

EDO Principal Correspondence Control

FROM: DUE: 09/24/04

EDO CONTROL: G20040574  
DOC DT: 08/12/04  
FINAL REPLY:

Alex Matthiessen  
Kyle Rabin  
Riverkeeper

TO:

Collins/Holian, RI

FOR SIGNATURE OF : \*\* GRN \*\*

CRC NO:

Dyer, NRR

DESC:

ROUTING:

Seismic Hazard Analysis for the Indian Point  
Nuclear Power Plant

Reyes  
Virgilio  
Kane  
Merschhoff  
Norry  
Dean  
Burns/Cyr  
Collins, NRR

DATE: 08/20/04

ASSIGNED TO: CONTACT:

NRR

Dyer

SPECIAL INSTRUCTIONS OR REMARKS:

Coordinate response with Region I.

Template: EDO-001

E-RIDS: EDO-01



August 12, 2004

Sam Collins  
Regional Administrator, Region I  
U.S. Nuclear Regulatory Commission  
475 Allendale Road  
King of Prussia, PA 19406

Brian E. Holian  
Deputy Director  
Division of Reactor Projects, Region I  
U.S. Nuclear Regulatory Commission  
475 Allendale Road  
King of Prussia, PA 19406

---

Re: Seismic Hazard Analysis for the Indian Point Nuclear Power Plant

Dear Mr. Collins and Mr. Holian:

We are writing to formally request the Nuclear Regulatory Commission to take immediate action to ensure that a competent and independent authority on seismic research conduct an updated seismic hazard analysis for the Indian Point nuclear power plant, particularly in relation to the high-density spent fuel pools and the proposed dry cask storage facility. Such an analysis should be subjected to peer review and public scrutiny. We are also requesting that the NRC subject Indian Point, both now and during the license renewal process, to the same stringent criteria applied to companies seeking to build new reactors on existing or new sites.

The NRC's requirements of Entergy with respect to seismic monitoring at Indian Point are not apparent. Furthermore, it is not clear at what point the NRC decided to change its requirements regarding seismic monitoring at Indian Point. But it is obvious that the seismic hazard analysis<sup>1</sup> for Indian Point -- which is situated adjacent to the Ramapo fault -- clearly needs to be updated.

---

<sup>1</sup> Seismic hazard analysis is generally based on a combination of earthquake data, geologic data on active faults, and on tectonic models. In the eastern U.S. there are earthquakes, but only few active faults are known. The Indian Point site is near some of these faults. All earthquake sources over a large area need to be considered since large earthquakes can do damage far away. The analysis is done by an established procedure that accounts for differing opinions and describes the hazard probabilistically; the result is formulated as the probabilities of exceeding a set of specific acceleration values at different frequencies of shaking over a given time. These results can be given for a site or mapped over a region. From these results engineers can then design to specific required low probabilities of damage or evaluate the probability that an existing structure is damaged.



In addition, an April 30<sup>th</sup> letter from Entergy to Riverkeeper contained inaccurate information. The letter, from Kathleen McMullin, Entergy's Communications Manager, made the following declaration: "An earthquake with a peak ground acceleration of 0.15 g is equivalent to a Richter magnitude of approximately 6.0." The attached statement from Dr. Lynn Sykes of Lamont-Doherty Earth Observatory explains why this is incorrect and raises concerns about Entergy's lack of understanding on the issue of the seismic hazard threat to Indian Point. Other misinformation is posted to Entergy's website at <http://www.safesecurevital.org/articles/2004/drycaskfaq/seismic.html> is based on outdated studies.

A great deal more information on earthquakes<sup>2</sup> has become available since the hazard analysis that was performed decades ago regarding the risk of damage to Indian Point posed by seismic activity. For example, a sequence of earthquakes that started in August 2003 is being studied by the Lamont-Doherty Earth Observatory near the New Jersey-Pennsylvania border about 75 miles southwest of Indian Point. These earthquakes are particularly pertinent to the potential for earthquakes near Indian Point because they are associated with the same fault system (the Ramapo fault). Furthermore, new research suggests that damaging earthquakes could nucleate at a shallower depth than previously thought. While the probability of a damaging earthquake may be low, damage to various facilities at Indian Point may have dire secondary consequences for the region.

In the 1970s, measurements of acceleration came almost exclusively from earthquakes in the western U.S. and Japan and were assumed to be the same for the rest of the U.S. Measurements are

---

<sup>2</sup> Most earthquakes in southern New York and northern New Jersey occur in two belts each about 20 miles wide that are situated within the older rocks of the region. One belt extends from Putnam and Westchester counties to New York City and thence to central New Jersey. The other belt, which extends southwesterly along the Hudson Highlands from Peckskill NY to near Reading PA, is bounded on the southeast by border faults of the Newark Basin, including the Ramapo Fault. The two belts merge near Stony Point and Indian Point as the younger rocks of the Newark Basin pinch out. Thus, estimates of earthquake risk to Indian Point need to include possible future earthquakes along these two belts.



now available for several earthquakes in eastern North America, which indicate that seismic shaking is greater at high frequencies—those from about 3 to 100 Hz (cycles per second) than it is for earthquake of comparable magnitude in California and Japan. Hence, dry casks, critical piping and spent fuel assemblies, are likely to be more sensitive to shaking at higher frequencies at sites east of the Rocky Mountains. This information needs to be re-evaluated for Indian Point since the design spectrum used in the 1970s is likely to be too low and hence not as safe at high frequencies as previously supposed. A key question is why this has not been done already. New data, for example, are now available for the 2002 Au Sable Forks, Adirondacks NY shock, which was of similar magnitude to the 1884 New York City earthquake.

