control panel needed to operate the emergency diesels. Further along the coast of Japan other nuclear power plants also felt the thrust of this enormous earthquake, but did not experience a similar tsunami. Follow up studies on these undamaged plants showed that the earthquake did not cause any failures or damage to safety equipment in these plants. It was the tsunami that caused the Fukushima accident and we do not get tsunamis in the Hudson River.

Even if a very large earthquake struck Indian Point and all active safety features failed, it would still take many hours before there would be a release of radioactive material to the environment. Based on analyses performed by Sandia National Laboratory for a nuclear power plant with a containment building similar to that of the Indian Point nuclear power plants, it would take between 25 to 45 hours before a release began to enter the environment. Those members of the public who lived within two miles of Indian Point and survived this very large earthquake might use this time to walk out of the innermost two miles and seek shelter if any nearby buildings were still standing. The direct effects of large natural events, like earthquakes, are far more likely to cause consequences that greatly exceed those that

might be caused by the nuclear power plants affected by these same large natural events.

If the Ramapo fault is as dangerous as some claim, then Indian Point should be among the last places that need the State's attention. Perhaps one should start by examining the survivability of Kensico Dam.

3.2.3.6 Overall Conclusions About the NY State and Riverkeeper Safety Claims

The claims by New York State and by Riverkeeper about the need for massive 50 mile evacuation in the event of an accident at Indian Point are false. The claim that the Ramapo fault represents an unacceptable increase in seismic risks because of the location of Indian Point is unsupported. Other seismologists question the validity of the methods used to assess the seismic risk from the Ramapo fault. Even if the threat from the Ramapo fault were shown to be essentially correct and capable of causing damage to the Indian Point containment buildings, the radiological consequences, if any, from Indian Point would be small, while the non-radiological damages of such a huge earthquake would be overwhelming.

Neither NY State nor Riverkeeper have demonstrated any factual basis to shut down Indian Point for safety reasons.

3.3 SCENARIO THREE: What the PSC is Doing

3.3.1 State of our Planet

NOAA's report "State of the Climate of 2016" warned us that we had experienced the hottest year, the highest greenhouse gas levels, and record sea levels in 2016. This follows 2015 which was the hottest year and this trend has continued into 2017. Some scientists believe we are already seeing the forecast consequences of climate change with high numbers of category 4 and 5 hurricanes, huge fires in California, and enormous masses of ice breaking off from Antarctica and falling into the ocean.

Dealing with climate change is an existential challenge: one that has been severely underestimated and poorly responded to. The United Nations has stated in its 2016 Emissions Gap Report that the world is still heading for a temperature rise of 2.9 to 3.4 degrees C this century, even if the Paris climate change pledges are implemented. By 2030 emissions will be 12 to 14 gigatonnes above levels needed to limit global warming to 2.0 degrees C. Just one gigatonne is roughly equivalent to the

emissions generated by transport in the European Union (including aviation) in one year.

We are not going to get a second chance to get this right, so it is important to evaluate how well we are doing. New York State is often considered as a leader in the United States in dealing with climate change through its REV program. It is important then to examine how well NY State is doing in reducing its greenhouse gas emissions. To review how well NY State is doing the actions of the NY Public Service Commission were examined because it is a lead State agency on this matter.

3.3.2 NY's Energy Goals

New York has established two major energy goals. The first goal is to have 50% of its electricity generated by renewable energy by 2030. The second goal is to reduce all of its GHG emissions by 80%, relative to 1990, by year 2050.

Unless major changes are made, the State will not meet its 2030 and 2050 energy goals. Not meeting its 2030 goal is less troublesome as it could be remedied by changing a few words in the State's goal. Instead of calling for 50% of the State's electricity to be produced by renewable energy, replace the word "renewable" with the word "clean" or by "carbon-free". This would give credit to the nuclear plants in the State. New York's renewable electricity sources, plus its nuclear plants, already achieve over 50% carbon-free electricity generated in the State.Table 4 identifies where the State's GHG come from where the term $MMTCO_{2e}$ means millions of metric tons of carbon dioxide equivalent.

