

Corrective Action Order to Shut the Gas in the Algonquin Gas Transmission Pipelines at the Indian Point Nuclear Facility

Request New York State notify the Pipeline Hazardous Materials Safety Administration (PHMSA) to immediately issue a Corrective Action Order to stop the flow of gas at Indian Point until decommissioning operations are completed and federally compliant risk assessment is conducted that also addresses all decommissioning conditions and unresolved risks. The ongoing catastrophic danger posed by the Algonquin pipelines at Indian Point that is further intensified by decommissioning activities underway and the lack of compliance with required 49 CFR 192 and 49 USC 601 demands immediate action by PHMSA (NYS Authority outlined below)

BACKGROUND

INDIAN POINT IS THE ONLY NUCLEAR FACILITY IN THE U.S. WITH GAS TRANSMISSION PIPELINES

The Algonquin Pipeline System Expansion

The Algonquin gas transmission pipeline system was first constructed in the 1950s in Rockland, Westchester, Putnam, Connecticut, Rhode Island and Massachusetts and included two pipelines, 26" and 30" diameter, over which the Indian Point nuclear facility was sited in the 1960s. A new massive three-part segmented expansion by Spectra/Enbridge replaces the original 26" with a 42" diameter, high-pressure pipeline and adds new pipeline segments in new right-of-ways.

The Algonquin Incremental Market (AIM) pipeline, the first phase of the expansion, was approved in 2015 and was completed and became operational as of January 2017. It includes the addition of a new 42" diameter, high-pressure pipeline segment in Rockland, which, from Stony Point, crosses under the Hudson River into Westchester traversing the Indian Point nuclear facility through Buchanan, Peekskill and ending at Yorktown. The expansion continues from Putnam into Connecticut and New England as part of the Atlantic Bridge segment.

Pipeline Co-Location at the Indian Point Nuclear Facility

The 42" diameter, high pressure AIM pipeline is constructed 115 feet from critical safety infrastructure at Indian Point. The site is next to two major earthquake fault lines. Independent engineering experts have confirmed that the potential explosion from a

pipeline rupture at that location would have a blast impact radius of over 4,000 feet, which would encompass the entire Indian Point site. Nuclear, pipeline and medical disaster experts repeatedly warned that a pipeline rupture at this site could result in a serious disaster posing an ongoing threat to millions of people across the New York tri-state area as well as across the Eastern Seaboard.

Pipeline Failures

Pipelines and their infrastructure are subject to leaks, fires and explosions. According to data from the Pipeline Hazardous Material Safety Administration (PHMSA), pipeline failures continue to be a serious problem. Approval for siting the pipeline at Indian Point was predicated on the false and unsubstantiated claim by the operator that the pipeline could be shut down within three minutes of a rupture despite science based documentation from a leading pipeline disaster expert that it was not possible. Following a test in 2019, Enbridge confirmed that it could not even achieve a pipeline shutdown within three minutes of notification of an event. Detection of a pipeline failure itself can take at least 30 minutes and up to 25 hours or more according to reports to PHMSA.

Cyber Security and Other Threats

The cyber threat to pipelines and other infrastructure is well recognized. Operation of the pipelines, including their closure in the event of a pipeline event or other emergency, is controlled remotely from an Enbridge operations hub in Texas. Segments of the pipeline infrastructure at Indian Point are buried under public roads and are at risk of serious intentional damage. A nationally recognized pipeline safety expert stated in his sworn affidavit that mitigation measures, including concrete pads buried over the pipeline, do not provide protection and could become projectiles in the event of a pipeline explosion. Other segments of this pipeline infrastructure are also visible and easily accessible.

Risk Assessment

In February 2016, after a series of serious incidents at Indian Point, including a major spike of radioactive tritium in groundwater registering up to 8,000,000 pCi/l, 400 times higher than the regulatory limit, along with mounting concerns about FERC's siting the AIM pipeline at Indian Point, the Governor directed New York State agencies to conduct a risk assessment of the co-location of the AIM pipeline at Indian Point. Numerous FOIA requests and many letters from local and state officials requesting its release were submitted for nearly two years. The State finally released the Executive Summary of the risk assessment in June 2018. The State agencies' letter to FERC accompanying the full risk assessment (never publicly released) confirmed years of findings and warnings by independent nuclear and pipeline experts, raising many questions and concerns regarding unresolved risks posed by the three Algonquin pipelines located at Indian Point. In the

letter, the State agencies call for further investigation and action by FERC including re-evaluation of the NRC and Entergy analyses relied on for the pipeline approval, consideration of termination of gas flow, recognizing, among the increased risks, the imminent closure of the nuclear reactors with the potential for excavation operations to compromise pipeline integrity during the decommissioning process.

Closure of Indian Point Does Not Resolve Risks, Decommissioning Exacerbates Them

Closure of the reactors does not resolve the catastrophic risks posed by the three co-located gas transmission pipelines traversing the site especially in close proximity to more than 1500 tons of highly radioactive nuclear waste, including in the densely packed cooling pools. Dry cask storage remains vulnerable. Heavy decommissioning operations further exacerbate the risks of a pipeline rupture. Excavation damage is a leading cause of natural gas and hazardous liquid pipeline failure incidents according to the Pipeline Hazardous Materials Safety Administration (PHMSA). A pipeline rupture will generate very high methane gas release rates with extremely high heat fluxes that melt steel and vaporize aluminum at considerable distances. A potential fire in the spent fuel pools triggered by a pipeline rupture, attack or other event could release more radioactivity than a reactor meltdown, rendering tens of thousands of square miles uninhabitable according to studies conducted at Princeton.

Office of the Inspector General at the Nuclear Regulatory Commission Released Report (Feb 2020): Concerns Pertaining to Gas Transmission Lines at the Indian Point Nuclear Power Plant

The serious flaws, falsehoods and egregious errors in the so called “risk analyses” performed by the NRC and Entergy misrepresented the actual catastrophic risk posed by the AIM pipeline and the two old Algonquin pipelines at Indian Point, yet served as the basis for the approval of the AIM pipeline in 2015 by the Federal Energy Regulatory Commission (FERC). The OIG report calls into question the safety of the Algonquin pipelines at the site stating that the analyses “used backward engineering for a desired result.”

In response to the OIG report, the NRC established an Evaluation Team, which issued a report in April 2020. The Evaluation Team’s report recommended that the analysis conducted by Entergy be revisited and that the NRC should review and improve its own processes, procedures, and coordination with other federal agencies. The report also included the findings of the Sandia National Laboratories, which confirmed the catastrophic risk of a potential pipeline rupture at Indian Point concluding:

“The vapor cloud will be heavier than air which will cause it to disperse near the ground and will persist after the pipe has been closed. The dense-gas vapor

cloud will propagate through the vegetation and congested areas which increases the likelihood of a deflagration to detonation transition. Simulation results indicate that at approximately 6 to 7 minutes after release the flammability region of the vapor cloud will be either near or begin to engulf the SOCA and at 8 minutes the flammability region would surround the SOCA. Thus, if the cloud is ignited within the flammability region, the explosion would have a high likelihood of exceeding an overpressure of 1 psi at the SOCA. The NRC analysis also considered a 60-minute release using ALOHA to calculate the maximum average sustained flow rate of 311,000 lbs/min. The mass released over the first minute was considered and not the total mass released over 60 minutes. The NRC analysis assumes that since the cloud will be buoyant it will disperse within 1 minute and thus an explosion will occur during the first minute independent of release duration and thus uses a mass of 311,000 lbs for the TNT equivalency calculation. If the cloud is not immediately buoyant, then for a 60-minute release using the total mass calculated by ALOHA the result is 8872 ft or 1.7 miles.”

Non-Compliance with PHMSA Regulations

Federal regulations specify only minimum pipeline safety standards but require a risk assessment compliant with regulations be conducted in order to approve and continue to permit the operation of the pipelines. Although the risk assessment was never conducted, the Final Environmental Impact Statement (FEIS) for the AIM pipeline implies compliance. PHMSA also fails to assess or comply with the Public Awareness regulations associated with extensive radioactive damage that would result from a potential pipeline rupture at Indian Point.

Solution: Issuance of Corrective Action Order by PHMSA

The inadequate assessment of risk outlined in the NRC OIG report and the lack of a federally compliant risk assessment as well as an assessment that factors in the increased risks from decommissioning operations constitute “a violation or probable violation of an applicable safety standard.” Federal regulations outline PHMSA’s role in issuing a Corrective Action Order to direct the pipeline operator to shut down and purge the pipelines until these corrective actions are fully addressed and rectified in order “to protect the public, property, and the environment from potential hazards.” Dangerous decommissioning operations that can compromise pipeline integrity combined with the lack of compliant risk assessments warrant the immediate shutdown and purge of the pipelines until these corrective actions are fully addressed and rectified. The continued operation of the Algonquin pipelines at the Indian Point facility without immediate corrective measures may “likely result in serious harm to life, property and the environment,” the basis for the immediate issuance of a Corrective Action Order pursuant to 49 U.S.C. 60112.

The U.S. Secretary of Transportation (U.S. DOT/PHMSA) has the authority to issue the Corrective Action Order to shut the gas in the Algonquin pipelines at Indian Point pursuant to 49 U.S.C. 60112 "to protect the public, property, and the environment from potential hazards"

"General Authority. —After notice and an opportunity for a hearing, the Secretary of Transportation may decide that a pipeline facility is hazardous if the Secretary decides that

(1)operation of the facility is or would be hazardous to life, property, or the environment; or the facility is or would be constructed or operated, or a component of the facility is or would be constructed or operated, with equipment, material, or a technique that the Secretary decides is hazardous to life, property, or the environment

Section 60112 provides for the issuance of a Corrective Action Order without prior opportunity for notice and hearing upon a finding that failure to issue the Order expeditiously will likely result in serious harm to life, property or the environment. In such cases, an opportunity for a hearing will be provided as soon as practicable after the issuance of the Order."

Federal regulations also designate a safety role for the State of New York, which includes the submission of a Notification to PHMSA to request a Corrective Action Order. NYS has the authority, according to federal regulations, to send Notification to PHMSA to request that they act with utmost urgency and immediately issue a Corrective Action Order to shut down the gas in the pipelines at Indian Point.

49 U.S.C. 60109(c)(9)(C) and (10) clearly designates a safety role for the State of New York by plainly stating:

"(C)Transmittal of programs to state authorities. — The Secretary shall provide a copy of each risk analysis and integrity management program reviewed by the Secretary under this paragraph to any appropriate State authority with which the Secretary has entered into an agreement under section 60106.

(10)STATE REVIEW OF INTEGRITY MANAGEMENT PLANS.

A State authority that enters into an agreement pursuant to section 60106, permitting the State authority to review the risk analysis and integrity management program pursuant to paragraph (9), may provide the Secretary with a written assessment of the risk analysis and integrity management program, make recommendations, as appropriate, to address safety concerns not adequately addressed by the operator's risk analysis or integrity management program, and submit documentation explaining the State proposed revisions. The Secretary shall consider carefully the State's proposals

and work in consultation with the States and operators to address safety concerns.”