It does not take a long feature like the Ramapo Fault to generate a damaging earthquake. The 1737 and 1884 shocks of M 5.2 probably had rupture lengths of only about 5 miles. An event of that size has occurred historically along the two belts I described about once every 150 years. If spent fuel is stored at Indian Point for the next 40 years (assuming operating licenses for the reactors are extended an additional 20 years), the chance of an earthquake occurring along either of those two belts is about 23%. The lack of more extensive knowledge of earthquakes and active faults in this area should result in conservative judgments about risks to critical structures like nuclear power facilities and their spent fuel storage systems.

It is now obvious that Entergy has not commissioned an up-to-date assessment of the seismic hazard posed to the plant based on the latest research. This is an extremely timely matter given Entergy's interest in seeking a 20-year license renewal from the Nuclear Regulatory Commission that would extend their license to operate Indian Point 2 and 3 to 2033 and 2035, respectively. The NRC must subject Indian Point, both now and during the license renewal process, to the same stringent criteria applied to companies seeking to build new reactors on existing or new sites.



### Relicensing Criteria for Seismic Hazard

For the sake of argument, if Entergy chose to immediately close Indian Point's existing reactors and seek to replace them with new reactors, the new reactors would clearly have to meet the NRC's new and more stringent seismic criteria (10 CFR Part 100.23 deals with geologic and seismic siting criteria). The same stringent criteria pertaining to new reactors should also apply to existing reactors, like those at Indian Point, that are seeking a 20-year license renewal. However, it is unclear whether such stringent criteria are being applied to Indian Point. Recently, the owners of the Clinton, Grand Gulf, and North Anna nuclear plants experienced unexpected difficulty in meeting the new seismic criteria of early site permitting applications (i.e., for a permit from the NRC to build a new reactor on an existing or new site). As a result, these plant operators were forced to delay their application submission for several months.

### Funding for Seismic Monitoring Stations that have been Closed

Finally, over the years, a few seismic monitoring stations near Indian Point have been closed due to funding cutbacks, thereby resulting in a lack of vital data needed to assess activity of local faults and potential for negatively impacting Indian Point, particularly the spent fuel pools and reactor buildings. We request that the NRC help to ensure that a new source of funding is developed to reopen these monitoring stations. Needless to say, the cost burden associated with more extensive research into the plant's vulnerability to an earthquake should *not* be placed on the public. The public is already subsidizing Entergy's operation of Indian Point in so many different ways.



We are providing you with the contact information for Dr. Klaus Jacob and Dr. Lynn Sykes  
at Lamont-Doherty Earth Observatory of Columbia University:

Dr. Klaus Jacob  
Senior Research Scientist  
Lamont-Doherty Earth Observatory  
Palisades NY 10964  
Tel: 845-365-8440; Fax: 845-365-8150  
[jacob@ldeo.columbia.edu](mailto:jacob@ldeo.columbia.edu)

---

Dr. Lynn Sykes  
Professor of Earth and Environmental Sciences  
Lamont-Doherty Earth Observatory  
Palisades NY 10964  
Tel: 845-359-7428; Fax: 845-365-8150  
[sykes@ldeo.columbia.edu](mailto:sykes@ldeo.columbia.edu)

Dr. Jacob and Dr. Sykes can provide you with additional information. In addition, attached to this letter is a copy of the statement that Dr. Sykes made at the July 15<sup>th</sup> public meeting that the NRC held in Peekskill, NY in relation to Entergy's proposed dry cask storage system for Indian Point and the company's lack of understanding on.

We are interested in meeting with you and officials from Lamont-Doherty to discuss this matter further. Thank you for considering our request and we look forward to hearing back from you soon given the immediacy of this issue.

