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Indian Point 2017 Annual Assessment Meeting Written Comments Compilation

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NUCLEAR REGULATORY COMMISSION'S ASSESMENT OF THE SAFETY PERFORMANCE OF INDIAN POINT UNITS 2 & 3 FOR 2016

June 14, 2017

My name is John Ravitz, the Executive Vice President & COO of The Business Council of Westchester (BCW). The BCW is the county's largest and most influential business membership organization. Our mission is to enhance wealth, profitability and economic opportunity for all in Westchester County by helping our members grow their businesses.

The BCW has always supported the re licensing of Indian Point due to their long history or safety, protecting the environment and playing a pivotal positive role in the county's fiscal landscape.

Indian Point is a vital economic engine in Westchester County and the Lower Hudson Valley region. It has been operated in a safe and reliable manner since it was first built. As the former head of Westchester County's branch of the American Red Cross, I can attest that Indian Point is focused on the safety and security of the plant and area residents. Safety redundancy and backups are built into physical plant and its operations. The Nuclear Regulatory Commission recognizes this time and time again. Attendees here tonight should know that the NRC maintains a presence within the plant 365 days a year. First responders work with plant officials to coordinate emergency response plans and run safety and evacuation drills. Indian Point is thoroughly prepared for any emergency, extreme weather event, or contingency that should arise. Not only is Indian Point one of the safest energy sites in the nation, it is a model for rigorous processes, competent responses and regulatory cooperation.

Furthermore, our families and local economies cannot sustain the loss of affordable energy and incomes which would destabilize our communities across the board. Indian Point is one of the largest businesses in the area. As you know, most of the job growth in the state happens exclusively within the bounds of New York City, and New York is consistently rated as one of the worst states for business.

An independent study by The Business Council of Westchester found the effects of closing Indian Point will be catastrophic for Westchester County. Businesses and consumers will be left with higher electric rates, more power outages, and increased carbon emissions: all told, $11.5 billion in negative economic impact.

It is important to remember that Indian Point supplies New York City and surrounding areas with one quarter of its entire baseload power. Scrambling to transition from Indian Point energy could throw the area into disarray and be very costly. Other solutions would be harmful for the lives of citizens, since they would probably involve revamped production from peekers, exacerbating asthma and air pollution, which is also contrary to the goals of the CES that is at the heart of this meeting.

Nuclear Regulatory Commission Annual Meeting – June 14, 2017

Susan Van Dolsen Harrison, NY

Thank you for allowing me to speak. My name is Susan Van Dolsen and I have lived in Westchester most of my life. Indian Point has been operating for most of that time. I was in college in central Pennsylvania during the Three Mile Island nuclear accident and our school was evacuated. The students were thrilled to get what we called a "radiation vacation," but at the same time the fear of radioactive disaster has stayed with me since that time in 1979. For many years, I ignorantly assumed that oversight of the Indian Point nuclear power plant here in our backyard was adequate and that we were ok. However, in the past four years I've learned that the NRC is captive to the industry it is supposed to regulate and willingly ignores and dismisses serious problems with potentially grave consequences. There are three gas pipelines currently operating on the Entergy property, one is a 30" pipeline only 300 feet from the control room that was installed prior to the plant's siting, and the other is the recently completed huge 42" diameter Spectra AIM high-pressure fracked gas pipeline that runs across Entergy property for 2,159 feet. The NRC never conducted an analysis of the old pipelines. An analysis of the siting of the new AIM pipeline was done using false information and in violation of the NRC's own regulations that require an independent risk assessment to be conducted. A "back of the envelope" calculation that wouldn't be acceptable from an 8th grader was used to justify the NRC's conclusion that the pipeline did not pose an "additional risk." National pipeline expert, Richard Kuprewicz, said "My extensive experience in pipeline rupture investigations, spanning many decades, indicates that Entergy, the NRC, and others making statements that a 42-inch pipeline rupture can be quickly isolated and implying that the pipeline operator can quickly remotely recognize and isolate the pipeline rupture within minutes (such as shutdown in three minutes) are misleading and downright false."

A few months ago, Entergy announced a deal with New York State and Riverkeeper to close the plant in 2020/21. The announced closure of Indian Point now means

that the NRC will have the critical role of overseeing the decommissioning process. How are we to trust that the NRC will bring in the proper experts and ensure that the operator presents a viable and secure plan when you failed so miserably during the regulatory process for the Spectra AIM Pipeline? In order to foster trust, I believe that the NRC must engage an independent pipeline expert along with other independent nuclear experts to fully evaluate the risks posed by the gas pipelines and other hazards, including the potential for terrorism and seismic activity at the plant whether it is open or closed. Additionally, an independent citizens advisory board should be engaged to participate in the process of planning the decommissioning. The tons and tons of irradiated fuel are extremely vulnerable and it will take 60 years or more to decommission the property. Any ideas to develop the Indian Point property or the nearby Con Edison property for use for a gas fired power plant are foolhardy and should be dismissed publicly immediately. The dangers and risks are already misunderstood, so it would be extremely foolish to add yet another energy infrastructure component, a climate killing fossil fuel plant, to this potentially disastrous situation. I urge you to engage the public and independent pipeline, seismic and nuclear experts to participate in the decommissioning planning process as soon as possible in order to try to rebuild some trust in your ability to regulate the process.

Thank you.

Spent fuel fire on U.S. soil could dwarf impact of Fukushima

By Richard Stone May. 24, 2016 , 8:00 PM

A fire from spent fuel stored at a U.S. nuclear power plant could have catastrophic consequences, according to new simulations of such an event.
A major fire "could dwarf the horrific consequences of the Fukushima accident," says Edwin Lyman, a physicist at the Union of Concerned Scientists, a nonprofit in Washington, D.C. "We're talking about trillion-dollar consequences," says Frank von Hippel, a nuclear security expert at Princeton University, who teamed with Princeton's Michael Schoeppner on the modeling exercise.
The revelations come on the heels of a report last week from the U.S. National Academies of Sciences, Engineering, and Medicine on the aftermath of the 11 March 2011 earthquake and tsunami in northern Japan. The report details how a spent fuel fire at the Fukushima Daiichi Nuclear Power Plant that was crippled by the twin disasters could have released far more radioactivity into the environment.

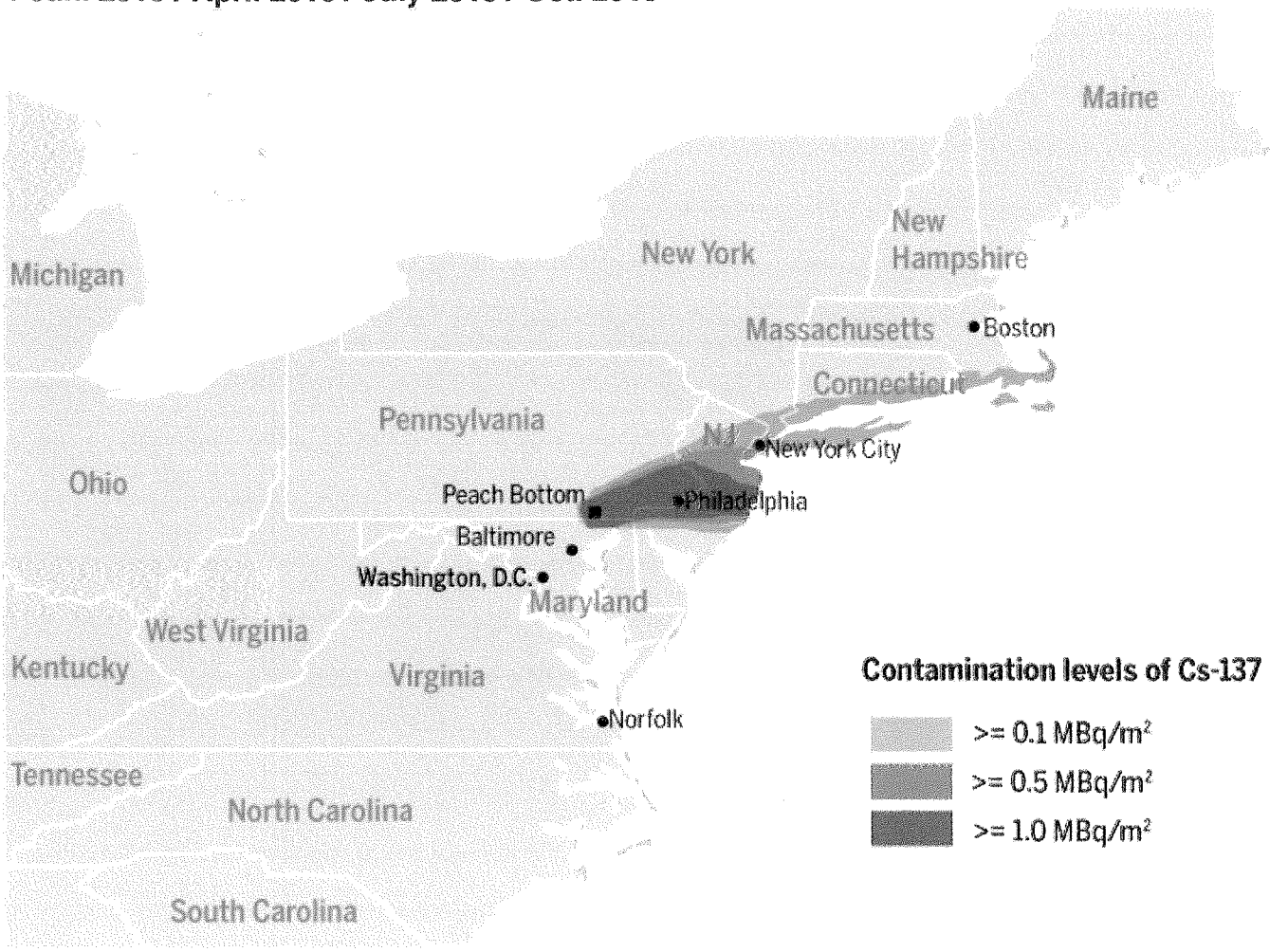
The nuclear fuel in three of the plant's six reactors melted down and released radioactive plumes that contaminated land downwind. Japan declared 1100 square kilometers uninhabitable and relocated 88,000 people. (Almost as many left voluntarily.) After the meltdowns, officials feared that spent fuel stored in pools in the reactor halls would catch fire and send radioactive smoke across a much wider swath of eastern Japan, including Tokyo. By a **stroke of luck**, that did not happen.