Extensive supportive documentation includes experts’ testimony, affidavits and reports.

***Excerpt from Richard Kuprewicz, a renowned pipeline forensic expert and President of Accufacts, who stated to the NRC Petition Review Board in 2015:**

“I reviewed a series of rupture analysis statements concerning the AIM 42-inch transient pipeline rupture near the Indian point plant....I’ve got to come to the conclusion that they do not represent the transient dynamics associated with a 42-inch gas transmission rupture should it fail near Indian Point... For example, based on extensive experience, pipe fracture mechanics will demonstrate that gas transmission pipeline ruptures are always full-bore ruptures, even buried. Pressure drop will not be a timely indicator of pipe rupture, even for a 42-inch pipeline. Assumptions about closure within three minutes to cut off gas flow near the plant are unrealistic and unscientific. A further recent analysis concluded that a rupture release of one hour on the 42-inch pipeline does not impact the nuke plant needs further explanations, as it makes no sense for this system. The above key assumptions, as stated in agency studies, ignore proximity to a compressor station upstream and ignore system dynamics associated with a gas transmission pipeline rupture that increases gas releases well above pipeline flow before the rupture.

Quite simply, agency studies are violating the basic laws of science concerning gas pipeline rupture and associated forces that result in massive cratering, pipe shrapneling, and violate the science associated with such releases, especially a 42-inch pipeline.... It appears that various agencies are attempting to dismiss risk as low when gas pipeline rupture may drive the nuke facility to non-safe shutdown in a highly sensitive area. Agency studies create the appearance of risk management tampering to favor a project agency decision and raise the question, Are involved agencies capable of performing a scientifically neutral study for such a sensitive issue?....Lastly I must comment that a truly independent safety analysis should be performed, subject to a reasonable open peer review. Security claims should not be permitted to shelter malfeasance in a scientific method involving incomplete risk analysis for such a highly sensitive infrastructure.”

***Dr. Irwin Redlener, Former Director, National Center for Disaster Preparedness, Earth Institute at Columbia University stated: (As of June 2020, Dr Redlener is Director, Pandemic Resource and Response Initiative (PRRI) and Senior Research Scholar at the National Center for Disaster Preparedness at Earth Institute, Columbia University)**

“With the release of their risk analysis and letter to the Federal Energy Regulatory Commission-calling for urgent action, New York State agencies

confirmed the catastrophic risks posed to millions of lives by the co-location of the high pressure pipelines at the aging Indian Point nuclear plant. We strongly agree that close proximity of the pipelines to critical safety infrastructure and to highly radioactive nuclear fuel stored on site is a persistent and significant threat. This is particularly alarming as we have seen an increase in pipeline failure rates, especially in newly constructed pipelines. To make matters worse, decommissioning and decontamination work anticipated with the closure of the plant...will certainly involve heavy excavation, which may well further jeopardize pipeline integrity. From a public health point of view, the flow of gas at Indian Point presents an enormous risk to communities and families throughout the region. Shutting down this gas flow should happen immediately in order to avert the possibility of a catastrophic explosion that would have widespread, deadly consequences in our region."

REFERENCES:

- 1. NYS Agencies Letter to FERC (CC to PHMSA and NRC) re NYS Risk Assessment (June 22, 2018)**
<https://sape2016.files.wordpress.com/2018/12/nys-letter-to-ferc-re-risk-assessment-june-22-2018-2.pdf>
- 2. Letter from Richard Kuprewicz to FERC in response to NYS agencies' June 2018 letter to FERC and Executive Summary of NYS risk assessment (July 11, 2018)**
<https://sape2016.files.wordpress.com/2018/12/accufacts-7-11-18-kuprewicz-letter-to-ferc-3.pdf>
- 3. Declaration from Paul Blanch to FERC in response to NYS agencies' letter to FERC and Executive Summary of risk assessment (July 20, 2018)**
<https://sape2016.files.wordpress.com/2018/12/20180720-final-ferc-pmblanch-declaration-3.pdf>
- 4. Letter from Paul Blanch to Gov Cuomo, NYS DEC, DOH, DHS, PSC/PHMSA, FERC, NRC in response to Enbridge letter to FERC regarding NYS agencies' letter and Executive Summary (August 16, 2018)**
<https://sape2016.files.wordpress.com/2018/12/20180816-letter-to-cuomo-pmb-2.pdf>
- 5. NRC Office of Inspector General Report: Concerns Pertaining to Gas Transmission Lines at Indian Point Nuclear Power Plant (Feb 2020)**
<https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML20056F095>
- 6. Letter to FERC and NRC from NYS DPS (March 9, 2020 and March 26, 2020)**
https://sape2016.files.wordpress.com/2020/04/030920-and-032620-pcs-letter-to-nrc-and-ferc-ml200861280-dps-letter-to-ferc_nrc.pdf

7. Letter to FERC, NRC & PHMSA from NYS Attorney General (March 19, 2020)
<https://sape2016.files.wordpress.com/2020/05/2020-03-19-oag-joint-letter-re-aim-interim-safety-measures.pdf>

8. Letter from Paul Blanch to U.S. DOT Office of Inspector General (April 7, 2020)
<https://sape2016.files.wordpress.com/2020/04/20200408-corrected-paul-blanch-dot-oig-letter-final-2020-04-08-at-1-50-08-pm.pdf>

9. Letter to NYS PSC re Corrective Action Order (April 21, 2020)
<https://sape2016.files.wordpress.com/2020/05/2020-0421-final-letter-to-psc-re-notifications-to-phmsa.pdf>

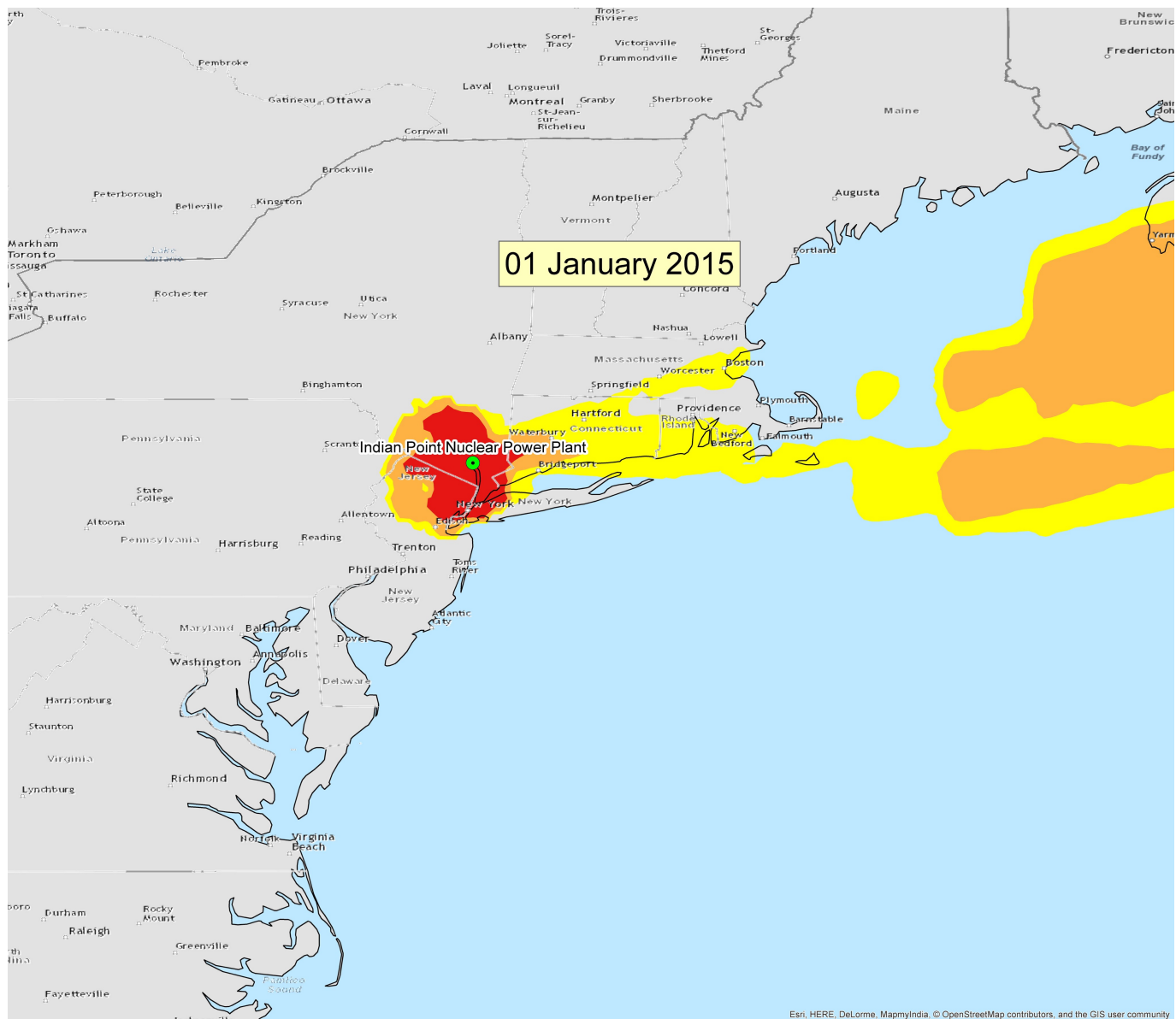
10. Spent Fuel Fire Relocation Maps (Princeton Study), Cesium Graph, PHMSA Pipeline Failure Graph, Independent Engineers' Calculations of Pipeline Blast Impact Radius (2016) (ATTACHED)
https://sape2016.files.wordpress.com/2021/05/indian-point-spent-fuel-fire-maps_article_alvarez-cesium_phmsa-pipeline-graph_calcs-pdf.pdf