Table 4: Sources of New York's GHG, $MMTCO_{2e}$

Source	**1990**	**1995**	**2000**	**2005**	**2010**	**2014**
Electricity generation	62.99	51.25	55.65	53.55	37.29	30.41
Net imported electricity	1.63	4.26	5.69	6.55	9.59	7.99
Transportation	60.40	64.57	75.68	83.73	74.91	74.01
Residential	34.22	34.94	40.25	39.79	31.67	35.50
Commercial	26.53	27.01	32.21	28.64	24.17	22.03
Industrial	19.99	22.48	17.47	15.01	10.27	11.04
Other sources	30.08	33.64	35.97	37.30	35.61	36.74
Total	**235.84**	**238.16**	**262.90**	**264.57**	**223.52**	**217.73**

Failing to meet the 80% reduction in GHG by 2050 goal is far more serious. In 2016, 82% of the GHG released in New York came from the end use sectors of transportation, residential, commercial, industrial, and others while only 18% came from fossil fueled electric power plants (See Table 4). The REV program through 2030 is focussed on just reducing a fraction of this smaller release. Even if successful, the REV program would hardly move the GHG release “needle”.

Reducing GHG releases from the end use sectors is far more difficult than reducing GHG releases from the electricity generation sector. There are two reasons for this added difficulty. First, there are far fewer fossil fueled power plants that need to be replaced than there are end use “devices” that need to be replaced. Second, the replacement end uses are likely to be energized by electricity, which inevitably means that more clean electricity sources must be built.

An example of the above can be illustrated by looking at the number of internal combustion engine (ICE) passenger cars in New York. There about 7 million passenger cars in New York, so if they are replaced on a one-to-one basis with electric vehicles (evs) it would require 7 million evs. Typically, an ev consumes about 0.354 kilowatt-hours per mile traveled. So if these 7 million evs traveled the same number of vehicle miles per year as the present gas cars do, this would require about 45,000 GW-hours per year. By comparison, all the hydropower, wind and solar energy generated in NY State in 2016 came to about 30,300 GW-hours. If these 45,000 GWH were to be generated by large nuclear power plants, 1150 MW each and operating at a capacity factor of 90%, it would take 5 such nuclear power plants. If the 45,000 GWh were supplied by the type of upstate wind turbines now in use, 2.3 MW at a capacity factor of 0.26, some 8600 such machines would be needed.

In 2016 upstate wind power generated about 3900 GW-hrs. Some 1600 additional 2.3 MW wind turbines are planned, which at capacity factor of 0.26 could produce about 8400 GW-hrs. The total number of GW-hrs from upstate wind power when fully install could be around 12,300 GW-hrs. Since there are severe transmission limitations in bringing this electricity into the Indian Point service area, its best use might be to support upstate electric vehicles. This would be superior to trying to replace Indian Point for a second reason: it would reduce the amount of GHG emitted by the State as evs replaced ICE cars. There would be no environmental benefit from using one clean electricity source to replace another clean electricity source.

A scoping study has been made on how much additional clean electricity would be needed to electrify the end use “devices” that replace ICEs in NY’s transportation

sector, and the fossil fueled space heaters and fossil fueled hot water heaters in the residential and commercial sectors, plus retired fossil fueled electric plants, plus retired existing nuclear power plants. This scoping study estimated that about 258,000 GW-hrs per year of clean electricity would be needed by 2050, beyond all the onshore and offshore wind power which is already planned. (This scoping study assumed that population growth offsets improvements due to greater energy efficiency.) To put this into perspective, the total amount of electricity generated in NY State in 2016 was about 138,000 GW-hrs. In other words an increase in the additional amount of clean energy needed by 2050 to satisfy many, but not all, of the end use sectors is 258,000/138,000 = 1.87. Using clean electricity to replace fossil fuels in the industrial and in other sectors would probably push this ratio to around 2.00. The amount of additional clean electricity NY State will need by 2050 to achieve its energy goals is in the order of twice what the State produces today from all sources. **Clearly this would require electricity generation from all clean energy sources: renewable energy and nuclear power, and with emphasis on energy efficiency. Shutting down Indian Point using fictional reasons could send the wrong message for any utility considering investing in new nuclear plants in New York.**

3.3.3 Other Issues

In spite of NYISO's conclusions about severe transmission limits, that the State plans to build, by 2030, the world's largest wind farm off of Long Island with a capacity of 2400 Megawatts, using gigantic 8 MW to 10 MW machines. This mammoth project is risky. There is essentially zero experience operating such gigantic machines in the United States. The closest comparison is five 6 MW machines recently completed off of Block Island, Rhode Island which are twice the height of the Statue of Liberty and have an electricity cost of 24.4 cents per kilowatt-hour.