But the national academies's report warns that spent fuel accumulating at U.S. nuclear plants is also vulnerable. After fuel is removed from a reactor core, the radioactive fission products continue to decay, generating heat. All nuclear power plants store the fuel onsite at the bottom of deep pools for at least 4 years while it slowly cools. To keep it safe, the academies report recommends that the U.S. Nuclear Regulatory Commission (NRC) and nuclear plant operators beef up systems for monitoring the pools and topping up water levels in case a facility is damaged. The panel also says plants should be ready to tighten security after a disaster.

At most U.S. nuclear plants, spent fuel is densely packed in pools, heightening the fire risk. NRC has estimated that a major fire at the spent fuel pool at the Peach Bottom nuclear power plant in Pennsylvania would displace an estimated 3.46 million people from 31,000 square kilometers of contaminated land, an area larger than New Jersey. But Von Hippel and Schoeppner think that NRC has grossly underestimated the scale and societal costs of such a fire.
NRC used a program called MACCS2 for modeling the dispersal and deposition of the radioactivity from a Peach Bottom fire. Schoeppner and Von Hippel instead used HYSPLIT, a program able to craft more sophisticated scenarios based on

historical weather data for the whole region.

Nightmare scenarios
A simulated spent fuel fire at the Peach Bottom nuclear power plant in Pennsylvania had a devastating impact on the mid-Atlantic region. Click on the dates to see the extent of contamination, which depended on weather patterns. Courtesy of F. Von Hippel and M. Schoeppner
1 Jan. 2015**1 April 2015 1 July 2015 1 Oct. 2015**



In their simulations, the Princeton duo focused on Cs-137, a radioisotope with a 30-year half-life that has made large tracts around Chernobyl and Fukushima uninhabitable. They assumed a release of 1600 petabecquerels, which is the average amount of Cs-137 that NRC estimates would be released from a fire at a densely packed pool. It's also approximately 100 times the amount of Cs-137 spewed at Fukushima. They simulated such a release on the first day of each month in 2015.

The contamination from such a fire on U.S. soil "would be an unprecedented peacetime catastrophe," the Princeton researchers conclude in a paper to be submitted to the journal *Science & Global Security.* In a fire on 1 January 2015,

with the winds blowing due east, the radioactive plume would sweep over Philadelphia, Pennsylvania, and nearby cities. Shifting winds on 1 July 2015 would disperse Cs-137 in all directions, blanketing much of the heavily populated mid-Atlantic region. Averaged over 12 monthly calculations, the area exposed to more than 1 megabecquerel per square meter -- a level that would trigger a relocation order -- is 101,000 square kilometers. That's more than three times NRC's estimate, and the relocation of 18.1 million people is about five times NRC's estimates.

NRC has long mulled whether to compel the nuclear industry to move most of the cooled spent fuel now held in densely packed pools to concrete containers called dry casks. Such a move would reduce the consequences and likelihood of a spent fuel pool fire. As recently as 2013, NRC concluded that the projected benefits do not justify the roughly $4 billion cost of a wholesale transfer. But the national academies's study concludes that the benefits of expedited transfer to dry casks are fivefold greater than NRC has calculated.

"NRC's policies have underplayed the risk of a spent fuel fire," Lyman says. The academies panel recommends that NRC "assess the risks and potential benefits of expedited transfer." NRC spokesperson Scott Burnell in Washington, D.C., says that the commission's technical staff "will take an in-depth look" at the issue and report to NRC commissioners later this year.

Posted in: **Chemistry**

Richard Stone
Rich oversees Science's international coverage.

https://www.yahoo.com/news/storage-nuclear-waste-poses-threat-u-scientists-warn-231439943.html

Storage of nuclear waste poses threat to U.S., scientists warn

By Ian Simpson, ReutersMay 26, 2017

WASHINGTON (Reuters) - The reluctance of U.S. federal regulators to require operators of nuclear reactors to spend $5 billion to enhance the security of spent fuel rods stored underground threatens the country with a potential catastrophe, scientists warned on Friday.

The Nuclear Regulatory Commission greatly underestimated the risk and potential contamination of a nuclear waste fire triggered by a quake or a planned attack, experts writing in the journal "Science" said.

In 2014, the NRC found the chance of a disaster caused by leaving radioactive waste in storage pools was too remote to warrant the cost of moving it to safer dry casks.

An earthquake that could trigger a radiation leak was likely less than once every 10 million years, hardly justifying the cost of about $50 million per reactor to transfer spent fuel, the NRC said in that report.

An accident at Japan's Fukushima nuclear plant in 2011 was triggered by a tsunami after an earthquake.

"We think the NRC gamed their analysis essentially to get the answer they want," said Edwin Lyman, a senior scientist at the Union of Concerned Scientists and one of the authors of the article in "Science," a magazine published by the American Association for the Advancement of Science.

Michael Schoeppner and Frank von Hippel of Princeton University were co-authors.

On average, such a disaster could force 8 million people to evacuate and cause $2 trillion in damage in the United States, the world's largest producer of nuclear energy, according to the report.

The commission said in a statement on Friday it stood by a staff finding last year that "the security of U.S. nuclear power plants remains extremely robust."

Rod McCullum, senior director at the Nuclear Energy Institute, an industry group, said in an email that there was ample evidence that used fuel at 90 U.S. storage sites was properly managed.

The collapse of a decommissioned tunnel at a plutonium-handling facility in Hanford, Washington, this month was a reminder of the potential risk of storing radioactive material. There was no spent fuel in the tunnel at the time and no indication anyone was exposed to radiation.

When removed from reactors, spent fuel rods are cooled under 23 feet (7 meters) of water. To reduce costs, rods are packed into vaults instead of dry storage casks, scientists wrote. If the water was drained away due to an attack or accident, the rods would burn and spew radioactive fallout.

Proposals for Reducing the Danger of Spent Fuel Pool Fires and the U.S. Nuclear Regulatory Commission's Response

Frank von Hippel
Program on Science and Global Security
Princeton University

UCS Webinar, 21 July 2016, noon EST

Based on a paper, "Reducing the Danger from Fires in Spent Fuel Pools," written with Michael Schoeppner, which has been submitted to *Science & Global Security.*

That paper builds on a recent National Academy of Sciences report,

Lessons learned from the Fukushima nuclear-accident for improving safety and security of U.S. nuclear plants, Phase 2 (2015)

http://www.nap.edu/catalog/21874/lessons-learned-from-the-fukushima-nuclear-accident-for-improving-safety-and-security-of-us-nuclear-plants

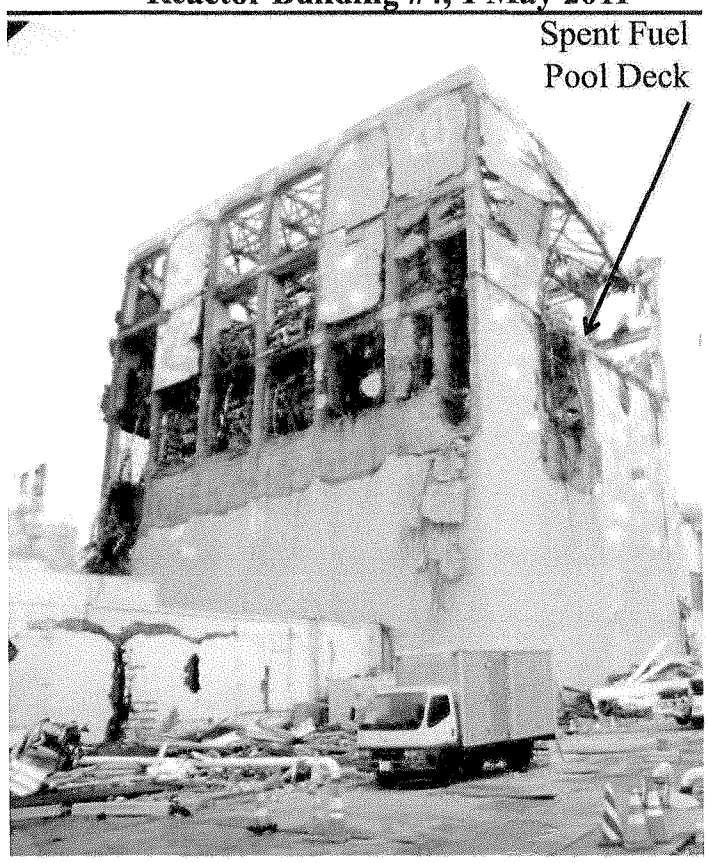
Spent fuel pool fires potentially much worse than reactor accidents.

Volatile 30-year half-life Cs-137 dominates long-term population dose and hence cancers and can force long-term evacuation of large areas.

19 megacuries (MCi) of Cs-137 in melted cores of Fukushima 1-3 but containment vessels released only 2 % to atmosphere.

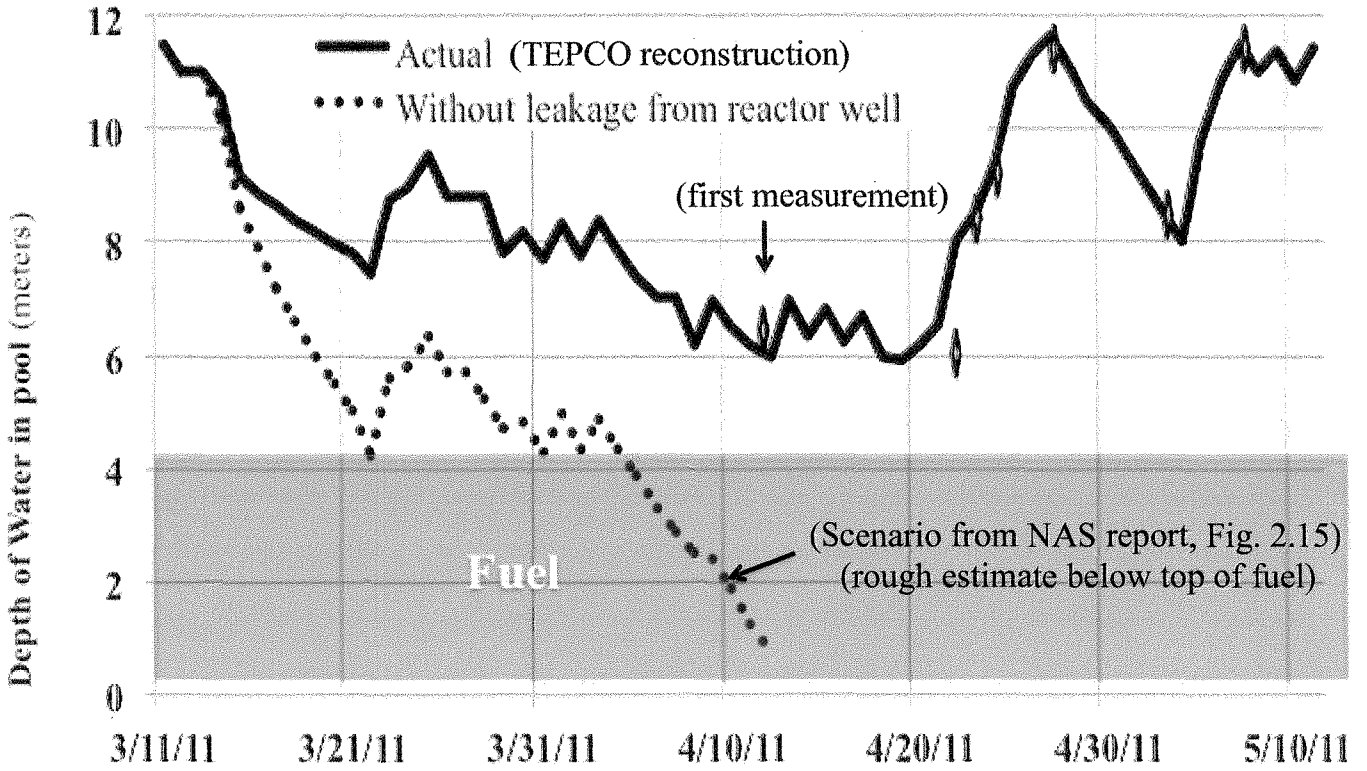
Spent fuel pool #4 contained 24 MCi but, after hydrogen explosion, it had no containment and Sandia estimates ~90% would have been released in a spent fuel fire.