11. Extensive supportive documentation requested by PHMSA following Sept 30, 2021 meeting (ATTACHED)

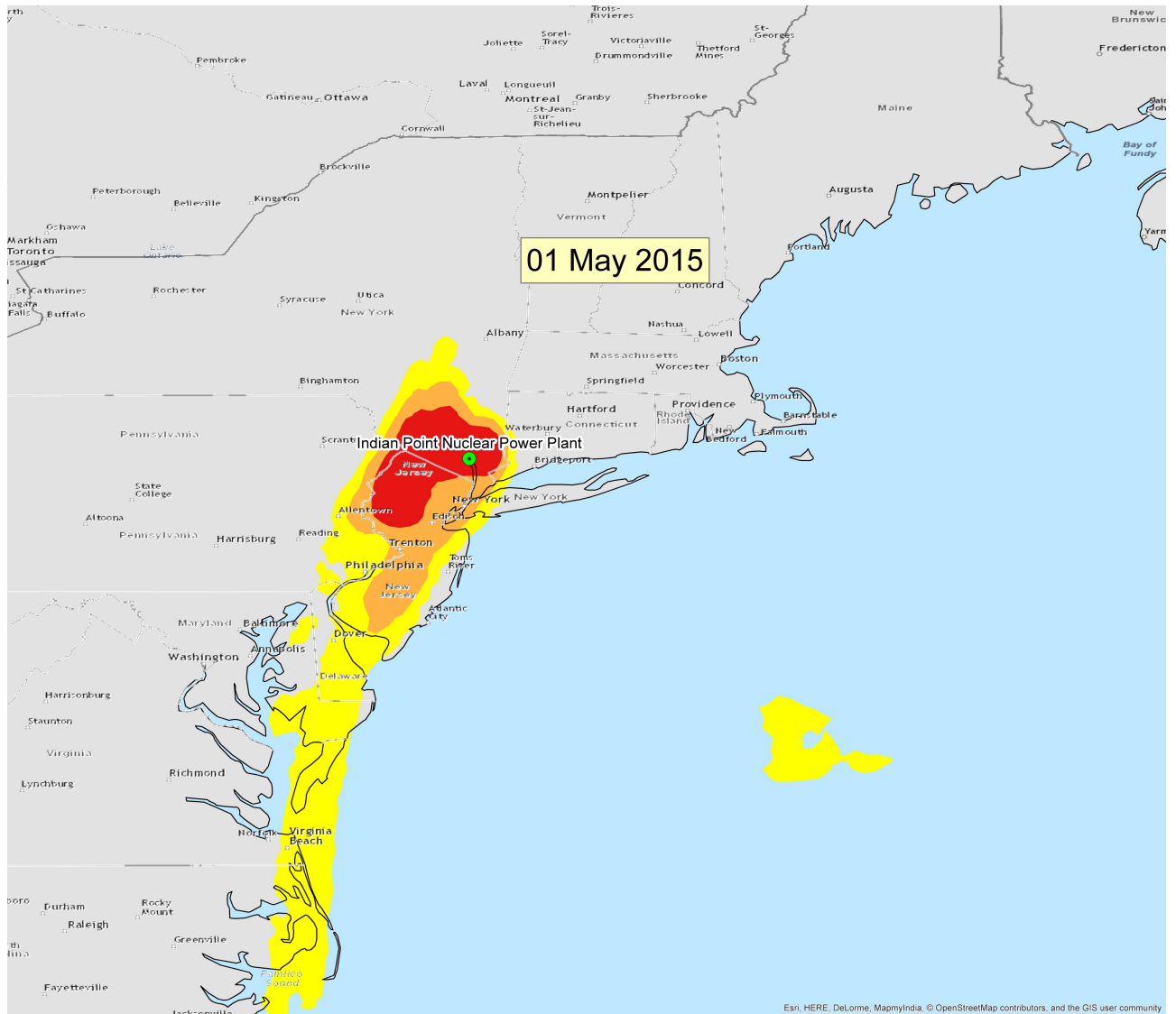
12. Photographs of Algonquin 26" diameter pipeline work (Oct-Nov 2021)
https://www.grassrootsinfo.org/pdf/HoltecEnbridge_Pipe_Photos_102521.pdf
Video <https://youtu.be/CFVYlxcPo4M>

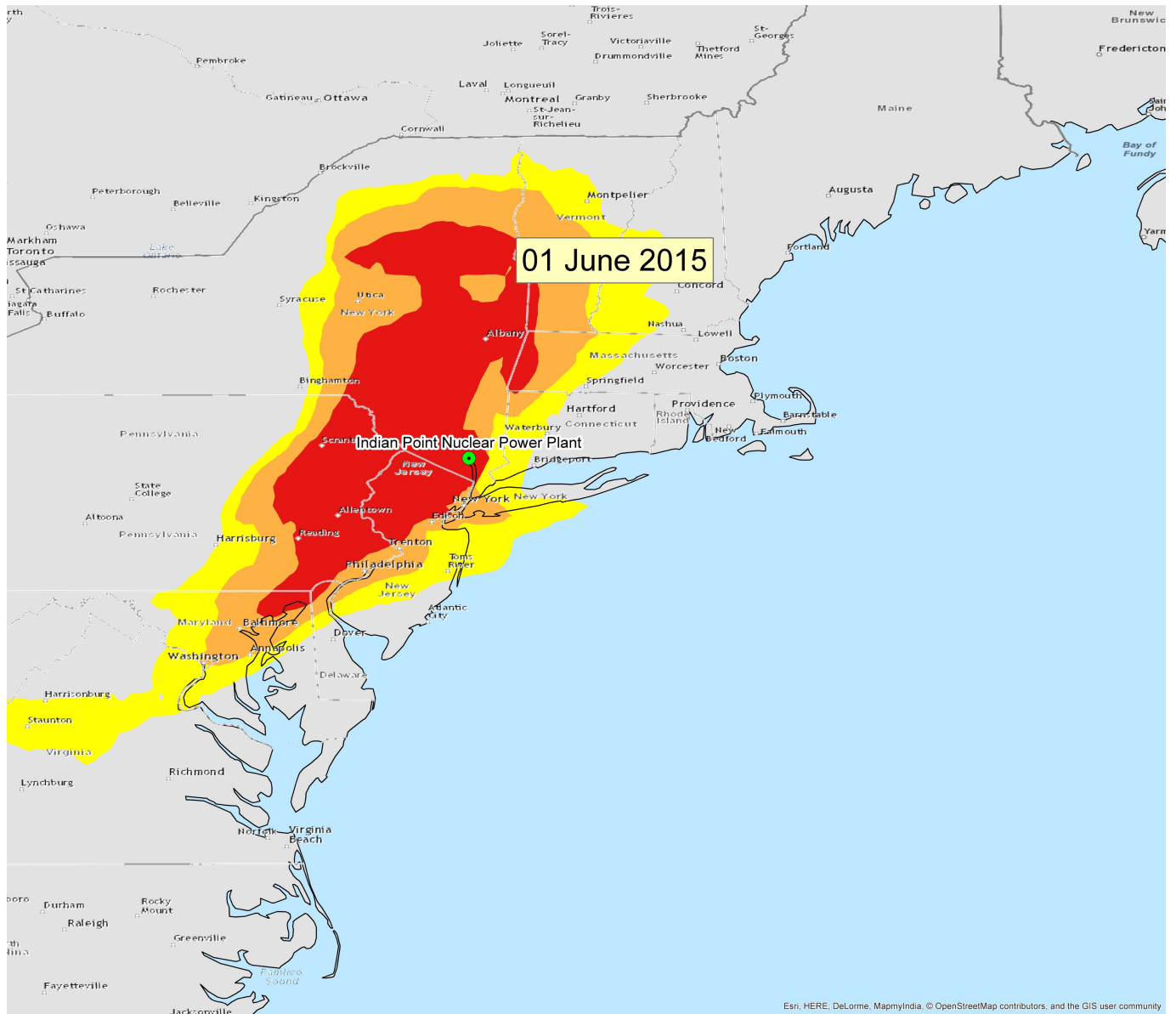
Compiled by Ellen Weininger, Director of Educational Outreach,
Grassroots Environmental Education and Co-Founder, SAPE, November 1, 2021

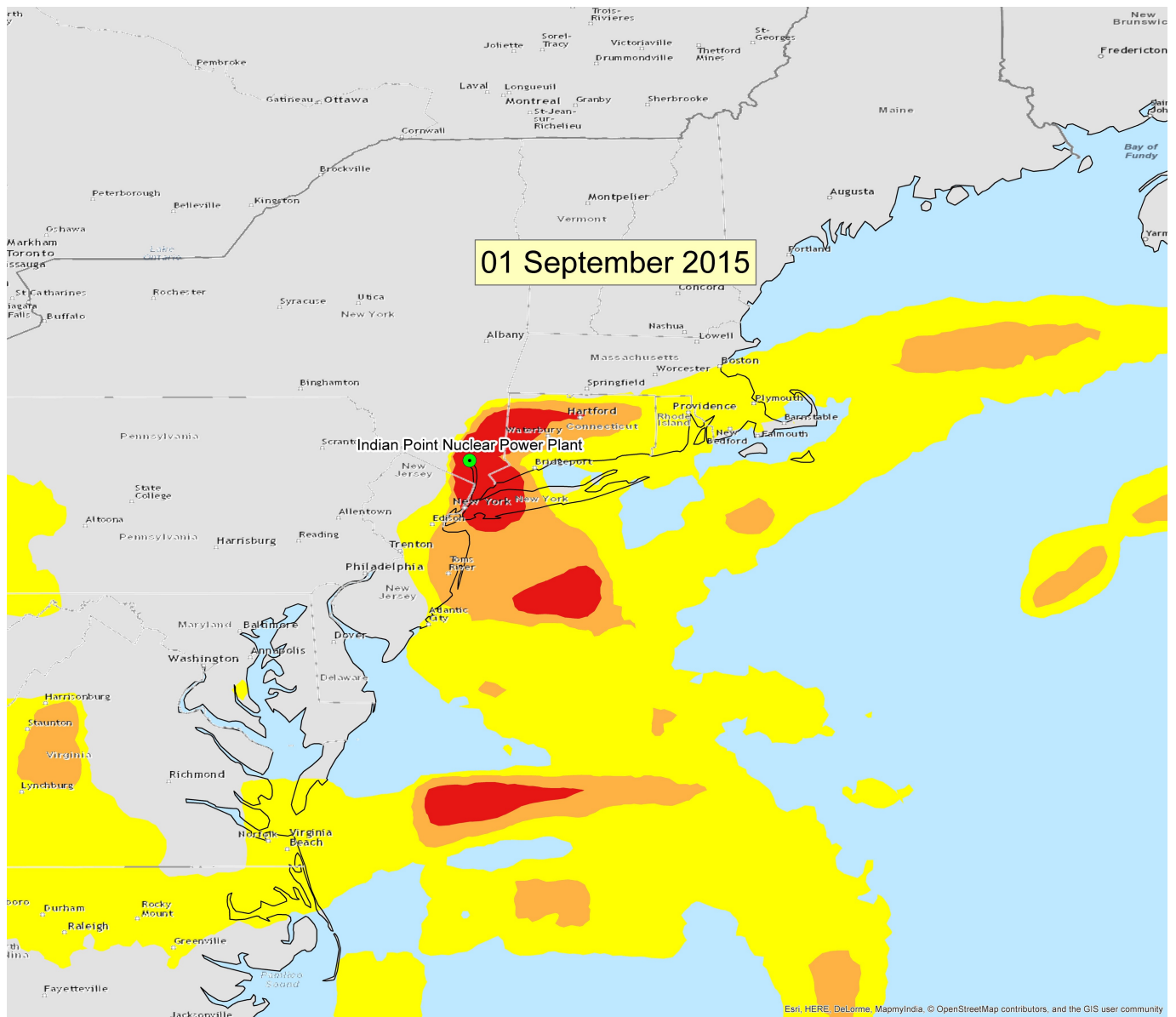
Long-term Relocation Areas Resulting From a Spent Fuel Fire at Indian Point