Constructing this offshore capability many first require expanding the ability of manufacturers to build the very large platforms these wind turbines depend upon. These platforms may have to be bigger than the ones in use off of Block Island because the wind turbines are considerably larger and the off-Montauk Point location has deeper water than the Block Island location. These huge machines also require special ships, called jack-up ships, to lift them into place. There are a limited number of such ships and to attempt to complete this mammoth project by 2030 might require funding the construction of more jack-up ships.

In early 2018 a report is expected to be published by NY State on this project. This report should be carefully reviewed as the cost for this “world’s largest wind farm” is likely to be many billions of dollars

3.3.4 Conclusions

Several conclusions can be reached about the role of the State, and especially the PSC, in meeting the State’s 2050 energy goal:

A. The threat from climate change is existential, but the time left to effectively deal with it is short.

B. The State is not acting in an coherent manner. The need to achieve reliability and the need to reduce the releases of GHG are in conflict and must be resolved.

C. The REV program is far too small. 82% of the GHG releases in NY State come from the end use sectors while the GHG releases from the electric power generation is only 18%. Even if all the electricity in NY State were carbon-free, this would be far from sufficient to deal with climate change.

D. Reducing the release of GHG from the end use sectors is much more difficult than reducing GHG releases from the electricity production sourcs.The number of fossil fueled end use items that must be replaced are in the tens of millions while the number of clean electricity sources that must be built run from a few dozen to 10-20 thousand. Both types of replacements need to go forward.

E. The State does not seem to have a plan to deal with all the end use sectors

F. All sources of carbon-free electricity are needed, including nuclear power.

G. Shutting down Indian Point increases the risks from climate change.

3.4 SCENARIO FOUR: Adjusting the Agreement

3.4.1 Purpose

The purpose of Scenario Four is to reduce or eliminate these risks and hardships caused by the Agreement.The bottom line, however, is that there are multiple reasons to continue to operate the Indian Point power plants well beyond its scheduled shutdown dates.

3.4.2 Regional Risks

3.4.2.1 NYC-Economic Risks

NYC is the economic engine for NY State. Degraded economic conditions in NYC would have a negative effect throughout the whole State of New York.

NYC's economic vitality, in turn, depends, in part, upon its transportation system. While many other sections of the nation await greater use of electrified transportation, often through increased use of electric vehicles, NYC's uniquely high rate of public transit makes it one of the nation's most energy efficient cities in the United States. New York State is tied with Alaska as the State with the fewest vehicle miles traveled per person.

Even though the NYC subways are critical to the economic health of NYC they are in *"unacceptable disrepair"*, according to Dani Lever[38], a spokeswoman for Governor Cuomo. According to the NY Times, *"Daily ridership has nearly doubled in the past two decades to 5.7 million, but New York is the only major city in the world with fewer track miles than it had during World War II."* After a rush hour train careened off the rails, a track fire sent nine riders to the hospital, a stalled train in a downtown tunnel left hundreds in the dark without air conditioning for nearly an hour, and another derailment that injured 34 people, Governor Cuomo declared that the subway system was in a *"state of emergency"*. These failures are the result of a lack of funds to perform adequate maintenance. As the NY Times points out, *"While many politicians have contributed to the decline of the subway over the years, the problems reached fever pitch under Mr. Cuomo, who as Governor appoints the M.T.A. chairman and effectively controls the authority."* Complex crit-

[38] "How Politics and Bad Decisions Starved New York's Subways", B. Rosenthal, et al, New York Times, November 18, 2017

ical systems, like NYC's subway system and the State's electricity supply, need to be protected from the neglect that can grow out of short term political expediencies.