Reactor Building #4, 1 May 2011

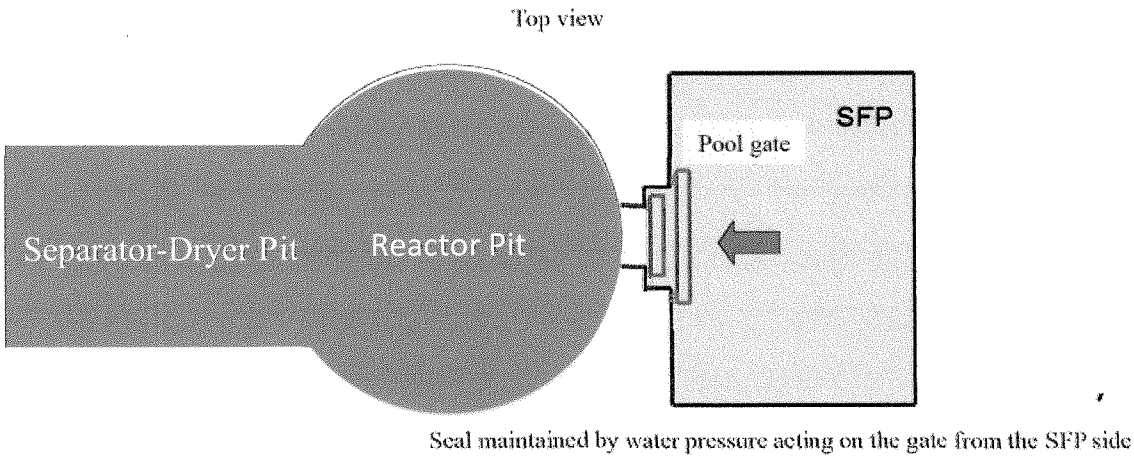


Fukushima Spent Fuel Pool #4 did not dry out because of leakage *into* the pool from the adjacent reactor pit

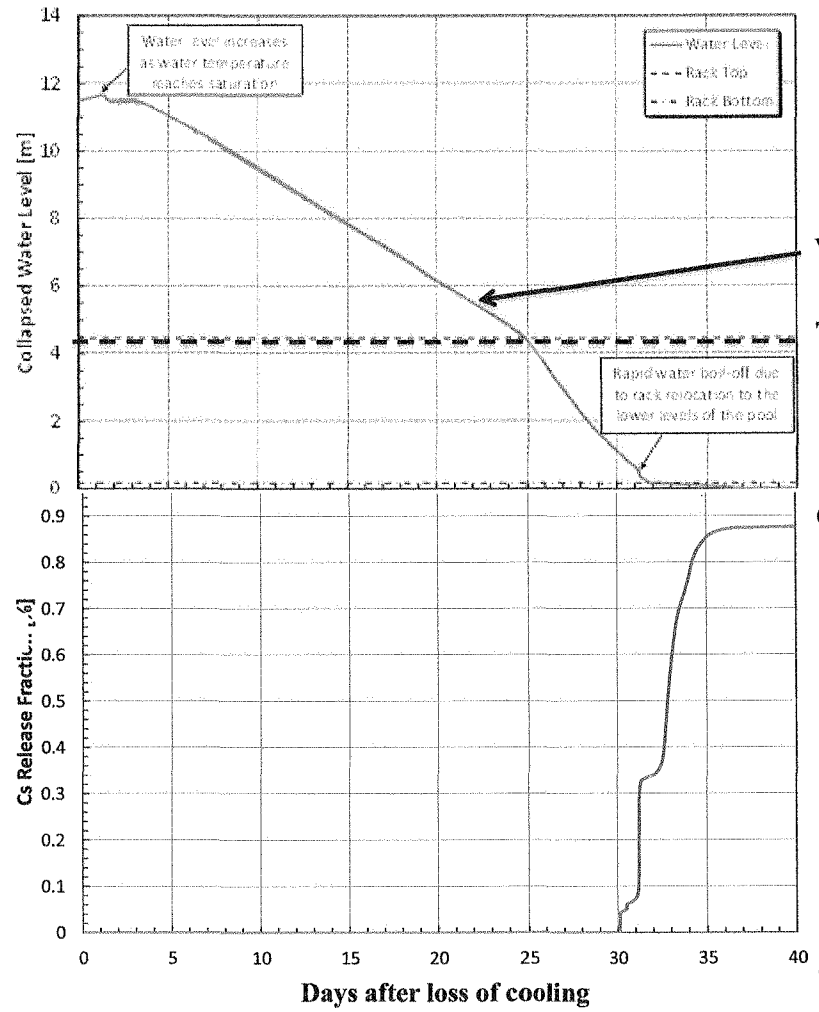
(peaks are due to additions of water by the "giraffe" cement pump)



Source of the water that kept the spent fuel covered



(Tepco 2012 Report, Attachment 9-5, Figure 3)



What if the water had evaporated?

Sandia scenario with no water addition

Water level

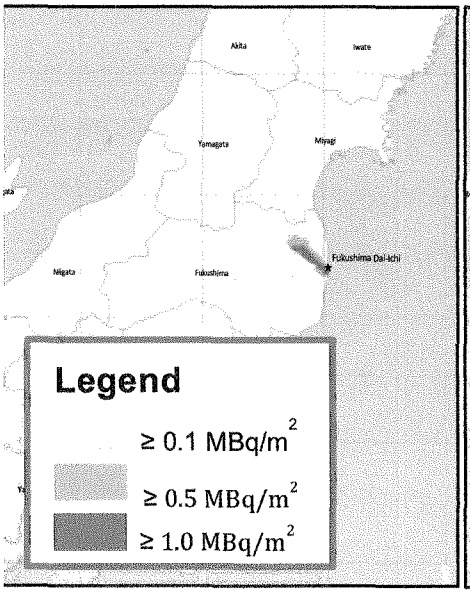
Top of the fuel

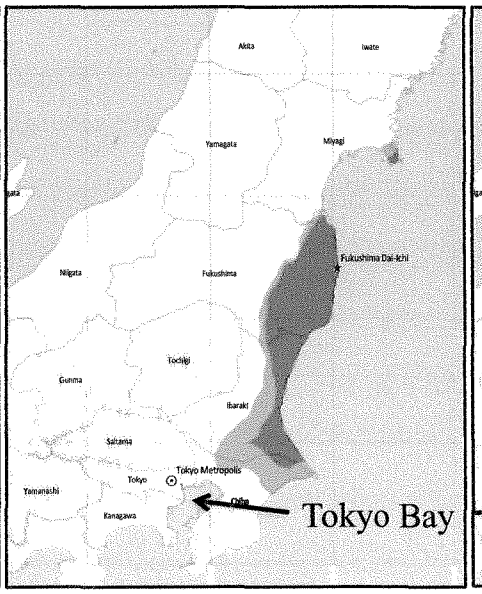
Cesium release fraction
(~88 %)

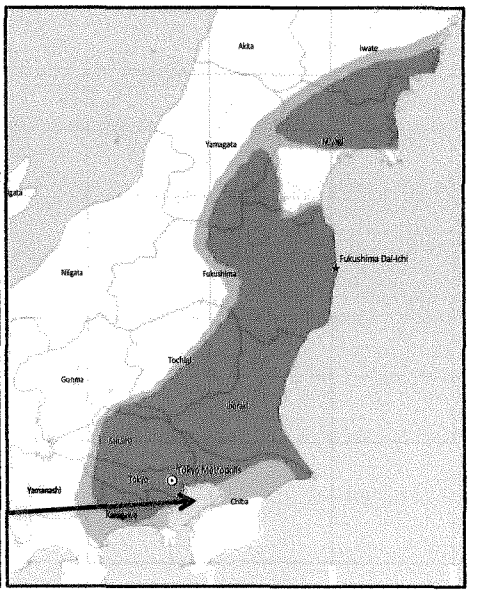
(*Fukushima Daiichi Accident Study, Status as of April 2012*, Sandia, 2012)

Fukushima evacuated populations and areas with ≥ 1 MBq/m² Cs-137 contamination

Actual Fukushima accident (3/15/2011)	Hypothetical fire in spent fuel pool #4 HYSPLIT calculations, historical weather	
	Wind to east (4/9/2011)	**Wind to south** (3/19/2011)
Evacuated: 88,000	Evacuated: 1,600,000	Evacuated: 35,000,000
1,100 km²	4,300 km²	31,000 km²







U.S. Nuclear Regulatory Commission and Spent Fuel Fires

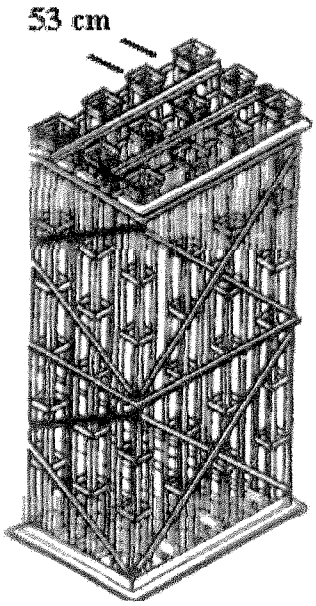
U.S. spent fuel pools originally designed to hold fuel for a few years until it could be shipped to a reprocessing plant.