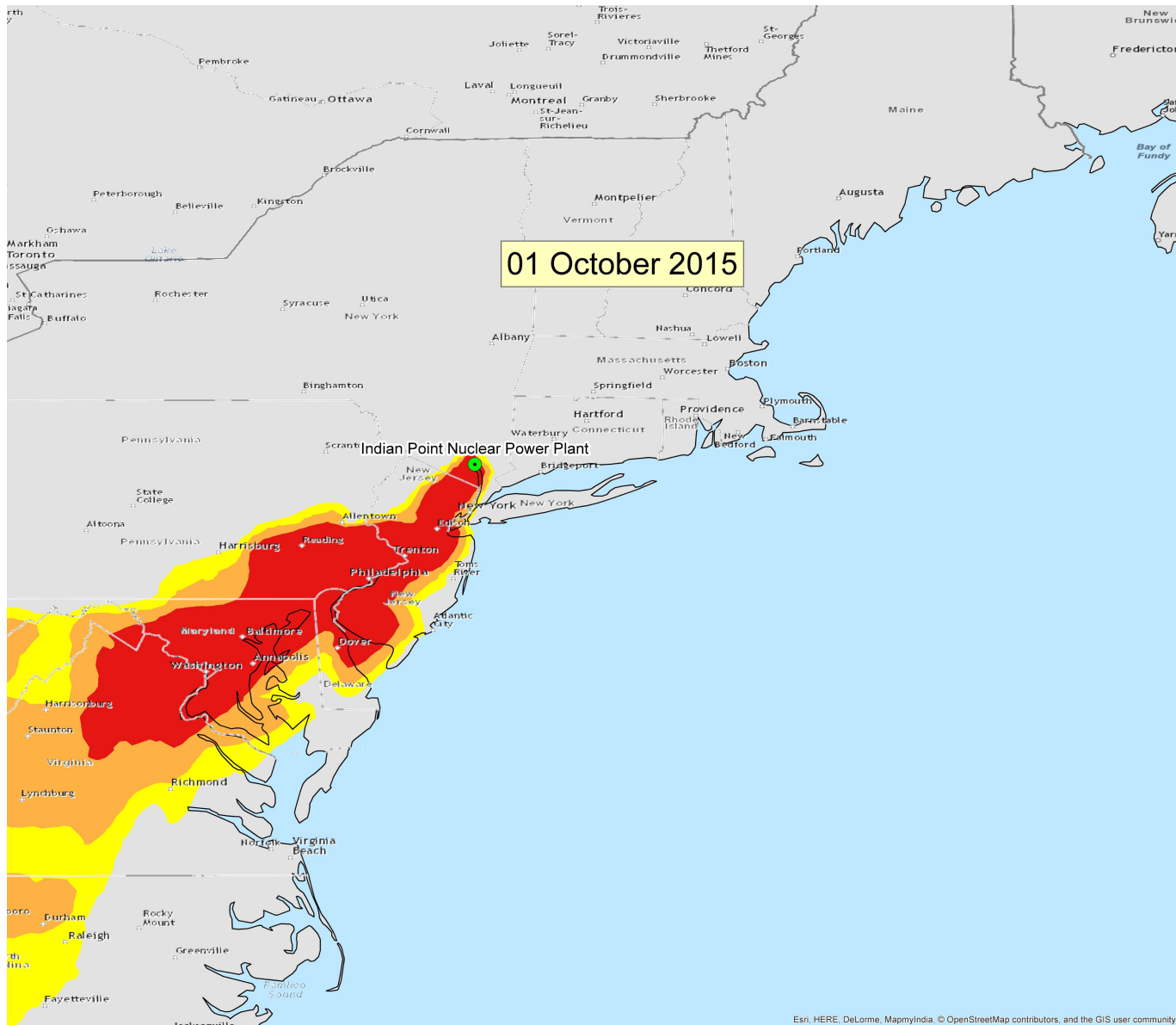


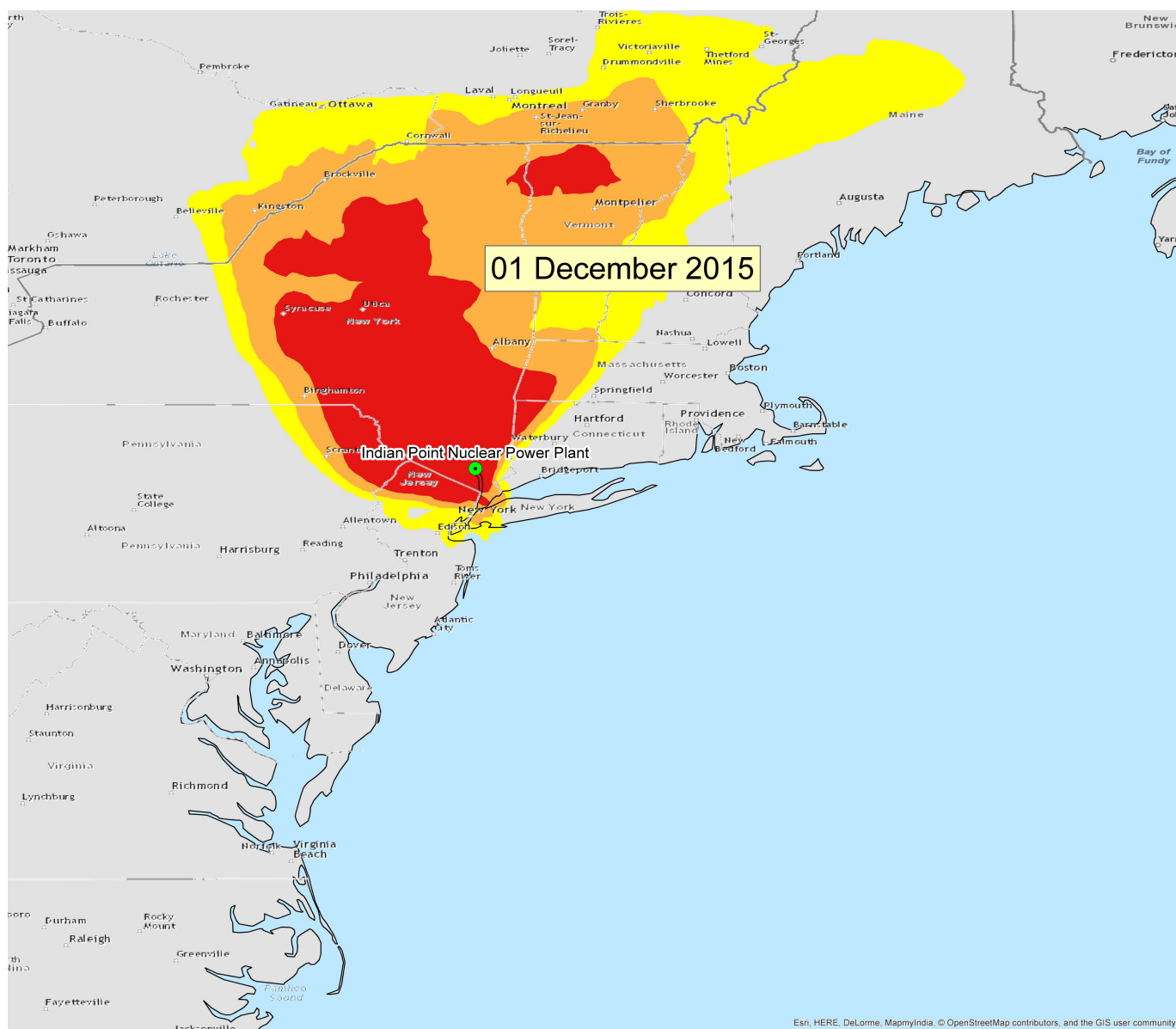
- Multi-year relocation would occur for **red** and **orange** areas
- At Chernobyl and Fukushima, a large fraction of the population also evacuated out of the **yellow** area.
 - Maps based on relocation standards used for Chernobyl and Fukushima and recommended by the EPA
 - Maps based on historical weather for the first date of each month of 2015











Maps by Michael Schoeppner, PhD, International Data Centre, Comprehensive Nuclear-Test-Ban Treaty Organization, Vienna.

Relocation areas and populations

- Average relocation would be about 60, 000 square kilometers
 - (30 times the area of New York City)
- Average relocated population would be 13 million
 - (1.5 times the population of New York City)

Month (release beginning on first day of month, 2015)	Area Interdicted (km2 contaminated above 1.5 MBq/m2)	Population in area
January	7,500	830,000
February	61,000	8,200,000
March	60,000	9,600,000
April	25,000	9,400,000
May	23,000	15,400,000
June	109,000	29,000,000
July	73,000	13,800,000
August	12,000	5,700,000
September	23,000	16,500,000
October	175,000	34,900,000
November	38,000	5,000,000
December	129,000	8,400,000
Average	61,292	13,060,833

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.

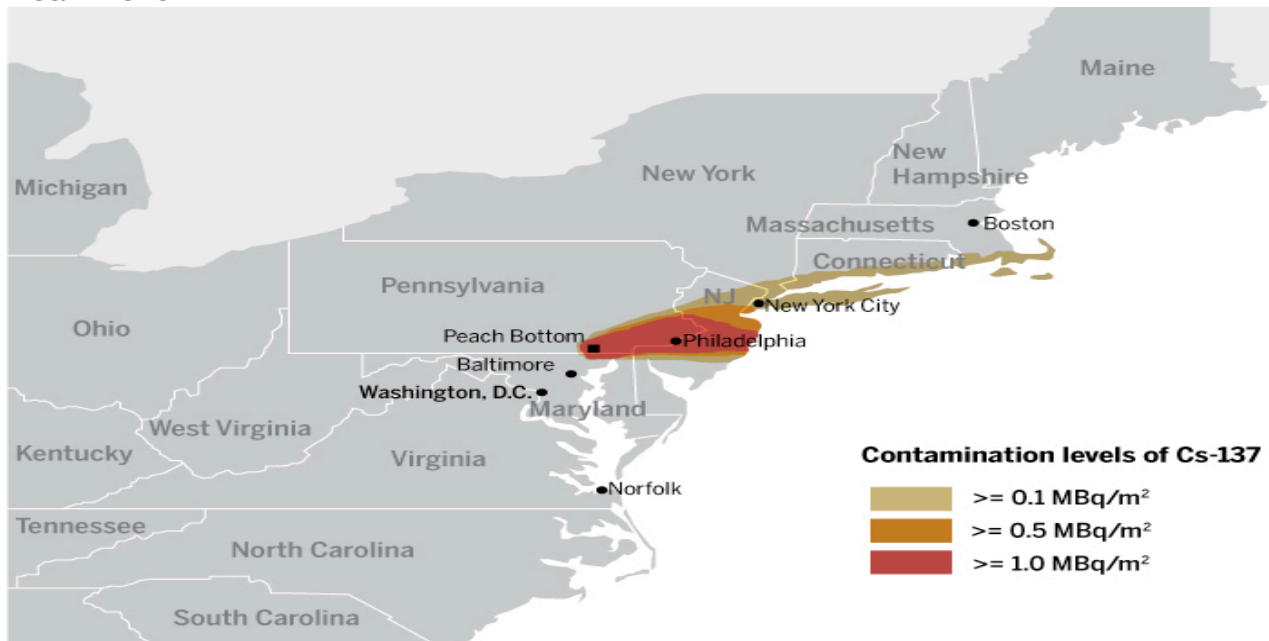
At most U.S. nuclear plants, spent fuel is densely packed in pools, heightening the fire risk. NRC has estimated that a major fire at the spent fuel pool at the Peach Bottom nuclear power plant in Pennsylvania would displace an estimated 3.46 million people from 31,000 square kilometers of contaminated 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.