Even if all the necessary repair and maintenance of the NYC subway system were performed over time, there is another complex critical system whose failure would also threaten the viability of the NYC subway system, and therefore NYC and NY State. This is NYC's complex electric power supply system that, among many other tasks, energizes the subways. So far the needed electricity to operate the subways has been comparatively reliable. A large portion of this electricity is supplied by the Indian Point nuclear power plants through the Con Edison's system. However, without Indian Point, NYC, the MTA, and the State government would have to find alternative reliable and adequate sources of replacement energy to avoid further transportation disruptions. **Because The Agreement allows Entergy to shut down of Indian Point at any time,** NY State needed to identify **by January 9, 2017** where this replacement subway electricity would come from. The State did not do this when the Agreement was signed. Now, after NYISO has published its report on where replacement electricity might come from, we find that it will not come from renewable electricity sources, but rather fossil fuels, and that by supplying this fossil fueled electricity to partially replace Indian Point it further jeopardizes the future reliability of NYC's electricity supply which is already in a shaky condition with a very high percentage of over-aged power plants. About $4 billion dollars are now going to be spent on new subway cars with great emphasis on getting them into operation as soon as possible. This is a partial down payment of what needs to be done. The NYC electric supply also needs greater investments without further delay. NYC should not go from crisis to crisis.

In summary, New York City, already experiencing a crisis in its subway system because of inadequate maintenance, is also facing a challenge in its electricity supply system where many of its generating facilities are already beyond the age when they would normally be retired. The present subway crisis could be greatly magnified if the Indian Point plants are prematurely retired since these nuclear plants supply, through the Consolidated Edison system, about 25% of NYC's electricity. NYC probably would not be able to make up the shortfall in the electricity now supplied by the Indian Point power plants, even if it resorted to greater use of its existing fossil fueled power plants. Since NYC highly depends on its electrified transportation systems, an expanded subway crisis would be a threat to NYC's economic viability.

3.4.2.2 New York City and Surrounding Areas- Health Risks

NYC, Westchester County, and Rockland County do not meet EPA's air pollution standards. In NYC alone air pollution[39] is identified as the cause of 400 premature deaths per year, 850 hospitalizations for asthma per year, and 4,500 emergency department visits for asthma per year.

Westchester and Rockland Counties also experience air pollution which leads to asthma and cardiac deaths. In NYC the two biggest sources of air pollution are from automobile exhausts and from burning fossil fuels, like oil, for space heating and hot water in the residential and commercial sectors.

To lower or eliminate these air pollution related deaths and emergencies, the burning of fossil fuels in the transportation, residential, and commercial sectors must come to an end. This could be achieved with replacement of fossil fueled end use "devices", such as the replacement of today's passenger cars with electric vehicles. Other world cities, like Paris, are headed towards an all electric transportation future. However, such clean replacements would require more electricity to be produced. Yet NYC is already facing an electrical infrastructure challenge, which would be made all the worse if gas plants now in construction are dedicated to replacing Indian Point instead of NYC. As long as there is a electrical reliability situation in NYC, it is difficult to believe that NYC would be able to take on additional electric loads that would be needed to stop air pollution. It is ironic that 400 deaths, year after year, could occur in NYC, partially because of a lack of sufficient electricity, while NY State has acted to shut down Indian Point which does not produce any air pollution. All the gas plants in NYC have a back up capability to operate on oil if there is a shortage of natural gas. So the reality of NYC's electric supply system is that NYC uses fossil fuels backed up by other fossil fuels, while touting insignificant solar energy systems. If gas shortages occur, burning oil would be more polluting than burning gas.

[39] NYC Department of Health and Mental Hygiene: Air Pollution and the Health of New Yorkers

3.4.3 Reducing Local Economic Risks

3.4.3.1 Jobs and the Tax Base

Cortlandt Town Supervisor Linda Puglisi has estimated that the closure of the Indian Point plants will result in the loss of at least 1600 jobs between employment at the plants and contractors. Some 46% of the village of Buchanan's tax revenues come from Entergy. One of the biggest impacts would be on the local schools and that will affect local homeowners. One third of the annual revenue of the Hendrick Hudson School District comes from Entergy. The closure of Indian Point will also affect the tax revenue for Westchester County. It is reported that Entergy pays about $1 million dollars per year to the town of Cortlandt and about $4.5 million to Westchester County. As WCBS 880's Peter Haskell reported, Indian Point pays $32 million dollars a year in State taxes.