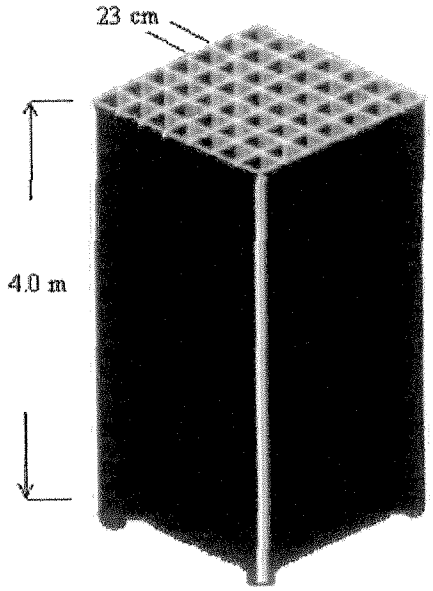
In 1982, U.S. policy changed to direct disposal.

Utilities decided to go from low-density open racking to high-density racking.

Partitions containing boron added around each assembly to prevent criticality.

National lab experts suggested staying with low-density racking in case of loss of coolant but NRC decided probability too low to be of concern.





2003 Proposal of expedited transfer to dry-cask storage

Proposal: Transfer of spent fuel to dry casks after 5 years and return to open-rack storage.*

Congress asked for a National Academy of Sciences review. NAS report recommended consideration within the context of terrorism vulnerability assessments (2004, 2006).**

In 2011, Fukushima happened.

NRC decided to study the proposal further.

Proposal failed screening test because the risks to individuals could be limited by relocating them out of contaminated zones.

Staff decided to do a cost-benefit analysis for good measure.

* Robert Alvarez, Jan Beyea, Klaus Janberg, Jungmin Kang, Ed Lyman, Allison Macfarlane, Gordon Thompson & FvH, "Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States," *Science & Global Security*, Vol. 11 (2003) pp. 1-51.

** *Safety and Security of Commercial Spent Nuclear Fuel Storage* (National Academy Press, 2006). There also was a classified report in2004.

Dry-cask air-cooled storage

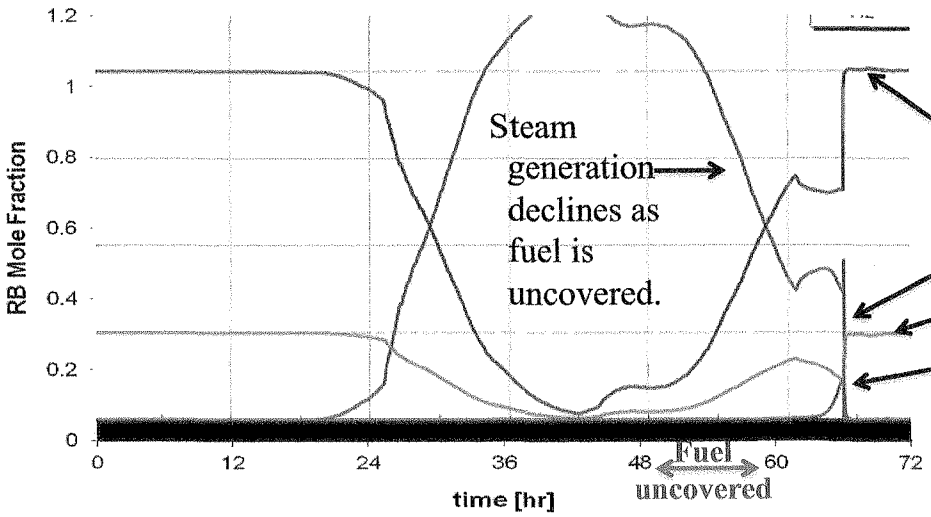
(Connecticut Yankee Nuclear Power Plant lifetime spent-fuel discharges)

NRC cost-benefit analysis: Hydrogen explosion

Staff found less hydrogen would be produced during drain-down of low-density fuel. Makes hydrogen explosion less likely.

Hydrogen is produced when the zirconium cladding of the spent fuel gets hot after it is uncovered, i.e. during drain-down by the reaction:

$$H_2O \text{ (steam)} + Zr \rightarrow H_2 + ZrO.$$



Nitrogen returns to 80% after explosion

Steam dissipates

Oxygen returns to 20%.

Explosion when H_2 reaches 10%. Building destroyed.

NRC, *Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool of a U.S. Mark I Boiling-Water Reactor (2014)*

85 Reactor building mole fraction for unmitigated high-density small leak (

The NRC cost-benefit analysis

NRC staff estimated average release of 43 MCi from a fire in a high-density pool with a hydrogen explosion and 0.6 MCi from a low-density pool without a hydrogen explosion.

Estimated cost of extra casks ~ $50 million per pool

Estimated economic costs for a high-density pool fire ~ $700 billion

Cleanup costs and radiation doses monetized at $4000/(person-rem).

Staff estimated probability of accident at 1/10,000 per pool during remaining licensed life).

($700 billion)/10,000 ~ $70 million probability-weighted benefit/pool.

But NRC rules for cost-benefit analyses:

1. ***Don't include consequences beyond 50 miles***
2. ***Use 1995 $2000/p-rem instead of current estimate of $5000/p-rem***
3. ***Discount benefits of reduced consequences in future years relative to expenditures today by 7%.***

Probability-weighted benefits go down to $7 million.

Cost-benefit test failed (using NRC's rules).

Other problems with the NRC's cost-benefit analysis

- ***Assumed zero probability of a successful terrorist attack.***[1]
- ***Assumed only involved nuclear power plant would be shut down.*** (Fukushima shut down all Japan's nuclear power plants for 5 years.)[1]
- ***Assumed decontamination by up to factor of 15 and within a year.***[2] (Japan has not achieved a decontamination factor anywhere near that large and most of the displaced population has not yet returned home.)
- ***Ignored psychological impacts.***[1] (Annual Chernobyl psychological impact has been monetized at 2-6% of Ukraine's GDP 20 years later.)[3]
- ***Ignored impacts on food exports and tourism.***[1]

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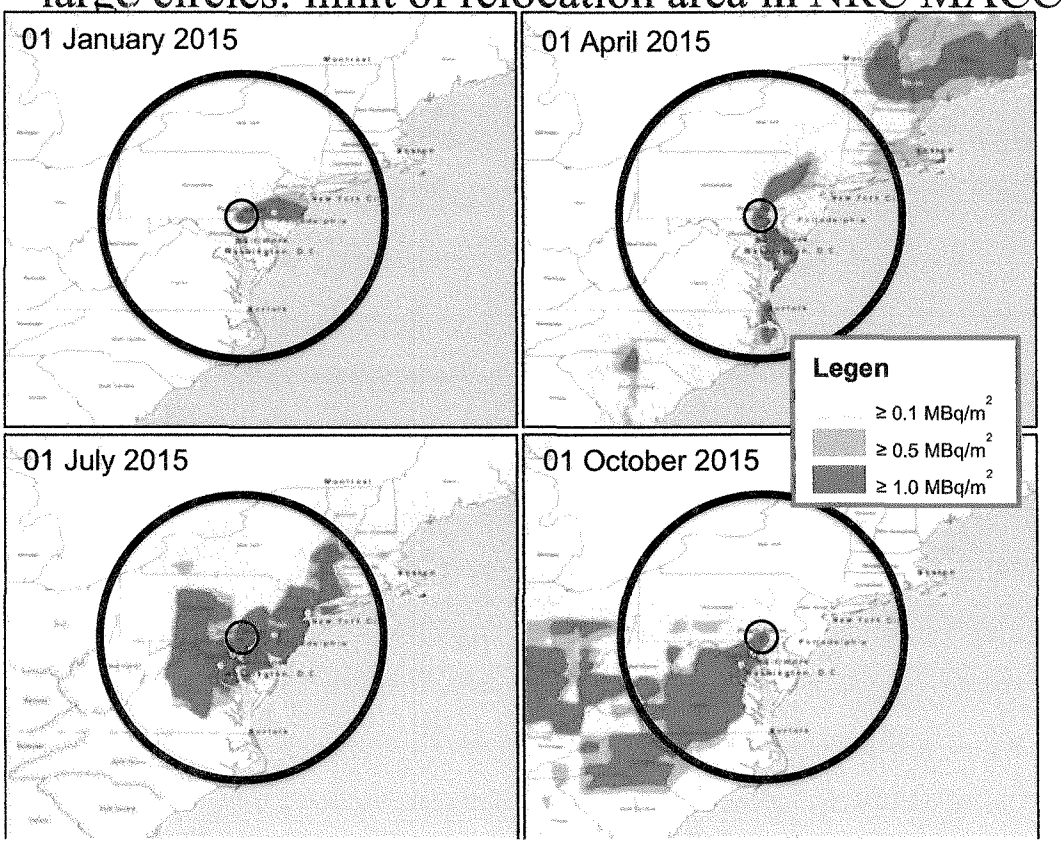
[1] NAS Report, chapter 7.

[2] U.S. NRC "In the Matter of Indian Point Generating Units 2 & 3," 4 May 2016.

[3] Danzer and Danzer, "The long-run consequences of Chernobyl: Evidence on subjective well-being, mental health and welfare," *Journal of Public Economics*, Vol. 135 (2016) pp. 47-60.

HYSPLIT calculations for 43 MCi release of Cs-137 from Peach Bottom Nuclear Power Plant with historical weather

(small circles: NRC's 50-mile cutoff,
large circles: limit of relocation area in NRC MACCS2 calculation)



Areas and populations interdicted by release at Peach Bottom, PA

(area of New Jersey is (23,000 km^2, 1600 PBq = 43 MCi)

	NRC estimate	Average of first-of-the-month 2015 HYSPLIT calculations for release of 1600 PBq from Peach Bottom for different interdiction thresholds				
		5 MBq/m^2	2.5 MBq/m^2	1.5 MBq/m^2	1 MBq/m^2	0.5 MBq/m^2
Interdicted Area (km^2)	31,000	25,000	50,000	77,000	101,000	156,000
Relocated Population (millions)	3.5 (1.3-8.8)	6.3	11.1	15.3	18.1	26.3

EPA guidance for relocation is 2 rem in first year *unshielded* (~1.5 MBq/m^2).

NRC assumed 4 rem in 5 years *shielded* with a shielding factor of 0.18-0.33(?) (~2.5-5 MBq/m^2). Would explain difference in areas.

With regard to population, NRC considers Peach Bottom in 90th percentile. Resolves that discrepancy as well.

Shielding factor is a new unresolved issue re NRC's analysis.

NRC's 1986 Quantitative Health Objectives.
If QHOs met, no need for regulatory change.

1. "***risk*** to an average individual in the vicinity of a nuclear power plant ***of prompt fatalities*** ...from reactor accidents [i.e. death from high radiation doses within weeks] should not exceed ... (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed."