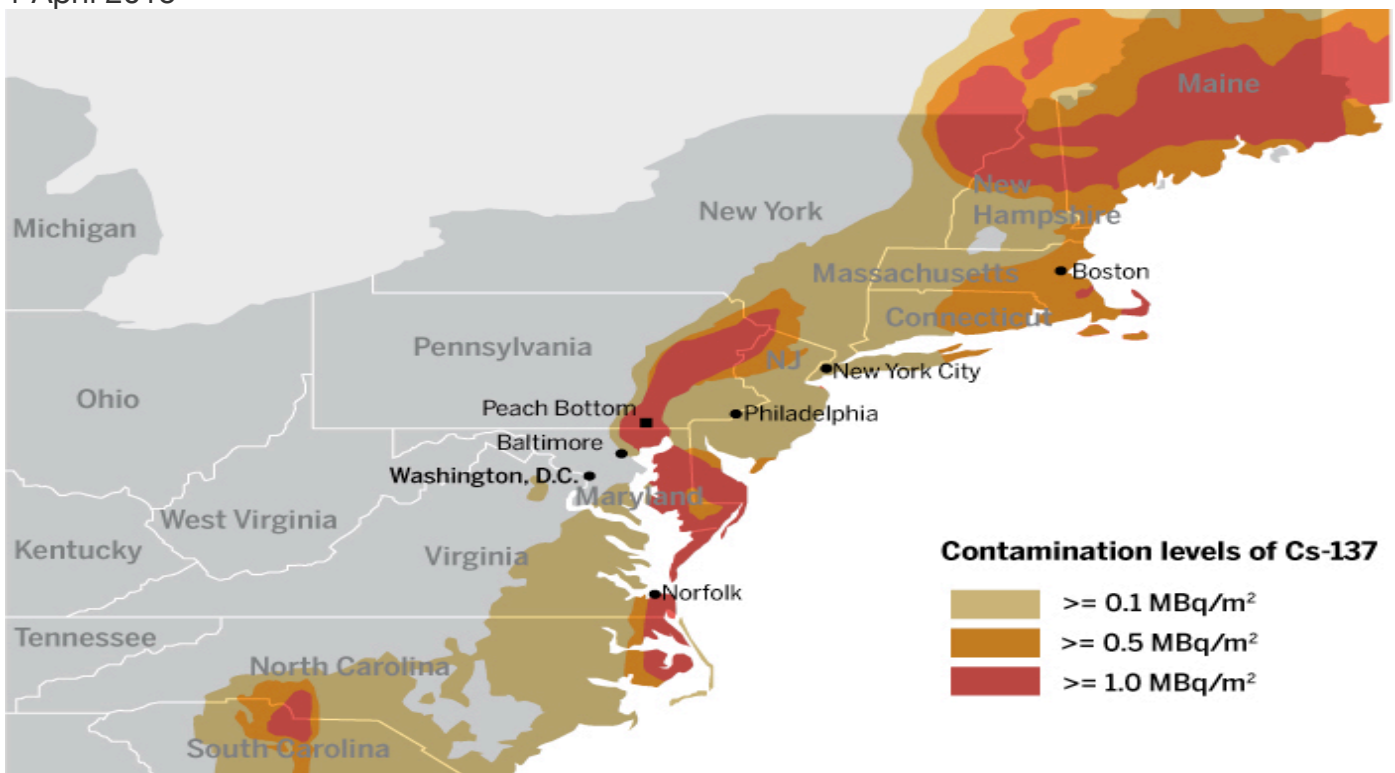
Nightmare scenarios

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. Schoepner

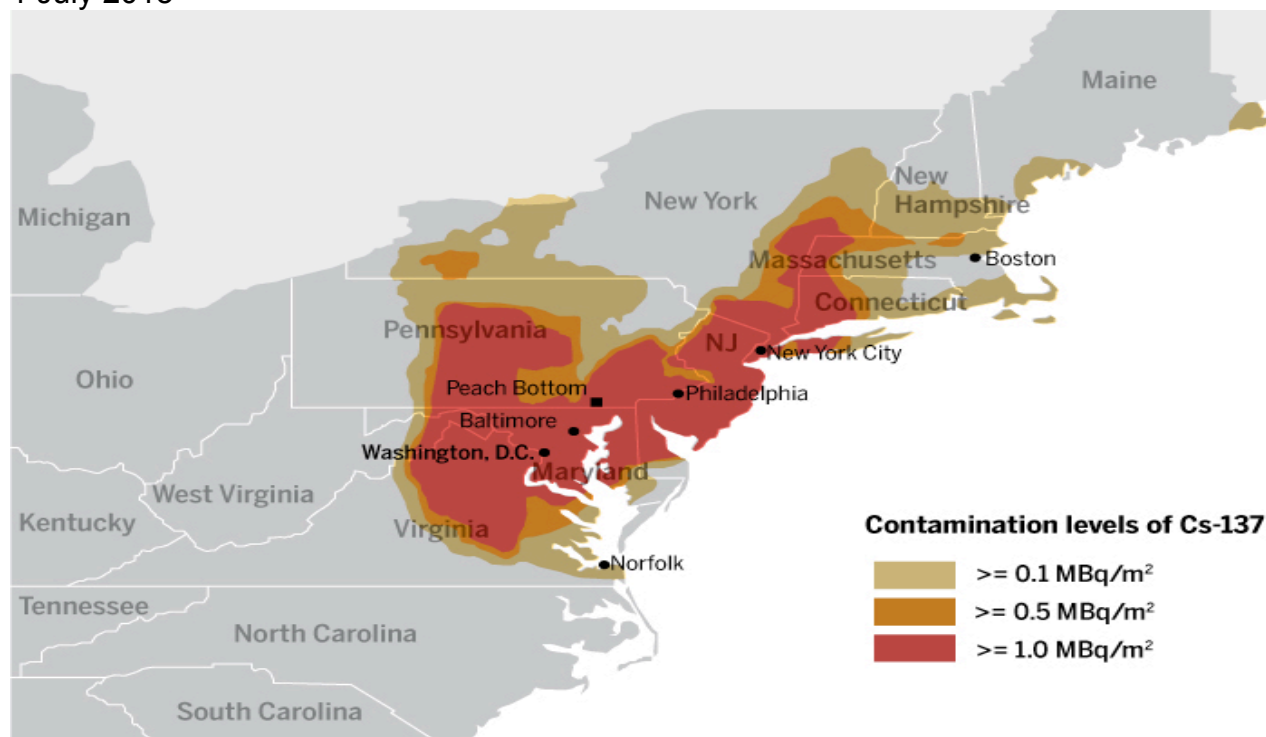
1 Jan. 2015



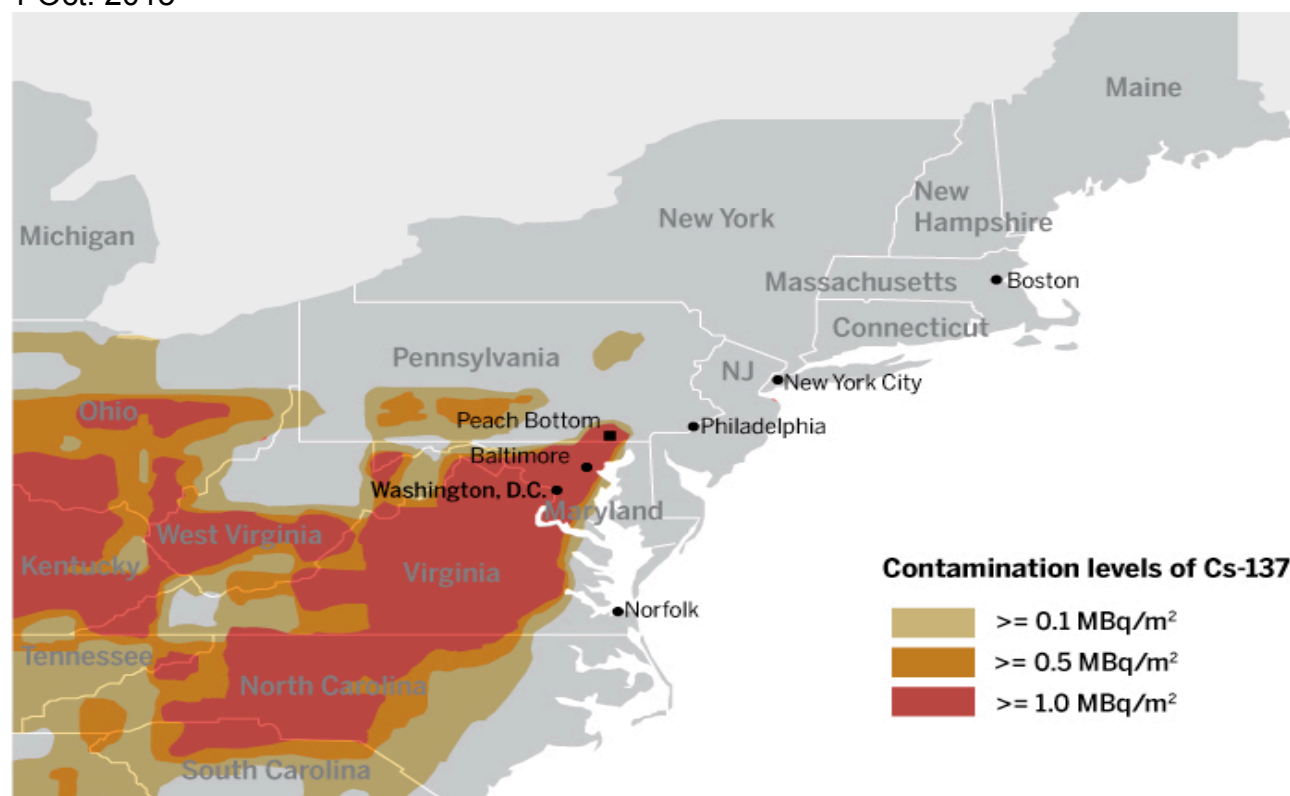
1 April 2015



1 July 2015



1 Oct. 2015



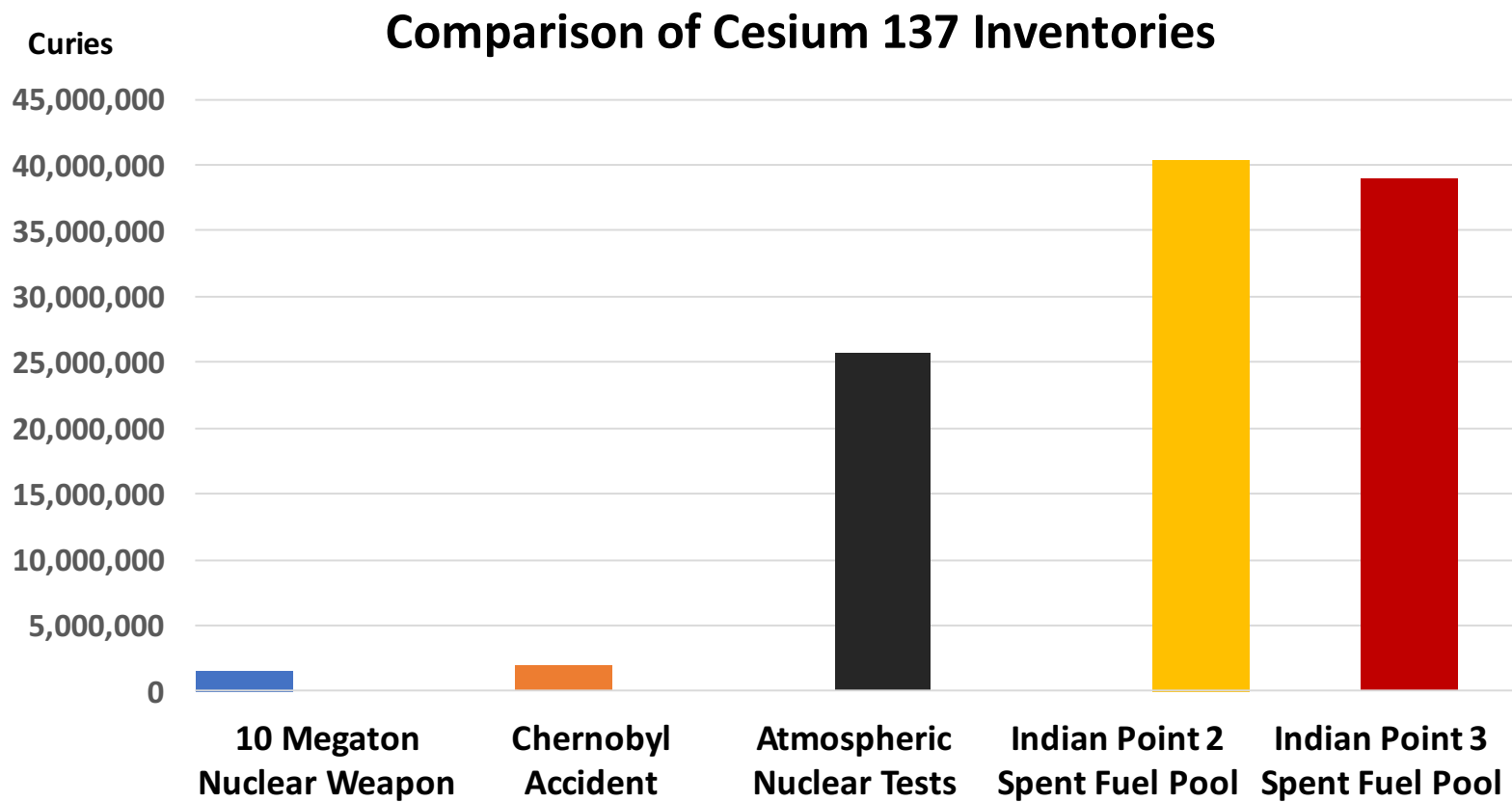
In their simulations, the Princeton duo focused on Cs-137, a radioisotope with a 30-year half-life that has made large tracts around Chernobyl and Fukushima uninhabitable. They assumed a release of 1600 petabecquerels, which is the average amount of Cs-137 that NRC estimates would

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.

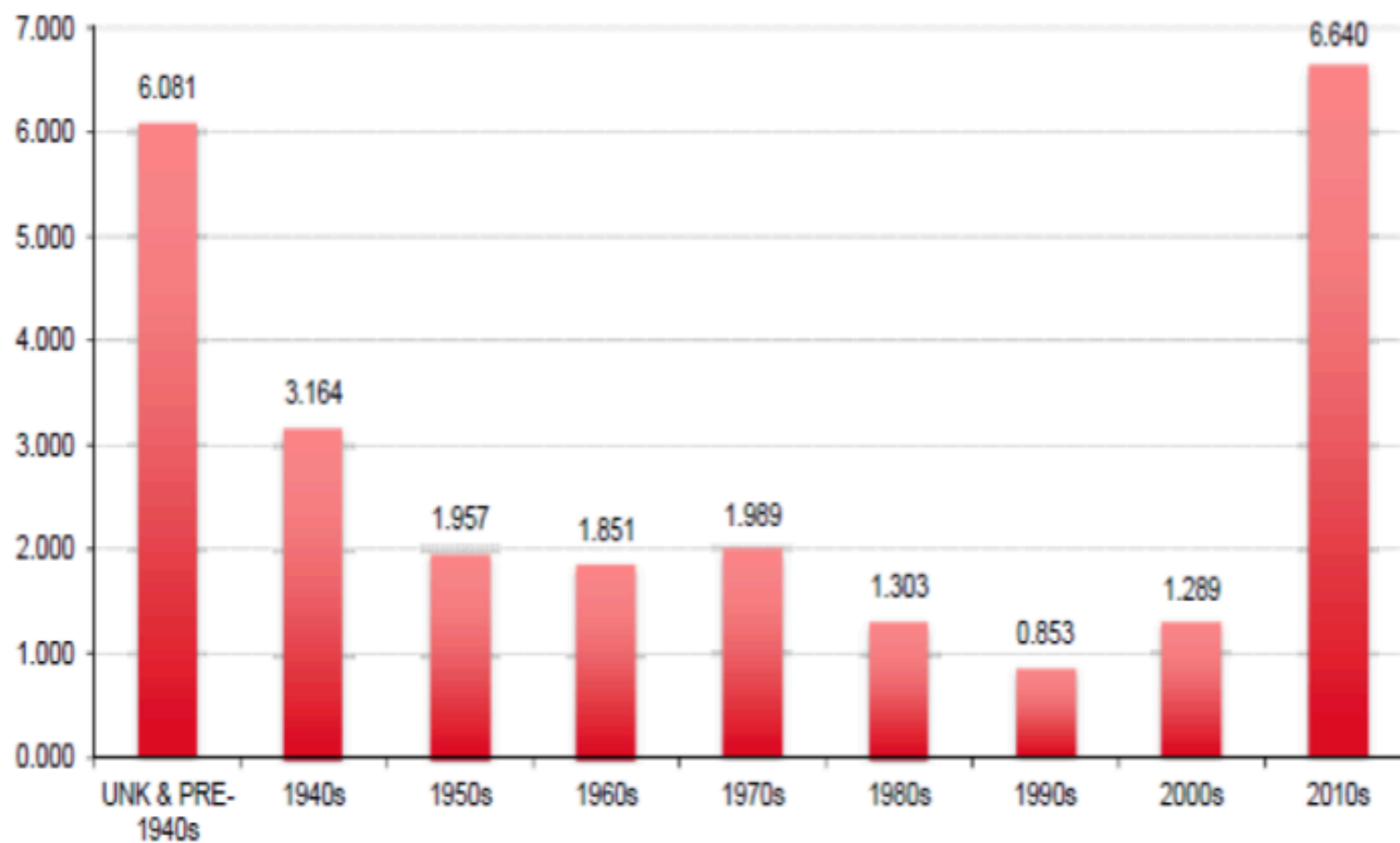
NRC has long mulled whether to compel the nuclear industry to move most of the cooled spent fuel now held in densely packed pools to concrete containers called dry casks. Such a move would reduce the consequences and likelihood of a spent fuel pool fire. As recently as 2013, NRC concluded that the projected 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.



Sources: CDC 2000, NCRP No. 154, DOE GC-859, Exchange Monitor 01-2017, DOE EIS-0250, Appendix A, (PWR/ Burnup = 41,200 MWd/MTHM, enrichment = 3.75 percent, decay time = 23 years.)

Average number of annual incidents over 2005-2013 per 10,000 miles of onshore gas transmission pipe by decade of pipe installation



As of March 2015.

Sources: U.S. Pipeline and Hazardous Materials Safety Administration, Pipeline Safety Trust