Suggestions by Entergy that it would offer jobs to Indian Point workers at other Entergy facilities rings hollow. Entergy is in the process of shutting down its nuclear plants. If NY State hadn't taken the action it did, the FitzPatrick plant in upstate NY, once owned by Entergy, would also have been closed. Entergy plans to close its Pilgrim nuclear plant in Massachusetts and, until recently, its palisades plant in Michigan. How many jobs did/will Entergy provide for the workers at the other nuclear plants it plans to shut down? In addition to Entergy, other utilities have closed or may close some of their nuclear plants because of the present very low price of natural gas. Therefore many experienced Indian Point nuclear workers could be looking for employment in an industry that is contracting at this time. If Entergy actually could provide meaningful employment for some Indian Point workers, it should provide specific job descriptions now, before the plants have closed. To date, how many specific jobs have been offered by Entergy?

The whole issue of job loses and tax revenues could be postponed for many years if the Agreement were revised to reflect the new information that has come forward in the past year. There is no basis to shut down Indian Point at this time and multiple reasons to keep it open. People, businesses, local governments, school districts and other stakeholders should insist that the ill-conceived Agreement be rewritten to reflect both the will of the people and the supporting science.

3.4.3.2 Eliminating Decommissioning and Remediation Costs

The enormous issue of decommissioning was barely touched on in the Agreement. The Agreement stated that *"Radiological decommissioning, and those site remediation activities [are] under the sole authority of the NRC"*. This cryptic statement may leave some people with the impression that the Nuclear Regulatory Commission will pick up the expense of decommissioning. This is not so. The role of the NRC is limited to radiation protection. Since the Agreement was issued, the NRC has clarified that it is the licensee (Entergy in this case) that is responsible for meeting the expenses incurred in the decommissioning process. Further, the NRC has clarified that radioactive spent fuel could remain at the Indian Point site up to 60 years. As NRC Spokesman Neil Shannon recently said about Vermont Yankee[40] "Keep in mind, the spent fuel could remain on-site for many decades to come."

While it came as a surprise to many local people that the use of the Indian Point site could be lost for decades and that radioactive spent nuclear fuel could remain on the site during this lengthy time period, this appears to have been well known to some NY State officials. NY State, along with Vermont, Massachusetts, and Connecticut, have been lobbying the Nuclear Regulatory Commission to tighten its financial rules and broaden its cost projections for decommissioning nuclear plants[41]. These states argue that the 60-year decommissioning schedule allowed under NRC's SAFSTOR program should be reduced to 10 years.

All the costs for decommissioning the Indian Point power plants and the remediation of the Indian Point site are the sole responsibility of Entergy, not the Federal Nuclear Regulatory Commission's and not the people of New York. New York State should have required in the Agreement that Entergy produce the full amount of money to complete decommissioning and site remediation within ten years after the day when all power production at Indian Point ceased. If this decommissioning goal is applied to Indian Point it could become the template for the eventual shut down of the four upstate nuclear plants.

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[40] "Nuke agency OKs Entergy Nuclear's use of trust fund", Susan Smallheer, Rutland Herald, March 14, 2017.

[41] "Vt. Fears Covering Nuclear Cost", Mike Faher, VTDIGGER, March 24, 2016

What must absolutely be avoided is a repeat of the 1989 Shoreham nuclear power plant shutdown fiasco on Long Island. Based on the public's unjustified fears about evacuating the Shoreham area in the unlikely event of an accident, the brand new Shoreham plant was prematurely closed. Long Island Lighting sold Shoreham to a NY State agency, the Long Island Power Authority, for one dollar and in the process transferred a debt of about $6.5 billion dollars to the citizens of New York. Twenty years later, in 2009, Long Islanders were still paying off its remaining debt, $3.3 billion dollars at that time[42]. To this day the Shoreham site is unused and empty buildings still sit there. In large part the carbon-free electricity that Shoreham would have produced was generated by fossil fueled power plants.

There are several problems associated with the decommissioning of the Indian Point power plants and the remediation of the Indian Point site. There does not appear to be a full accounting of how much money is in the decommissioning funds for units one, two, and three. Further, a detailed cost estimate covering all three units may not have been produced. Therefore, at this time, the amounts of any financial shortfalls to perform decommissioning and remediation are unknown. When there are shortfalls the NRC allows up to 60 years in their Safstor program to complete the decommissioning and remediation process. The assumption is that the decommissioning funds will grow over time during this decades long period so that the decommissioning and remediation process can be completed. If the cost of decommissioning and remediation also increases through inflation, or for other reasons, the time to achieve sufficient funds may be stretched out, but still within 60 years. This arrangement results in an intergenerational transfer of financial burdens.