Satisfied trivially by evacuation. Prompt fatalities only above 100 rem.

2. "***risk*** ...in the area near a nuclear power plant ***of cancer fatalities*** ... from nuclear power plant operation should not exceed ... (***0.1 percent***) ***of the sum of cancer fatality risks resulting from all other causes***."

Also satisfied by evacuation if frequency of spent fuel fires in U.S. is less than one in four years. (Which is the case).

Requirements have been proposed for more stringent limit on probability of massive population displacements but no evidence of NRC interest yet.

Defense in depth once was NRC's approach to safety. Today, it is industry's approach to protection against costly regulation.

1. ***Aggressive regulators cannot be confirmed by Senate.*** (One was and then was appointed chairman by Pres. Obama but was driven out.)
2. ***Congress can use its control of the NRC's budget to rein it in.*** In 1998, chairman of Senate Appropriations subcommittee threatened to cut the NRC's budget by one third. "As a result, NRC streamlined its adjudicatory process, made improvements to its inspection process, and moved to risk-based regulations." [Pete Domenici, *A Brighter Tomorrow: Fulfilling the Promise of Nuclear Energy* (2004), "The NRC's Day of Reckoning."]
3. ***Today, NRC negotiates regulations with nuclear utilities' lobbying organization (Nuclear Energy Institute). NGOs such as UCS have much less clout. System out of balance*** (aka "regulatory capture).

What is to be done?

1. Sho uld adopt regulatory objective of minimizing large releases.

2. *Sho uld fix rules for cost-benefit analysis.*

NRC estimates probability in lifetime of current U.S. reactor fleet of evacuation of an area larger than New Jersey as between 0.14 and 6%, not including terrorism. Roughly 4x higher globally.

Would mean end of nuclear power in the country where it occurred and in most other countries as well.

Everyone should want to minimize this risk.

At current electricity prices, U.S. nuclear-energy industry not willing to invest more in safety.

Expedited transfer could be done for ~$4 billion. Should the government pay if the industry will not?

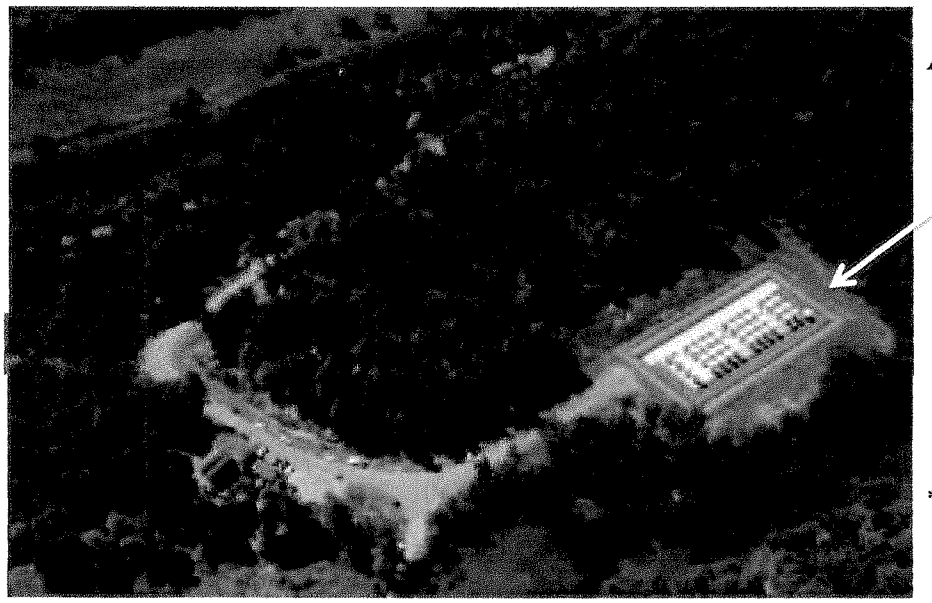
Better than paying for the consequences of letting the industry go out with a bang!

Dry casks safer but terrorist threat should not be ignored

At operating nuclear power plants there is security against a "design-basis threat" (number of attackers with specified equipment).

At storage sites associated with decommissioned power reactor or away from operating power reactors, the security can be much less.

NRC has been struggling with this issue since 2002.*



All that is left of the Connecticut Yankee Nuclear Power Plant.

*http://www.nrc.gov/about-nrc/regulatory/rulemaking/potential-rulemaking/isfsi-security/background.html#current-regs

An Assessment of Energy Needs in Westchester County

Prepared by:
Howard J. Axelrod, PhD
Energy Strategies, Inc.

Prepared for:
The Business Council of Westchester and the
Westchester Business Alliance
September 7, 2012

Summary of Study Findings

- ***Electric Rates***: Electric rates could increase by 6.3% or more if the Indian Point Energy Center (IPEC) is closed. Consumers will pay over $374 million per year in added electric charges.
- ***Reliability***: By 2020, the probability for significant electrical outages could increase by 280%.
- ***Environmental Impact***: Carbon emissions, a leading contributor to global warming could increase by over 6 million tons per year – the equivalent of adding 1,000,000 more vehicles on our roads.
- ***Economic Impact***: Westchester County could lose over 3,300 highpaying jobs, with over $200 million per year in lost wages.

Overall, some $11.5 billion (inflation adjusted), could be drained from the downstate economy due to higher electric bills. Other losses to Westchester include:

- $75 million per year in property taxes and revenue sharing with NYS
- $2 million per year in local charitable contributions

About this study

- Evaluating the impact of Indian Point's premature shut down is complex. At the present time there are no viable options on the table. The current scenario is that, while operating licenses for Units 2 and 3 expire in 2013 and 2015, respectively, the federal regulatory framework of timely renewal applies, as the owner/operator filed its application for license renewal more than five years before the current licenses expire (see next slide). This means that these units will not shut down in the near future, but instead will continue operating, at a minimum, until all license renewal proceedings are completed and the NRC makes a final decision on the license renewal application.

An Assessment of Energy Needs in

- This analysis assumes that both units are not available in 2016, even though both are likely to continue to operate beyond that date.
- For comparative purposes, we believe that the economic impacts associated with IPEC's early retirement would remain relatively constant regardless of actual date of closure as the minimal inflationary pressures would be offset by the time value of money.

The Timely Renewal Doctrine allows IPEC to continue to operate until the NRC makes its final decision.

"Section 9(b) of the Administrative Procedure Act (APA), referred to as the 'timely renewal doctrine,' provides that if a licensee of an activity of a continuing nature makes a 'timely and sufficient' application for renewal in accordance with agency rules, the existing license does not expire until the application has been finally determined by the agency. The timely renewal doctrine is embodied in the NRC's regulations at I0 CFR 2.109." 56 Fed. Reg. 64,943,64,962 (Dec. 13, 1991).

Section 2.109(b) states: "If the licensee of a nuclear power plant licensed under 10 CFR 50.21(b) or 50.22 files a sufficient application for renewal of an operating license at least 5 years prior to the expiration of the existing license, the existing license will not be deemed to have expired until the application has been finally determined."

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About Indian Point Energy Center (IPEC)

- The IPEC provides 2,065 MW of electric capacity for Westchester and the NYC region. IPEC produces over 16 billion kilowatt-hours per year – which represents 59% of Con Ed's retail electric sales or 25% of all electric sales in NYC and Westchester.
  - While the initial operating licenses expire in 2013 & 2015, under the NRC's "Timely Renewal Doctrine" the plants will continue to operate until the NRC makes it final decision as to the requested 20 year license extension.
- Because the downstate area is transmission constrained, replacement generation and/or transmission interconnections from other regions will be required. Furthermore, this will require substantial investment and time to plan for, license and construct these facilities within a very short time frame. Alternative solutions such as distributed generation (e.g. wind and solar) and conservation measures will also take time and require additional funding.
- The impacts associated with IPEC's closure include:
  - Loss of system reliability and voltage support
  - Higher electric prices
  - Deteriorating air quality
  - Loss of employment and economic output -
- Electric prices influence economic activity including jobs and wages

- The closure of a labor and capital intensive power plant on economic activity including employment, economic output and local tax revenues.

Key Observations

- As of mid-2012, there are no affirmative plans by any entitypublic or private- to replace the electric energy and capacity produced at the Indian Point Energy Center.
- Projected energy efficiency, demand side management and renewable resources cannot be added in time to offset the output of IPEC at least for the foreseeable future. In fact, current plans for added renewable resources are behind schedule even with IPEC in operation.
- The NYISO has assessed the impact of Indian Point's potential closure in 2013 & 2015, respectively, and has found reliability issues that could potentially cause brownouts and blackouts.
- Leading specialists (CRA/NERA) have found the loss of IPEC would cause a:

- Decline in reliability (see NYISO reliability reports)
- Rise in energy costs (CRA report)
- Increase in environmental emissions (NERA letter to DEC)

Summary of Economic Impacts without IPEC

- Electric rates could increase by 6.3% as early as 2016 above any other approved or anticipated rate increases including inflation.
- Wholesale electric prices could increase by 13% assuming currently low natural gas prices (Con Ed predicts 12%) Prices could rise even higher if gas prices begin to rise. Electric prices in the downstate region are highly correlated (about 90%) or driven by natural gas prices.
- The combined effects of higher electric prices and the closure of a major manufacturing facility (e.g. IPEC) will cause:
  - Lost Earnings in Westchester: $200 million per year or $4.15 billion (2011$) from 2013 – 2032

- Lost jobs in Westchester: 3,300+ jobs per year or 66,000 FTE jobs over 20 years
- Lost regional commercial output: $11.5 billion

What does IPEC provide to the Westchester region?

- IPEC is, for all practical purposes, a large industrial "factory" that produces electricity
  - Number of employees: 1200 full-time employees at IPEC plus the White Plains office. In addition, over 200 contractors work on the site on a daily basis. Annual refueling outages in project/maintenance include bringing in additional individuals to work at Indian Point. Many of these individuals are union members including, but not limited to; Millwrights, ironworkers, Teamsters, boilermakers, carpenters, electricians, engineers, insulators, laborers, painters, divers and steamfitters
- Total annual wages and salary: $130 million annual full-time employee payroll
- Property taxes paid in Westchester County: $75 million in annual property taxes plus revenue sharing with New York State
- Annual charitable contributions made to local communities:$2 million in annual charitable contributions
- Based on a 2002 study of direct effects including plant output secondary effects of operations, IPEC was found to contribute $363 million in annual local purchases

Indian Point is a major regional employer, a consumer of local goods and services, a contributor to local charities and a payer of local and state taxes.

If not IPEC, then what? Should IPEC close, the energy produced by these power plants will need to be replaced by either alternative sources of generation or energy management and conservation.