Calculation from David Lochbaum

Pipeline calculation check by Dave Lochbaum, Union of Concerned Scientists

From NRC Regulatory Guide 1.91, Rev. 2, April 2013

Equation (1):

$$R_{min} = Z * W^{0.333}$$

where

R_{min} = distance from explosion to point where overpressure will drop to 1.0 psi

Z = scaled distance = 45 ft/lb^{0.333} when R is in feet and W is in pounds

Z = scaled distance = 18 m/kg^{0.333} when R is in meters and W is in kilograms

Check: NUREG-1805 (December 2004) Figure 15-3 supports 45 ft/lb^{0.333} for 1 psi overpressure

Equation (2):

$$W_{eff} = (H_{exp}/H_{TNT}) * W_{exp}$$

where

W_{eff} = effective charge equivalent

W_{exp} = weight of the explosive charge

H_{exp} = heat of detonation of the explosive

H_{TNT} = heat of detonation of TNT

Equation (3):

$$E = \alpha * \Delta H_c * mf$$

where

E = blast wave energy, BTU or kilojoules

α = yield (fraction of available combustion energy participating in blast wave = 5% from Table 1)

ΔH_c = theoretical net heat of combustion (BTU/lb or kilojoules/kilogram)

mf = mass of flammable vapor released (pounds mass or kilograms)

Equation (4):

$$W_{TNT} = E / (1900 \text{ BTU/pound mass}) \text{ or } E / (4420 \text{ kilojoules/kilogram})$$

From FOIA-2015-0076:

$$\Delta H_c = 50,030 \text{ kilojoules/kilogram}$$

Check: NUREG-1805 (December 2004) Table 3-2 gives 50,000 kJ/kg for LNG and 46,000 kJ/kg for LPG