Adequate safety must be assured as long as there is radioactive material on the site.The NRC allows the radioactive spent fuel elements to remain on site, but stored in dry casks or in the spent fuel pools until they are cool enough to be put into dry casks.

Paying decommissioning costs has been a source of conflict. Entergy is embroiled with the State of Vermont over decommissioning costs after shutting down its Vermont Yankee nuclear plant. Entergy plans to shut down its Pilgrim Nuclear plant in Massachusetts in 2019. There is a group of people in Massachusetts that argue that the decommissioning fund for the Pilgrim plant is not adequate.

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[42] "Planning the Fate of a Nuclear Plant's Land", John Rather, NY Times, Jan.1, 2009

Concerns about the adequacy of the decommissioning funds can be greatly reduced by allowing Indian Point to continue to operate as long as the Nuclear Regulatory Commission determines that it has maintained high safety levels. The goal should be to have sufficient decommissioning funds so that the Indian Point site could once again be open for business within ten or fewer years after final shutdown. There could be ample time to achieve this. Many nuclear power plants already have NRC licenses that are valid for 60 years and, recently, there are efforts by a few power plants to increase this period to 80 years. **Again, the key to avoiding decommissioning conflicts is to safely operate these plants until the size of the decommissioning fund is large enough so that it would take 10 or fewer years to return the Indian Point site to a source of jobs and tax revenue.**

3.4.3.3 Opening up the Indian Point Site for New Jobs and New Tax Revenue

How long might the Indian Point site may be unavailable before new businesses could create jobs and tax revenue? Tom Joyce, a lobbyist for Entergy, stated[43], at a meeting on Entergy's Pilgrim nuclear plant, that the average time frame for decommissioning is 12 to 15 years. The actual length of the decommissioning time period depends on the sufficiency of the decommissioning fund. As a minimum, it takes about 5 years for the last batch of spent fuel to cool off enough to begin the transfer to on-site dry casks. It takes time to complete this final transfer to dry casks.The removal of these dry casks containing the radioactive spent fuel from the Indian Point site depends on the ability of the US Department of Energy to construct nuclear waste storage facilities with enough capacity to take the nuclear waste from Indian Point, along with all the nuclear waste from already closed nuclear plants that may be in line ahead of the Indian Point plants.

Congresswoman Nita Lowey, Ranking Member of the House Appropriations Committee, introduced legislation, the Removing Nuclear Waste from Our Communities Act, (H.R. 4442), to expedite the removal of spent fuel rods to interim nuclear waste storage facilities **elsewhere** in the country. Had this legislation been introduced and enacted years ago it is possible that interim or permanent nuclear waste storage facilities would exist today.

There are radioactive spent fuel elements from the three nuclear reactors, Units 1,2, and 3 at the Indian Point site (Unit 1 has not been operated for years). There also are

[43] "$25 million a year decommissioning fee proposed for Pilgrim nuclear plant", Cape Cod Times, November 6, 2017

radioactive spent fuel elements from the four upstate nuclear plants. It may be that the removal of nuclear wastes from existing plants sites would be accomplished most rapidly if New York built its own, federally approved, nuclear waste site and gave priority to the nuclear plants within New York. If so, local communities that host such interim sites should be compensated.

The complete removal of radioactive material from the Indian Point site is likely to take many years if these plants are shut down on their present schedule. **However, the longer these plants operate, the more time there is to grow the decommissioning fund and the more time there is to build interim nuclear waste facilities. The longer these plants operate the sooner the Indian Point could be returned to a location where new businesses could locate, create jobs, and pay tax revenues.**

3.4.4 Improving Safety

An opportunity exists to improve the safety at Indian Point. The present emergency plan should be modernized. Specifically, if the General Emergency alarm was issued, people in the inner most one mile from the plant, about 5,000 people, should be evacuated to pre-designated shelters prior to any release of radioactive material into the atmosphere. If plant conditions did not stabilize within another 2 hours, the evacuation should be expanded to the innermost two miles prior to the release of radioactive material, for a two- mile total of around 20,000 evacuees. These additional evacuees would also be directed to pre-designated shelters. In the event of an actual release of radioactive material, people downwind of the site would be advised to take shelter until they are informed that they can resume natural activities. After the radioactive plume had passed, Emergency Responders would also look for radioactive “hot spots” and relocate people out of these hot spots. In response to the Fukushima accident, citizens were relocated from two “hot spots”, even though these hot spot locations were beyond the ten mile radius of the Emergency Planning Zone. There would be ample time to carry put these localized relocations. In Japan there were two localized relocations, one about one month after the accident and another after about two months.