- In the near term (2-3 years) not much can be done to address a premature shutdown, except to rely upon existing transmission and generation, regardless of costs, and to encourage consumers to conserve especially during peak periods. It is again noted that "timely renewal" mean that thankfully, local residents will not have to face these draconian choices in the near term.
- By 2016, if the plants were to retire, reliability levels would deteriorate to a point where outages could be expected. By 2020, the chance of an outage could quadruple. Electric power systems are designed to minimize outages to less than one day in 10 years or an LOLE of .1 days per year. Without IPEC, the LOLE rises to .38 by 2020. (LOLE = loss of load expectation)
- One scenario would be a portfolio of energy management, dispersed small-scale generation, new transmission and new base load capacity. The least cost, most efficient alternative is a combined cycle gas turbine (CCGT)

- However, these alternatives will take a years to implement and at a substantial additional cost to consumers. Under even the most the most optimistic assumptions, without IPEC, rates will rise, reliability will decline and air quality will be adversely affected.

Cumulatively, IPEC employs 1,200 full-time individuals plus 200 contractors, many high-paying jobs – in contrast to a similarly sized alternative- a combined cycle gas turbine- that would employ less than 20 individuals.

Study approach

- Only publicly available information was used in this study.
- Entergy played no role in the development of this report except for providing publicly available information on IPEC employment, payroll and taxes incurred at the facility.
- Alternatives to IPEC were based on best available information and power systems planning experience. Comparative economic models for nuclear and CCGT were based on best available industry projections including the US DOE Energy Information Administration's annual energy Outlook and ESI's proprietary generation risk assessment model. Con Edison electric information was obtained from Con Ed's annual reports in its FERC Form 1 filing. Those economic impacts evaluated:
  - The direct impact of the plant closing in Westchester – loss of employment, wages, etc., as well as secondary impacts caused by economic multiplier effect.

- Impact of higher electric prices in Westchester. This was derived by estimating the component of costs associated with IPEC energy purchased by Con Edison
- The economic multiplier effects were derived by applying US Bureau of Economic Analyses (BEA) RIMS II economic multipliers for Westchester County purchase from the BEA.

- Reliability impacts were obtained from the New York ISO website
- Environmental impacts were derived by Energy Strategies Inc.'s generation risk assessment model which compares both economic and environmental impacts of nuclear, coal and CCGT alternatives. The primary environmental parameters measured were CO_2 and NOx and SO_2 emissions.

Summary of Findings

- The average cost of electricity derived by dividing total revenues by total sales was 17.37 cents/kwh. However, ~1/2 of its retail customers also need to procure their electricity from competitive suppliers which is an added expense.
- After allocating non-production costs, fully bundled retail rates averaged 22.7 cents/kwh Con Ed's IPEC purchases amounted to 41% of the total output of these plants (based on 2069 MW & 90% capacity factor). It is unknown, but other IPEC purchases could also have been made by competitive suppliers serving the downstate area. (see note)
- The average cost of IPEC including both energy & demand charges was $77.6/MWH; the average cost for all other purchases was $133/MWH

- IPEC expenses were ~9% of total electric revenues after removing sales to customers with competitive suppliers
  - IPEC represents:
    - 26% of the production portfolio (kwh sales), but only 17% of production costs
    - 9% of adjusted electric revenues
- Every $10/MW increase in IPEC replacement costs, produces ~$68 million in added revenue requirements. Average rates would rise from $.227/kwh to $.230/kwh or 1.3%. If IPEC were replaced by other purchases at $133/MWH, total costs would rise by 6.3% or $374,000,000 per year. The $133 amount is the average cost of all other power purchases made by Con Edison for its full service customers and includes both energy and capacity charges.

Note: Competitive suppliers who bid for electricity thru the NYISO real time markets pay the market clearing price, but do n ot know the source of the generation procured. Approximately, one half of all the electricity procured in New York is purchased on the NYISO open market. As a result, Entergy, the owner of IPEC would likely bid any surplus energy not committed under purchase power agreements on the NYISO mar ket. Proximity to NYC and Westchester also limits competitive suppliers from incurring excessive transmission congestion charges.

Alternatives to IPEC

- There are several possible alternative scenarios to replace the 2,000 MW of electric generation from Indian Point; however, none can simply replace these plants by 2016 or even later in the decade, that is, without negatively impacting electricity prices, electric reliability, economic recovery and the environment.
- Primary alternatives include:

- Constructing new, state-of-the-art natural gas fired combined cycle generation (CCGT);
- Constructing new high voltage transmission networks from Canada and Upstate New York to the Hudson Valley and New York City;
- Expediting the construction of extensive distributed generation including large scale wind and solar projects in the region;
- Promulgating laws and regulations to try and foster great penetration of consumer orientated energy conservation and load management programs and hope that they will work;
- A combination of all of the above.

- However, with downstate electricity usage expected to grow 1% per year, by 2016 demand should grow another 500 MW even after considering government subsidized conservation, demand management and new renewable resources

Factors that will limit the success of these alternatives

- First, any one of these alternatives will require near lightning speed in planning, licensing and construction in order to effectively replace IPEC.

- As of today, there are no affirmative programs to replace the power from Indian Point.
  - There are no sites approved for 2000 MW of new CCGT in the downstate region.
  - There are no plans for added natural gas pipelines, estimated to cost over $350 million, to bring low cost gas to market
  - There are no approved plans to construct a super transmission highway to Upstate NY by 2013 or 2015
  - While the Governor's proposed Energy Highway Task Force has received a number of ideas to advance New York's energy infrastructure, the Task Force is still in the early planning stages with an Action Plan scheduled for the Fall of 2012.
  - On-going development of renewable resources is not keeping pace with targets for 2015 without consideration of the need to add another 2,000 MW
  - While economic recovery in New York State has been slow, recovery in New York City has been growing with projected electric load growth of about 1% (NYISO). From the beginning of 2012 thru the end of 2015, Con Ed's peak load could grow by over 500 MW and that already factors in aggressive conservation and load management initiatives
  - Such renewable and dispersed generation such as wind and solar are intermittent and while they are beneficial to the mix of supply of electric generation they cannot be depended upon as a reliable source of supply. Typically, wind and solar can produce electricity only 15–25 percent of the time; whereas, base load generation (IPEC or CCGT) generate electricity over 90% of the time. Even if there were available cost effective electric storage technologies, we would need nearly three times the capacity of wind to generate the same amount of electricity as a base load plant.
  - New York's aggressive Renewable Portfolio Standard (RPS) program funded by NYSERDA appears to be behind schedule and again, this does not take into account replacing 2,000MW of our current energy portfolio.

Impact on Reliability

- There are no affirmative plans to replace over 2000 MW of electric capacity that operates over 90%+ of the time. There's nothing in the 2012 - 2016 planning horizon that can be added that can displace all of this capacity.
- The New York ISO has studied the impact of closing IPEC and found that the electric reliability will deteriorate to a point where outages and other disturbances will increase in degree and frequency beginning in 2016 and significantly worsen by 2020. This is based on detailed engineering and power systems analysis of the New York electric energy infrastructure which evaluates the probability of a loss of load under a range of operational conditions. With IPEC, there are no conditions foreseen where the probability of loss of load (e.g., a brownout or blackout) exceeds design standards.
- However, the occurrences of widespread outages are four times greater without IPEC by 2020. (NYISO 2010 Comprehensive Reliability Plan and the NYISO 2010 Reliability Needs Assessment.) These studies assume that all available resources are available to mitigate system disturbances.
- It should be emphasized, these are not local disturbances resulting from a lightning strike or a falling tree, but regional outages caused by overloaded high-voltage transmission

networks and associated substations that connect Westchester and New York City to available power plants in upstate New York as well as other regions.

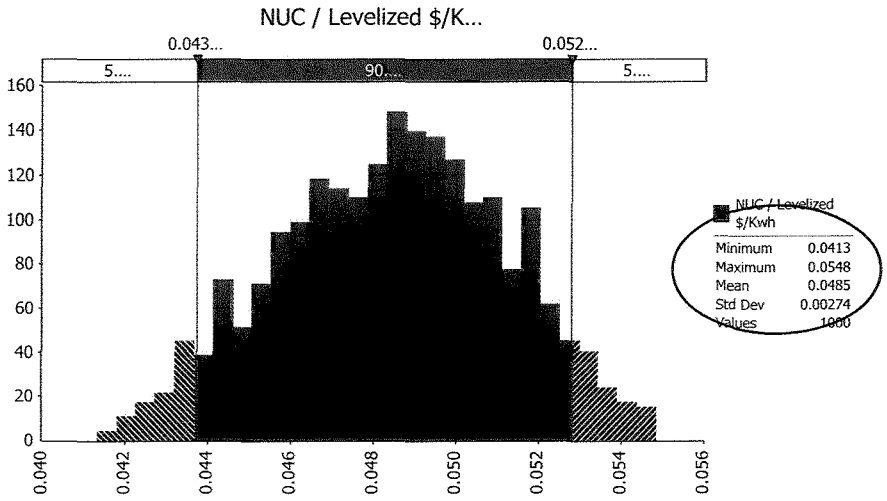
Impact on Electric Prices

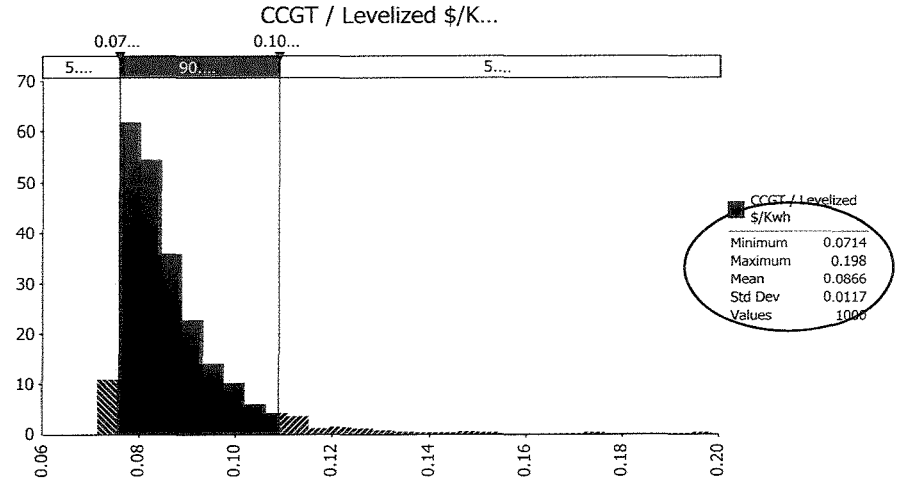
- We found no scenario where electric prices decline without IPEC. Con Edison offers a bundled electric rate in which approximately ½ of its customers choose this service as opposed to a competitive energy supplier. With NYS PSC approval, Con Edison procures a portfolio of energy supplies including IPEC. Based on its FERC Form 1 report, the IPEC contract is among the lowest-cost resource in this portfolio.