Check: NUREG-1805 (December 2004) Table 15-2 gives 50,030 kJ/kg for Methane gas

Check: NUREG-1805 (December 2004) Table 15-2 gives 46,360 kJ/kg for Propane gas

Check: NUREG-1805 (December 2004) Table 15-2 gives 47,490 kJ/kg for Ethane gas

$$mf = 376,000 \text{ kilograms} + 200,000 \text{ kilograms} + 100,000 \text{ kilograms} = 676,000 \text{ kilograms}$$

Solving Equation (3):

$$E = \alpha * \Delta H_c * mf$$

$$E = 0.05 * 50,030 \text{ kilojoules/kilogram} * 676,000 \text{ kilograms}$$

$$E = 1,691,014,000 \text{ kilojoules for } 676,000 \text{ kilograms}$$

$$E = 940,564,000 \text{ kilojoules for } 376,000 \text{ kilograms}$$

Solving Equation (4):

$$W_{TNT} = E / (1900 \text{ BTU/pound mass}) \text{ or } E / (4420 \text{ kilojoules/kilogram})$$

$$W_{TNT} = 382,582 \text{ kilograms for } 676,000 \text{ kilograms}$$

$$W_{TNT} = 212,797 \text{ kilograms for } 376,000 \text{ kilograms}$$

Solving Equation (1):

$$R_{min} = Z * W^{0.333}$$

$$R_{min} =$$

$$1,301 \text{ meters for } 676,000 \text{ kilograms}$$

$$R_{min} =$$

$$4,269 \text{ feet for } 676,000 \text{ kilograms}$$

$$R_{min} =$$

$$0.81 \text{ miles for } 676,000 \text{ kilograms}$$

$$R_{min} =$$

$$1,070 \text{ meters for } 376,000 \text{ kilograms}$$

$$R_{min} =$$

$$3,511 \text{ feet for } 376,000 \text{ kilograms}$$

$$R_{min} =$$

$$0.67 \text{ miles for } 376,000 \text{ kilograms}$$

Blast Radius of 4200 feet
for 3 minute release

Calculation Summary from NRC Professional Engineer

$$R_{min} = Z * W^{1/3} \quad (1)$$

where

R_{min} = distance from explosion where P_{50} will equal 1.0 psi (meters)

W = mass of TNT (kilograms)

Z = scaled distance equal to 18 m/kg^{1/3}

For a mass of 380 metric tons of TNT, R_{min} is calculated as follows from Equation 1:

$$R_{min} = 18 * (380,000)^{\frac{1}{3}} \approx 1,300 \text{ meters} = 1.3 \text{ km}$$

Thus, assuming a rupture of the section Algonquin Incremental Market pipeline passing through Indian Point were to take three minutes to isolate and were to release 676,000 kg of natural gas and assuming that the released mass of gas was to result in a vapor cloud explosion (VCE) with an explosive yield efficiency factor of 5%, then it is possible that structures within 1.3 kilometers (4300 feet) of the rupture would experience adverse affects from that explosion.

Blast radius of 4300 feet

Calculation From DOE Professional Engineer

Paul

Per your request, I have reviewed your calculation assuming the average flow rate from a ruptured line is 1877 Kg per second and lasting for 360 seconds. This information was provided from a response to FOIA 2015-0246.

DHC is a constant of 50030

Applying equation from FOIA

$$W_{TNT} = M_f * DHC * Y \quad 4500 = 675,720 \text{ Kg(TNT)}$$

This is equivalent to 1,486,584 pounds or 743 tons of TNT after 6 Minutes.

The NRC provides the equation $d = 45 * \sqrt[3]{w}$ where d is the minimum safe distance in feet .

Applying this NRC equation¹ $45 * \sqrt[3]{1,486,584 * 50030 * .05 / 4500}$ equals 4,185 feet as the Minimum blast radius from a 6 minute release using the following:

$$d_{ft (3 Minutes)} = 45 * (w_{Pounds})^{1/3} = 45 * \sqrt[3]{\frac{Mf_{(Kg)} * DHC_{(Kj/Kg)} * Y_{(5\%Yield)}}{4500}} = 45 * \sqrt[3]{\frac{(Total flow after 3 Minutes)_{Kg} * 50030 * .05}{4500}}$$

Conclusion

Assuming a Yield of 5%, the lowest value from NRC Regulatory Guide 1.91, and a DHC of 50030 from FOIA 2015-0076, **my calculated blast radius is 4,185 feet**, consistent with Dave Lochbaum's calculated radius of 4269 feet and in total conflict with Entergy's and the NRC's results of about 1100 feet from Entergy's 10 CFR 50.59 analysis.

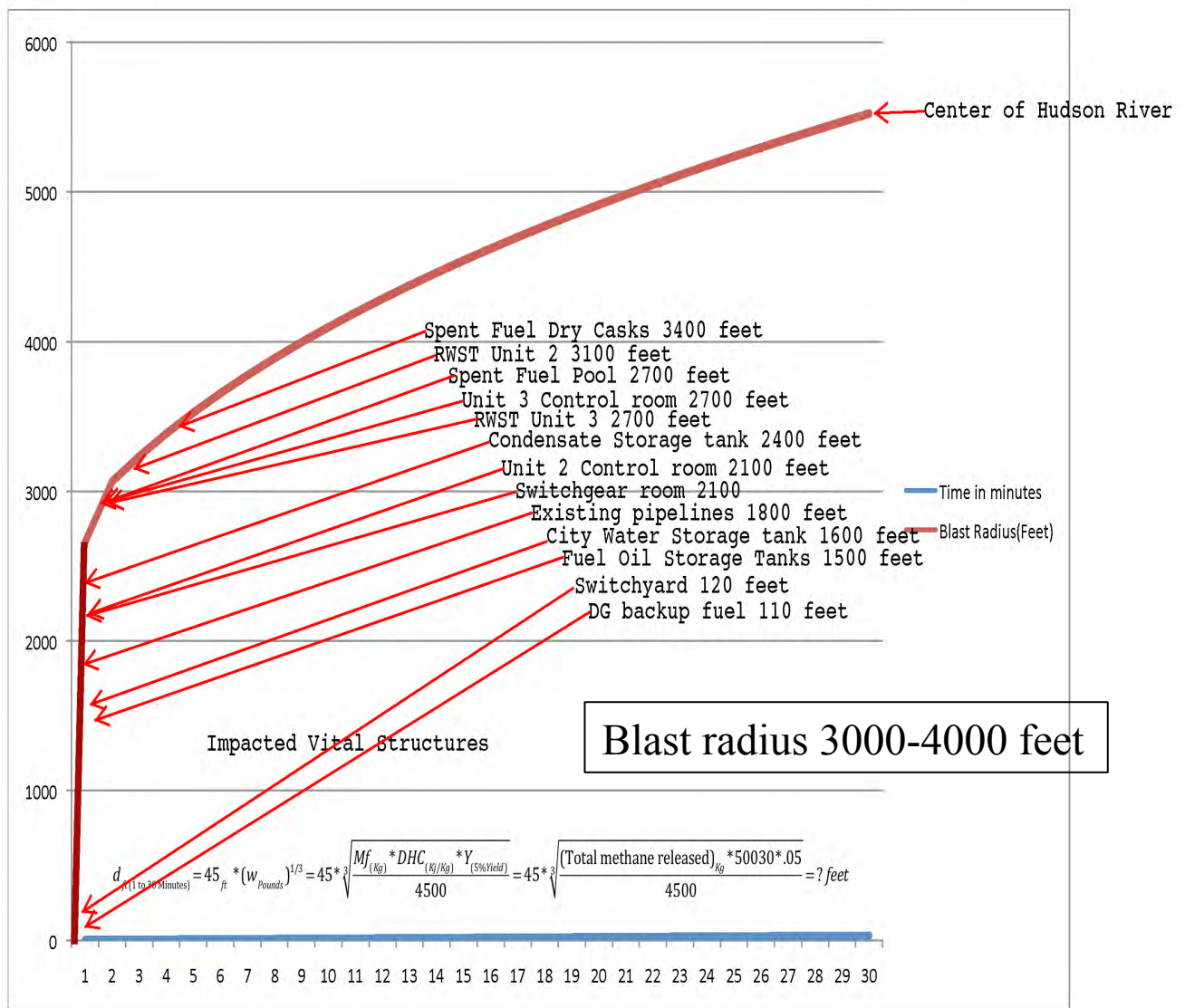
Blast radius of 4185 feet

¹

$$d_{ft (3 Minutes)} = 45 * (w_{Pounds})^{1/3} = 45 * \sqrt[3]{\frac{Mf_{(Kg)} * DHC_{(Kj/Kg)} * Y_{(5\%Yield)}}{4500}} = 45 * \sqrt[3]{\frac{(Total flow after 3 Minutes)_{Kg} * 50030 * .05}{4500}}$$

Calculation by Paul Blanch, PE

Indian Point Damaging Blast Radius (1 PSI) vs time from NRC RG 1.19 Equations



Co-locating Nuclear Plants with
Natural Gas Pipelines
Paul Blanch Energy Consultant

**SUPPORTIVE DOCUMENTATION REQUESTED BY PHMSA
MEETING OF SEPTEMBER 30, 2021, 6:30 PM - 8:30 PM
MORABITO RECREATIONAL CENTER, CORTLANDT, NY**

**PLEASE CLICK ON LINK OR COPY AND PASTE LINK INTO BROWSER TO
ACCESS DOCUMENTS.**

***Additional supportive documentation can be provided upon request.**

**Letter from U.S. Senators Gillibrand and Schumer and Congressman Jones to U.S.
DOT Secretary and PHMSA (July 23, 2021)**

<https://sape2016.files.wordpress.com/2021/08/2021-07-28-aim-pipeline-meeting-with-phmsa-2.pdf>

**NRC Office of Inspector General Report: Concerns Pertaining to Gas
Transmission Lines at Indian Point Nuclear Power Plant (Feb 2020)**

<https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML20056F095>

**Letter from NYS legislators to OIG DOT in support of letter from Paul Blanch (April
17, 2020) <https://sape2016.files.wordpress.com/2020/04/041720-galef-buchwald-letter-to-dot-oig.pdf>**

Letter from Paul Blanch to U.S. DOT Office of Inspector General (April 7, 2020)

<https://sape2016.files.wordpress.com/2020/04/20200408-corrected-paul-blanch-dot-oig-letter-final-2020-04-08-at-1-50-08-pm.pdf>

**Report of U.S. NRC Expert Evaluation Team on Concerns Pertaining to Gas
Transmission Lines Near the Indian Point Nuclear Power Plant (April 8, 2020)
Includes letter from Sandia National Laboratories re findings (p 72 -90)**

<https://www.nrc.gov/docs/ML2010/ML20100F635.pdf>

**Letter from Paul Blanch to NRC re Briefing on Agency Practice and Procedure
Issues: NRC expert evaluation on NRC OIG report (March 23, 2020)**