The major health advantage of updating Indian Point’s emergency plan is to avoid fatalities and injuries that might arise from radiological and non-radiological causes. By far the larger risk is from non-radiological causes. About 1600 fatalities are attributed to over-evacuation at Fukushima. Further, once told to evacuate, people

can refuse, out of fear, to return to their homes. Years after the Fukushima accident several tens of thousands of Japanese, many of whom need not have been evacuated, refused to leave the government's shelters and return to their original homes

3.4.5 A Better Role for Riverkeeper

In view of the facts that Riverkeeper's own website shows that Indian Point is safe and that a 50 mile evacuation idea is worse than absurd, that its Synapse report is seriously flawed and should not be used for decision making, that the final result of its efforts to close Indian Point will result in significantly increasing the release of greenhouse gases in New York, Riverkeeper should re-examine its purpose.

Climate change is the existential environmental threat to life on this planet and it would be valuable for Riverkeeper to make the climate change threat its highest priority. However, there is a need for Riverkeeper to regain some of its credibility after this Indian Point misadventure.

Regaining public confidence can be achieved by Riverkeeper through an opportunity in the present Agreement. The Agreement establishes that Entergy will provide $15 million dollar Community Fund, the goal of which is to fund projects designed to benefit the Hudson River and to support the community, and to provide environmental protection and other public benefits to the community.

It would certainly be a benefit to the community if some of this $15 million dollars was used to employ emergency planning experts to develop a detailed report on how to implement the modern emergency plan described in this report. Following the completion of this modern emergency plan report Riverkeeper could take on the task of communicating the results of this report to the community. If Riverkeeper took on the task of describing the modern emergency plan to the community it should be compensated from this Community Fund.

3.4.6 Interacting With Entergy

Entergy has consistently stated that Indian Point is safe and that the reason it is willing to shut down Indian Point is just economics, i.e., the low cost of natural gas. The low cost of natural gas has already forced the closure of many coal plants and some nuclear plants. However, New York has been a leader in recognizing the climate change, health, and jobs benefits of emission free nuclear power and is now subsi-

dizing the four upstate nuclear plants. Other States have followed New York's example and are financially supporting their nuclear plants.

What needs to be explored is whether a mutually beneficial financial arrangement might be reached with Entergy that results in keeping the Indian Point plants open. There are reasons to be optimistic that such a financial agreement could be reached.This report has already shown that the safety objections that have been raised are invalid. NY State and Riverkeeper have withdrawn their environmental objections to continued operation of these plants in order for Entergy to secure an extension of the original 40 year licenses held by these power plants. Some of the expenses Entergy has cited in these proceedings, like the high legal fees for litigating license renewal and the cost for safety upgrades following the Fukushima accident, are done with. The modern emergency plan discussed in this report is simpler than the present emergency plan and therefore may cost less per year. Extending the operation of Indian Point would significantly ease the whole decommissioning situation for Entergy.

Most encouraging, Entergy has shown that it is willing to respond to attractive financial arrangements. Entergy had originally planned to close its 798 MW Palisades plant in Covert, Michigan by October, 2018. This closure date has now been extended five years[44] until the spring of 2022 upon a significant payment by the Michigan Public Service Commission which has led to this extension.

As part of an adjusted Agreement, NY State and Entergy should work together to create a mutually acceptable new financial arrangement; one that ensures adequate decommissioning funds.

3.5 Conclusions

The longer these plants operate, the more time local jobs and tax revenues would continue, the more time carbon-free electricity would be produced, the more time electricity shortfalls would be delayed or reduced, the more time there is to grow the decommissioning funds, the more time there is to build interim nuclear waste facilities, the more time there is to avoid entering the NRC's Safstor program which would allow radioactive spent fuel to remain on the Indian Point site for up to 60

[44] "Entergy Gives Palisades Nuclear Plant Five More Years to Run", Power Magazine, 09/28/2017

years, the more time to modernize the emergency plan, and the more time there is for local jurisdictions to plan for the inevitable closure of these plants.