  Therefore, any replacement of IPEC energy would likely result in higher costs alternatives.
- It is important to note that the Con Edison region is already highly constrained which means that competition among suppliers is limited by the transmission constraints into the downstate region. The loss of 2000 MW of capacity within the constrained area would only further diminish this competitive environment and likely lead to even higher prices.

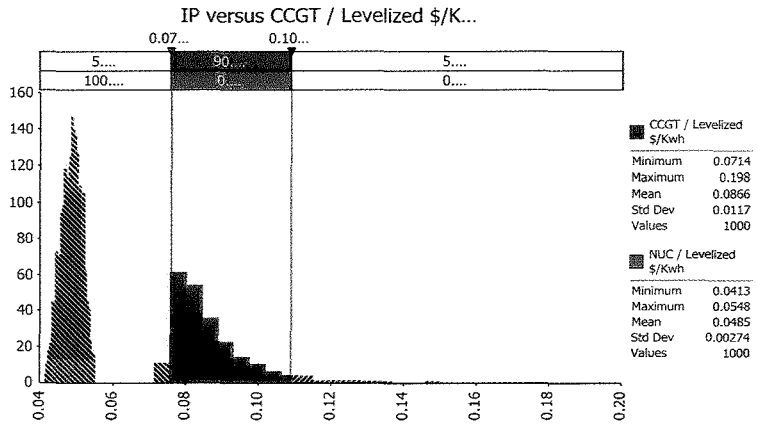
- The least cost alternative to IPEC would be a 2000 MW combined cycle gas turbine plant (CCGT) which would still cost as much as twice the cost of IPEC, and is of a scale that does not currently exist in the state.

Our risk analysis of lifetime costs demonstrates lifetime cost advantage of IPEC over a wide range of uncertainties. IPEC, on average, costs about one half the cost of the new CCGT including required natural gas pipeline extensions.





IPEC costs range between $43.7 - $52.8 per MWH within a 90% confidence band



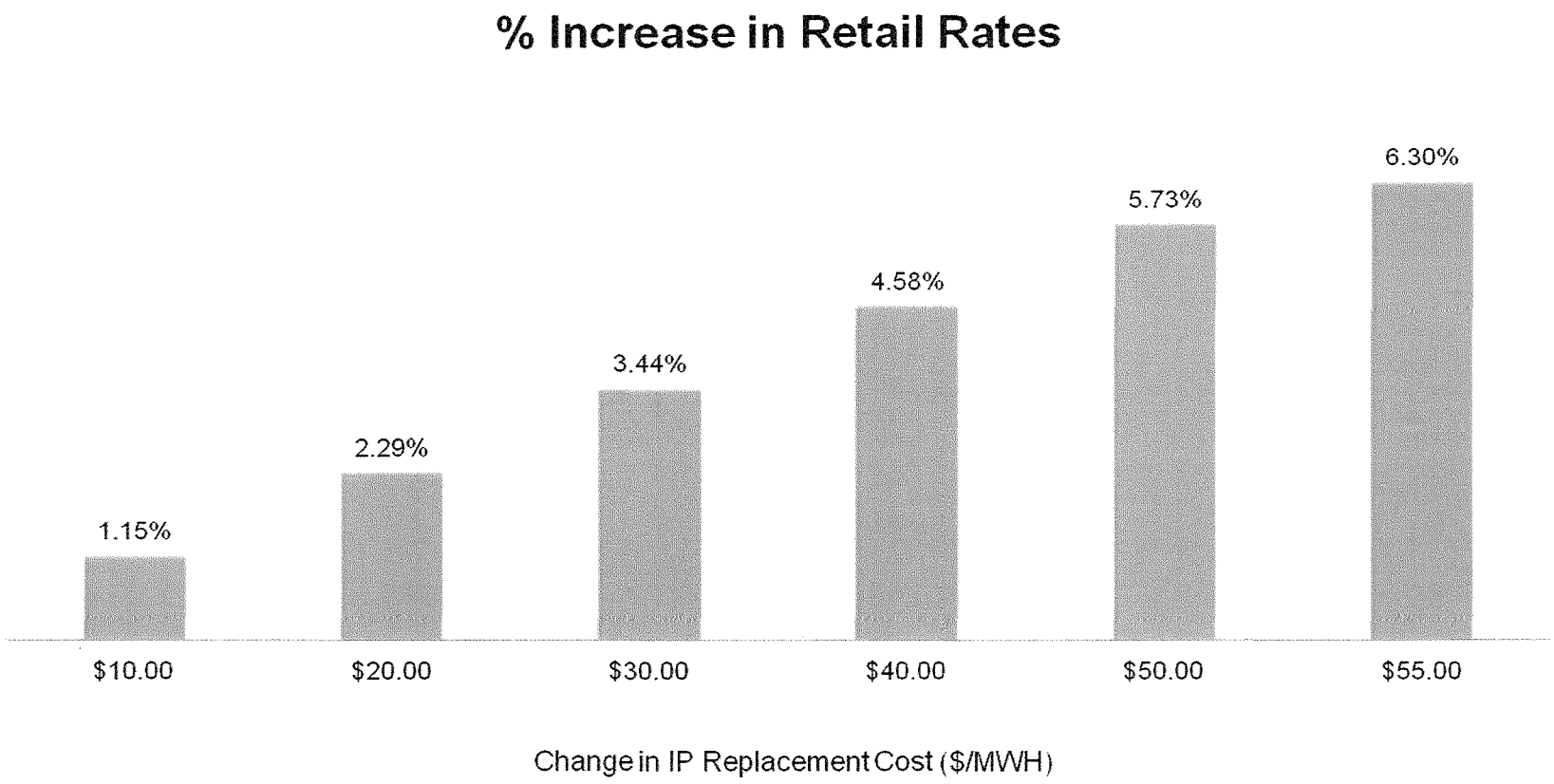
A CCGT would cost between $75.8 - $108.8 per MWH within a 90% confidence band

Computation of Con Edison Retail Rate Impacts

- Source: 2010 FERC Annual Report filed by Con Ed on April 1, 2011 & Con Edison Facts (for 2009 and 2010)
- Background:
  - Con Ed serves 3.3 million retail customers in NYC and Westchester – approximately 10% or 345,000 in Westchester
  - Total electric revenues = $8.4 billion
  - Approximately ½ of Con Ed's customers receive their electricity from competitive suppliers
  - The other ½ is provided by Con Ed using a portfolio of self owned and purchased power including IP
  - IPEC represented 29.7% of the portfolio as a % of kwh
  - IPEC represented 19.8% as a % of expenses
- Key Assumptions
  - The % of competitively-supplied electricity was based on the difference between Con Ed's total retail electric sales (MWH) and the total MWH generated by Con Ed (~10%) and purchased.

- The proportion of T&D (Delivery charges) and all other non-production related expenses were allocated proportionately.

The average difference between Con Edison's purchased power agreement for IPEC power and other sources of energy is about $55/MWH. The following graph translates each $10 increment of added replacement cost into an overall electric rate increase.


% Increase in Retail Rates
1.15%
2.29%
3.44%
4.58%
5.73%
6.30%
$10.00
$20.00
$30.00
$40.00
$50.00
$55.00
Change in IP Replacement Cost ($/MWH)

Environmental Impact:

Replacing IPEC with a gas plant (CCGT) would have the same effect on global warming as adding 1 million cars in downstate NY.
(Based on an average efficient car, 12,000 miles/yr and 6 tons of CO_2 per year)

- There is no question that manufacturing nuclear fuel and the disposal of nuclear waste has an environmental impact, just as a combined cycle gas turbine's use of shale gas would have an environment impact exogenous to the operation of either IPEC or a combined cycle gas turbine.
- However, when comparing localized air quality emissions, IPEC produces no significant amounts of carbon dioxide, nitrogen oxide, or sulfur dioxide. On the other hand, the most efficient combined cycle gas turbine, while emitting no SO_2, does produce significant levels of carbon dioxide and nitrogen oxide.
- Our models show that NOx will increase by nearly 2,000 tons per year. A 2010 study by NERA found replacing IPEC would add 7,000 tons per year.
- Our models also show that carbon dioxide, the key driver of global warming, will rise by about 6 million tons per year where the NERA study computed 9.6 million tons.

- When using even the lower emission rates, the cost of noncompliance could amount to $3 million per year for an NOX emissions and up to $150 million per year in SOX compliance costs.

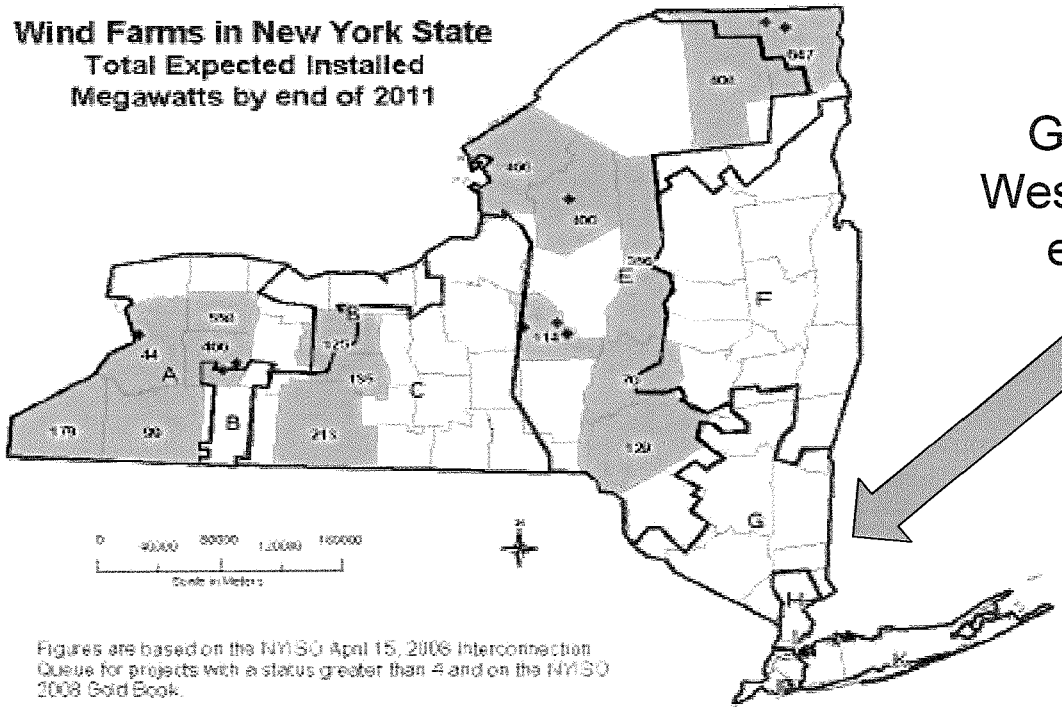
Can an aggressive renewable resource program also provide energy that has a minimal environmental impact?