<https://sape2016.files.wordpress.com/2020/05/2020323-ltr-skeen-revised-.pdf>

Official Transcript of Proceedings NRC Evaluation Team (March 20, 2020)
<https://www.nrc.gov/docs/ML2008/ML20087M178.pdf>

Official Transcript of Proceedings NRC Evaluation Team (March 19, 2020)
<https://www.nrc.gov/docs/ML2008/ML20087M164.pdf>

Letter to FERC and NRC from NYS PSC (March 9, 2020 and March 26, 2020)
https://sape2016.files.wordpress.com/2020/04/030920-and-032620-pcs-letter-to-nrc-and-ferc-ml20086l280-dps-letter-to-ferc_nrc.pdf

Letter to FERC, NRC & PHMSA from NYS Attorney General (March 19, 2020)
<https://sape2016.files.wordpress.com/2020/05/2020-03-19-oag-joint-letter-re-aim-interim-safety-measures.pdf>

Updated pipeline closure statement from Irwin Redlener, MD, Director, National Center for Disaster Preparedness at Columbia University in response to NYS agencies' letter to FERC and Executive Summary of risk assessment (Sept 6, 2018)
<https://sape2016.files.wordpress.com/2018/12/redlener-pipeline-closure-statement-3.pdf>

Letter from Paul Blanch to Gov Cuomo, NYS DEC, DOH, DHS, PSC/PHMSA, FERC, NRC in response to Enbridge letter to FERC regarding NYS agencies' letter and Executive Summary (August 16, 2018)
<https://sape2016.files.wordpress.com/2018/12/20180816-letter-to-cuomo-pmb-2.pdf>

Declaration from Paul Blanch to FERC in response to NYS agencies' letter to FERC and Executive Summary of risk assessment (July 20, 2018)
<https://sape2016.files.wordpress.com/2018/12/20180720-final-ferc-pmblanch-declaration-3.pdf>

Letter from Richard Kuprewicz to FERC in response to NYS agencies' June 2018 letter to FERC and Executive Summary of NYS risk assessment (July 11, 2018)
<https://sape2016.files.wordpress.com/2018/12/accufacts-7-11-18-kuprewicz-letter-to-ferc-3.pdf>

NYS Agencies Letter to FERC (CC to PHMSA and NRC) re NYS Risk Assessment (June 22, 2018)
<https://sape2016.files.wordpress.com/2018/12/nys-letter-to-ferc-re-risk-assessment-june-22-2018-2.pdf>

Calculation by Paul Blanch of TNT equivalency of pipeline rupture (April 23, 2017)
<https://sape2016.files.wordpress.com/2017/04/tnt-equivalent-blanch.pdf>

Spent Fuel Fire Relocation Maps (Princeton Study), Cesium Graph, PHMSA Pipeline Failure Graph, Independent Engineers' Calculations of Pipeline Blast Impact Radius (2016)

https://sape2016.files.wordpress.com/2021/05/indian-point-spent-fuel-fire-maps_article_alvarez-cesium_phmsa-pipeline-graph_calcs-pdf.pdf

Press Release - Medical and Disaster Experts Investigate Pipeline Construction Next to Indian Point Nuclear Plant: Prompts Strong Call to Immediately Halt Pipeline Construction and Operation (October 18, 2016)

<https://sape2016.files.wordpress.com/2013/10/psr-press-release-finalr-october-18j-2016.pdf>

Videotape of Irwin Redlener at Press Conference for Medical and Disaster Experts (October 18, 2016) <https://www.youtube.com/watch?v=nUU4sBQCKYA>

Statement from Irwin Redlener, Statements from Irwin Redlener, MD, Director, National Center for Disaster Preparedness, Earth Institute and Professor of Health Policy and Management, Columbia University. (As of June 2020, Dr Redlener is Director, Pandemic Resource and Response Initiative (PRRI) and Senior Research Scholar at the National Center for Disaster Preparedness at Earth Institute, Columbia University. (October 18, 2016)

<https://sape2016.files.wordpress.com/2013/10/redlener-statement-psr-press-101816.pdf>

SPECTRA ENERGY / ALGONQUIN GAS TRANSMISSION, LLC:

Harvey, Chris, Director, Rates and Certificates, Spectra Energy Partners / Algonquin Gas Transmission, LLC Letter to Kimberly D. Bose, Secretary, U.S. Federal Energy Regulatory Commission, re Algonquin Gas Transmission, LLC, Docket No. CP14-96-000, Oct 18, 2016.

<https://sape2016.files.wordpress.com/2013/10/101816-spectra-to-ferc-to-put-aim-in-service.pdf>

Affidavit by Richard Kuprewicz (Sept 21, 2016)

https://drive.google.com/file/d/0B7g3zFc9C_r6TUMxbHRGWWg0UHc/view?resourcekey=0-F9y8BbuJn_7cAEOsZ44x8Q

Affidavit by Paul Blanch (Sept 21, 2016)

https://drive.google.com/file/d/0B7g3zFc9C_r6Z3dKMVZSYnJJeGc/view?resourcekey=0-clNrBrM-qA6BCXzy_mWZDg

Letter from Paul Blanch to OIG NRC (February 25, 2016)

<https://sape2016.files.wordpress.com/2020/04/20160225-blanch-ltr-to-hubert-bell-nrc-oig-copy.pdf>

Letter from Richard Kuprewicz to Assemblywoman Sandy Galef (Oct 12, 2015)

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FOIA Document (2015)

**Entergy's 10 CFR 50.59 Safety evaluation of Algonquin Incremental Market project
Indian Point Energy Center**

<https://sape2016.files.wordpress.com/2014/05/foiadocument1.pdf>

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Indian Point gas line isolation time (April 27, 2015)

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**Official Transcript of Proceedings of the NRC Petition Review Board – Richard
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<https://sape2016.files.wordpress.com/2014/05/transcript-7-15-2015-ml15216a047.pdf>

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<https://sape2016.files.wordpress.com/2014/05/prb-transcript-1-28-2015-2-2.pdf>

**FERC Final Environmental Impact Statement for the Algonquin Incremental Market
project (January 23, 2015)**

<https://cms.ferc.gov/final-environmental-impact-statement-algonquin-gas-transmission-ilcs-algonquin-incremental-market>

**Review of AIM Pipeline for Town of Cortland by Richard Kuprewicz for Town of
Cortlandt (Nov 3, 2014)**

<https://sape2016.files.wordpress.com/2018/04/accufacts-report-110314-20141121-507829933631-2.pdf>

Letter from Entergy to NRC (August 21, 2014) re:
10 C.F.R. 50.59 Safety Evaluation and Supporting
Analyses Prepared in Response to the Algonquin Incremental Market
Natural Gas Project
Indian Point Nuclear Generating Unit Nos. 2 & 3
<https://www.nrc.gov/docs/ML1425/ML14253A339.pdf>

Community based environmental justice inventory for the City of Peekskill
(December 2010)
https://www.clearwater.org/wp-content/uploads/2011/03/CBEJI_FINAL-_DRAFT-1-30-11-for-printing.pdf

Letter from Paul Blanch to NRC (Oct 25, 2010) re: 10 CFR 2.206 Petition regarding
inadequacy of Entergy's Management of Spectra/Algonquin Energy natural gas
transmission lines within the site boundary at Indian Point nuclear plants
<https://sape2016.files.wordpress.com/2014/05/20101025-ip-2-206-petition-on-gas-lines-signed-4.pdf>

Natural gas pipeline hazard determination (January 19, 2004)
<https://sape2016.files.wordpress.com/2014/05/les-gas-line-risk-analysis1.pdf>

ADDITIONAL SUPPORTIVE DOCUMENTATION

Where are the U.S.'s natural gas pipelines? Often in vulnerable communities
New nation-wide analysis shows that counties with higher social vulnerability are home
to a denser web of natural gas pipelines. (June 4, 2021) National Geographic
<https://www.nationalgeographic.com/environment/article/where-are-the-us-natural-gas-pipelines-often-in-vulnerable-communities>

CDC's County level Social Vulnerability Index: Referenced in above analysis.
Measures how resilient a community might be in response to a major disaster
<https://www.atsdr.cdc.gov/placeandhealth/svi/index.html>
Peekskill (High vulnerability)
Westchester (Moderate to high vulnerability)

**Former Inspectors Describe Dangerous Flaws in Construction of Major East Coast
Gas Pipeline, DeSmog, Jul 19, 2016.**
<https://www.desmog.com/2016/07/19/former-inspectors-describe-dangerous-flaws-construction-major-east-coast-gas-pipeline/>

While Reviewing Spectra Energy Gas Pipeline Project, FERC Contractor Did Not Disclose Its Hiring by Spectra for Five Other Projects, DeSmog, Jul 19, 2016
<https://www.desmog.com/2016/07/19/while-reviewing-spectra-energy-gas-pipeline-project-ferc-contractor-did-not-disclose-its-hiring-spectra-five-other/>

LETTERS FROM LOCAL, COUNTY, STATE AND FEDERAL LEGISLATORS

Letter from NYS legislators to OIG DOT in support of letter from Paul Blanch (April 17, 2020) <https://sape2016.files.wordpress.com/2020/04/041720-galef-buchwald-letter-to-dot-oig.pdf>

Letter from NYS Senator Peter Harckham to FERC regarding NRC OIG report (March 9, 2020) <https://sape2016.files.wordpress.com/2020/03/030820-harckham-letter-to-ferc-to-shut-algonquin-gas.pdf>

Statement from Westchester County Board of Legislators re NRC OIG report (March 2, 2020) <https://sape2016.files.wordpress.com/2021/05/statement-on-nrc-inspector-general-report-march-2-2021.pdf>

Senators Schumer and Gillibrand call for an independent review of NRC analysis following report of agency's failure to properly analyze pipeline risks at Indian Point. Damning RNC Inspector General report details faulty analysis that led to approval of natural gas pipelines (February 28, 2020)
<http://static1.1.sqspcdn.com/static/f/356082/28264823/1583425805707/Schumer+Gillibrand+OIG+ltr.2.28.20.pdf?token=UnpJKI2dkLTZn2cUYqPMoLAT2oI%3D>

Statement from Congresswoman Nita Lowey (Feb 27, 2020) Nuclear Regulatory Commission Inspector General Report Reveals Dangerous Failings by Federal Agency
<https://sape2016.files.wordpress.com/2021/05/lowey-press-release-february-2020.pdf>

Letter from NYS legislators to FERC regarding NYS letter to FERC and Executive Summary of risk assessment (July 24, 2018)
<https://sape2016.files.wordpress.com/2018/12/nys-leg-aim-letter-to-ferc-3.pdf>

Letter from Congresswoman Nita Lowey to FERC calling for action (July 18, 2018)
<https://sape2016.files.wordpress.com/2018/12/2018-07-18-lowey-letter-to-ferc-chairman-on-nys-risk-assessment-july-18-2018-3.pdf>