- It is likely that, over time, the addition of such renewable resources as solar and wind generation will lower NY's dependence on fossil fuels and eventually be added at a cost comparable to conventional generation.
- However, to date, most renewable technologies are far more costly, require substantial subsidies and will take

years to replace the capacity resulting from the IPEC closure.

- The following slides highlight the unlikelihood of relying on renewable technologies to replace IPEC.

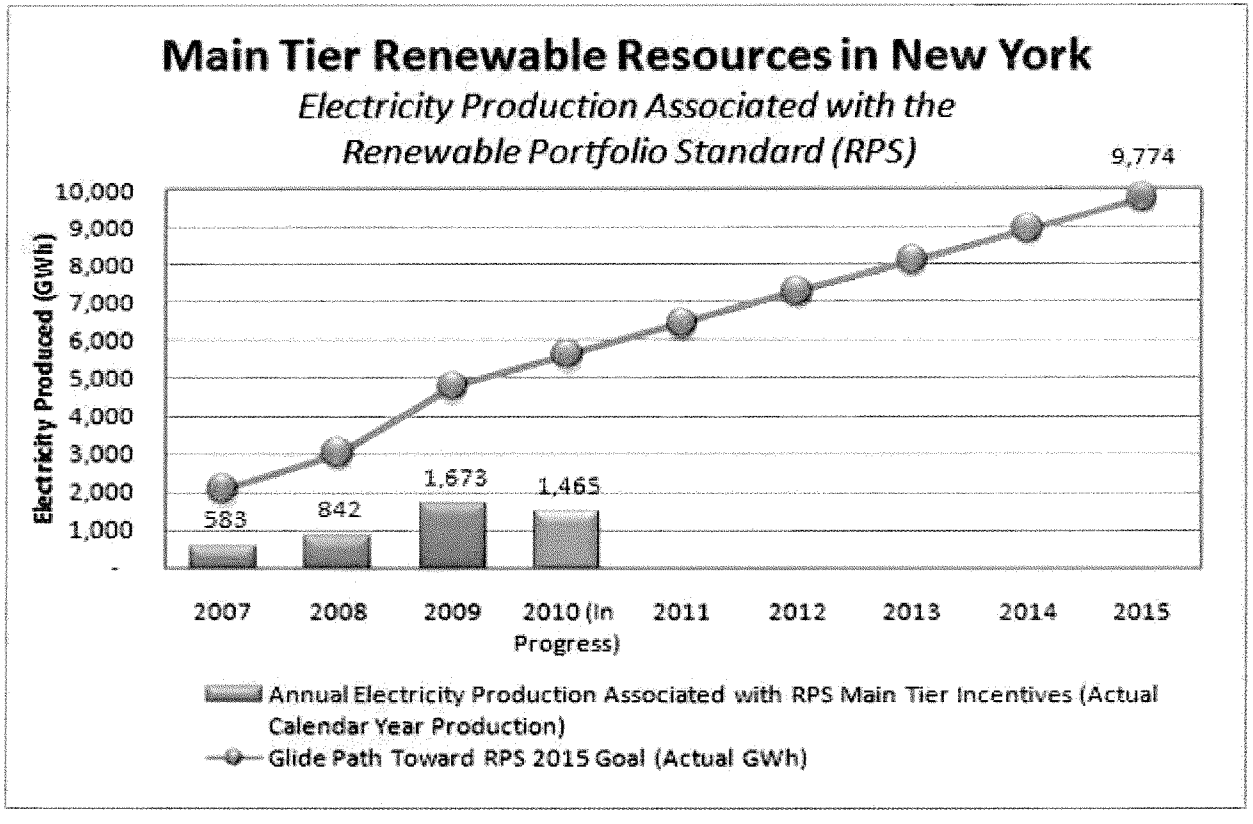
Map of Wind Farms in New York as recorded by the. Transmission constraints limit the amount of wind generation that can be supplied to downstate New York from other parts of the state.



No Wind Generation in Westchester as of end of 2011

The Statewide Renewable Portfolio Standard (RPS) for 2015 is 9,774 GWH: As of 2010, the RPS was 75% below target. Even the

statewide 9,774 GWH target for 2015 represents only 65% of the IPEC output.



Smaller scale renewable resource statewide amount to 29.77 MW. As of the end of 2009, actual installations were 11.45 MW. (The cost per kWh assuming no O&M charges equals $153/MWH with a capital cost of approximately $8800 per kilowatt)

Table 1-1. Funding Status of 2007 CST Operating Plan effective December 31, 2009

	Budgeted Funds	Encumbered and Pending Contracts	Balance
Photovoltaics	$ 75,333,734	$ 75,333,734	$ --
Fuel Cells	$ 5,794,420	$ 2,507,860	$ 3,286,560
Anaerobic Digesters	$ 20,100,000	$ 19,274,750	$ 825,250
Small Wind	$ 2,071,846	$ 1,405,036	$ 666,810
Metrics and Verification	$ 4,300,000	$ 2,359,400	$ 1,940,600
Total:	$ 107,600,000	$ 100,880,780	$ 6,711,220

Table 1-2. Actual and Expected Installed Capacity effective December 31, 2009 (MW)

CST Program	Original Operating Plan: Target Encumbered Capacity by 12/31/09	Pending Contracts	Planned Capacity (w/remaining funds)	Actual Installed Capacity	Total Pending, Installed, and Planned Capacity
Solar Photovoltaics	3.5	11.44	--	8.11	19.55
Fuel Cells	2.7	.415	0.75	.005	1.36
Anaerobic Digesters	3.7	6.01	--	3.20	9.21
Small Wind	1.8	0.30	0.15	.140	0.59
Program Total	11.7	18.17	.90	11.45	29.77

Table 1-3. Actual and Expected Energy Production effective December 31, 2009 (MWh)

CST Program	Original Operating Plan: Target Annual Generation Encumbered by 12/31/09	Expected Production from Pending and Planned Contracts	Actual Energy Production from Installed Capacity	Total Expected Production Progress
Solar Photovoltaics	4,533	14,837	10,512	25,349
Fuel Cells	18,700	1,680	--	1,680
Anaerobic Digesters	25,700	41,775	22,243	64,018
Small Wind	3,945	604	170	774
Program Total	52,878	58,895	32,925	91,820

Capacity (MW)	11.45
Output (kWh)	32,925,000.00
Initial Cost	$ 101,000,000.00
Amortization (Yrs)	20
Annual cost (no O&M)	$ 5,050,000.00
Average cost $/kwh	$ 0.153
Capital Cost/kw	$ 8,820.96
Target (MW) by 2015	29.77
as of 1/1/2010	11.45

Source: NYSERDA

Economic Impact: An IPEC replacement strategy translates into lost jobs, salaries and other economic measures.

- The IPEC is a "factory" that produces electricity and annually:
  - Employees 1,200 people plus 200 contractors living in and around Westchester County
  - Pays over $130 million in salaries
  - Pays over $75 million in property taxes and revenue sharing with NYS
  - Contributes annually $2 million to local charities
- **A similarly sized combined cycle gas turbine (CCGT) facility would employ as few as 20 workers.**
- The total regional impact when considering multiplier effect results in:
  - A total of 3,255 jobs lost each year
  - $202 million in lost salaries and wages
- Replacing IPEC will increase Con Edison's retail electric rates by about 6.3% which will further reduce employment in Westchester by approximately 50 – 100 jobs per year.
- Total lost jobs in Westchester County would amount to 3,300 jobs per year

- Total lost regional commercial output will decline by $11.5 billion (2011$) over a twenty year period.

Total Employment Impact in Westchester:
Combined effects of higher electric prices & IPEC closing

Industry Group	Average Annual Lost Jobs	Total Lost Jobs (20 years)
Utility	1,436	28,720
Construction	274	5,480
Professional, Scientific & Technical Services	269	5,380
Healthcare	216	4,320
Retail Trade	192	3,840
Food Services	168	3,360

Admin & Waste Services	153	3,060
Real Estate, Rental & Leasing	147	2,940
Finance & Insurance	79	1,580
All others	390	7,800
Total	3,326	66,520

Sources of information used in this assessment of energy needs in Westchester County.

- Con Edison electric rates: 2010 FERC Form 1 Annual Report and Con Edison Facts: 2009 & 2010
- System Reliability Impacts: NYISO 2010 Comprehensive Reliability Report and the NYISO 2010 Reliability Needs Assessment
- Environmental Impacts: Energy Strategies, Inc. Generation Risk Model using current Energy Information Administration (EIA) Energy Outlook data. Also compared findings

to a NERA 4/29/10 letter report to the NYS Department of Conservation on the "Effect of the Loss of Indian Point Nuclear Generating Units 2 and 3 Capacity and Generation on New York State Environmental, Economic and Energy Needs."

- Economic Impact: The US Bureau of Economic Analysis (BEA) RIMS Input/Output Regional Economic Multipliers for Westchester County, NY.
  - The RIMS **Final Demand** Multipliers were used to estimate the impact of the IPEC plant closing on local jobs and salaries.
  - The RIMS **Direct Effect** Multipliers were used to estimate the impact of higher electric prices on NYC and Westchester business as measured by jobs, salaries and economic impact.
- Also compared findings to a Charles River Associates (CRA) study (8/2/11) entitled "Indian Point Energy Center Retirement Analysis" for the New York City Department of Environmental Protection

About the Author

Dr. Howard J. Axelrod is President of Energy Strategies, Inc. an Albany-based management consulting firm established in 1993. Dr. Axelrod has been a management consultant for over 27 years serving such local clients as the New York Public Service Commission, the New York Independent System Operator and the New York Power Authority. He specialized in power systems planning, economic analysis and risk management.

Prior to his consulting career, he served over thirteen years for the State of New York in various capacities including Director of Utility Intervention for the New York State Consumer Protection Board, Project Manager for the New York State Energy Research & Development Authority, Chief Economist for the Shoreham Commission and senior analysis for the New York Public Service Commission.

Dr. Axelrod was awarded his PhD in Managerial Economics from Rensselaer Polytechnic Institute, and MBA from SUNY Albany and BSEE and MSEE degrees in Powers Systems Engineering from Northeastern University. Dr. Axelrod was also an Adjunct Professor at RPI and Russell Sage College. He is author of numerous papers and articles.