Sincerely,

Alex Matthiessen  
Hudson Riverkeeper  
& Executive Director

Kyle Rabin  
Senior Policy Analyst



Cc:

The Hon. Charles Schumer, U.S. Senate

The Hon. Hillary Rodham Clinton, U.S. Senate

The Hon. Eliot L. Engel, U.S. House of Representatives

The Hon. Nita M. Lowey, U.S. House of Representatives

The Hon. Sue Kelly, U.S. House of Representatives

The Hon. Maurice Hinchey, U.S. House of Representatives

---

The Hon. George E. Pataki, Governor of New York State

The Hon. Eliot Spitzer, Attorney General of New York State

The Hon. Carl Marcellino, NY State Senate, Chair of Environmental Conservation Committee

The Hon. Thomas Morahan, NY State Senate

The Hon. Thomas DiNapoli, NY State Assembly, Chair of Environmental Conservation Committee

The Hon. Richard Brodsky, NY State Assembly, Chair of Corporations, Authorities, and Commissions Committee

The Hon. Edward Diana, Orange County Executive

The Hon. Robert Bondi, Putnam County Executive

The Hon. C. Scott Vanderhoef, Rockland County Executive

The Hon. Andrew Spano, Westchester County Executive

The Hon. A. Alan Seidman, Orange County Chairman of the Board of Legislators

The Hon. Robert McGuigan, Putnam County Chairman of the Board of Legislators

The Hon. Salvatore Corallo, Rockland County Chairman of the Board of Legislators

The Hon. Bill Ryan, Westchester County Chairman of the Board of Legislators

Snr. Project Manager Stephen O'Connor, Spent Fuel Project Office, U.S. Nuclear Regulatory Commission, Reg. I

Commissioner Erin M. Crotty, NYS Department of Environmental Conservation



**ATTACHMENT**

**EARTHQUAKE RISKS TO SPENT FUEL AT INDIAN POINT**

**A STATEMENT BY**

**Lynn R. Sykes**

**Higgins Professor of Earth and Environmental Sciences**

**Lamont-Doherty Earth Observatory of Columbia University**

---

**Palisades NY 10964**

**MEETING OF U. S. NUCLEAR REGULATORY COMMISSION ON  
INTERIM STORAGE OF SPENT NUCLEAR FUEL AT INDIAN POINT**

**July 15, 2004**

email [sykes@ldeo.columbia.edu](mailto:sykes@ldeo.columbia.edu)

I am Lynn Sykes, a professor of Earth and Environmental Sciences at Columbia University. My specific field is earthquake studies. I have worked on earthquakes in New York and New Jersey for more than 35 years. I was an expert witness in the extensive hearings that were held by NRC on the earthquake safety of the Indian Point reactors in 1975 and 1976. I live in nearby Rockland County.

I will address briefly what has been learned since 1976 about earthquake risks and how those findings relate to proposals for spent fuel storage at Indian Point. I find that knowledge about earthquake risks does not seem to have been reviewed thoroughly since 1976. Older knowledge is now outdated. Several of the risks associated with earthquakes are similar to those of terrorism.



### Historical Earthquakes: Their Relationship to Indian Point

Most earthquakes in southern New York and northern New Jersey occur in two belts each about 20 miles wide that are situated within the older rocks of the region. One belt extends from Putnam and Westchester countries to New York City and thence to central New Jersey. It was the site of one of the two largest earthquakes in the region, that of 1884 of magnitude, M, 5.2, and of the widely felt Ardsley (Westchester) shock of 1985. An event in 1737 of M ~~5.2, which is not as well located as the 1884 shock, may have occurred in that belt. The other~~ belt, which extends southwesterly along the Hudson Highlands from Peckskill NY to near Reading PA, is bounded on the southeast by border faults of the Newark Basin, including the Ramapo Fault. The second belt includes the Wappinger Falls shock of 1974, M 3.3; the Annsville earthquake near Indian Point, 1980, M 2.9, the Milford NJ event, 2003, M 3.5 and a poorly studied and located shock in 1783 of M 4.9, the third largest in the region.

The two belts merge near Stony Point and Indian Point as the younger rocks of the Newark Basin pinch out. Thus, estimates of earthquake risk to Indian Point need to include possible future earthquakes along the two belts. Known earthquakes are rare beneath the Newark Basin between the two belts and to the west and north in central parts of Pennsylvania and New York State.

### Earthquake Design for Facilities at Indian Point

Kyle Rabin of Riverkeeper submitted several written questions to Entergy officials following a briefing on dry casks here on April 27 (which I also attended). A key answer to him in a letter of April 30 from Kathleen McMullin, Manager, Communications, at Indian Point, is wrong. She is correct in stating that the seismic design basis earthquake established in the late 1960s and early 1970s was anchored at a peak ground acceleration, PGA, of 0.15 g



horizontal, where  $g$  is the gravitational acceleration at the earth's surface. Her statement "An earthquake with a peak ground acceleration of  $0.15 g$  is equivalent to a Richter magnitude of approximately  $6.0$ ." is quite wrong. In 1975 that value was inferred to be that associated with the  $M 5.2$  shock of 1884. Shallow earthquakes of  $M 6$  often produce much larger accelerations and shaking. During the smaller  $M 5.0$  Leroy OH earthquake of 1986,  $0.17g$  was recorded at the Perry nuclear power plant about 12 miles away (L. Seeber, written communication, June 2004).

---

In the 1970s measurements of acceleration came almost exclusively from earthquakes in the western US and Japan and were assumed to be the same for the rest of the US. Measurements are now available for several earthquakes in eastern North America, which indicate that seismic shaking is greater at high frequencies—those from about 3 to 100 Hz (cycles per second) than it is for earthquake of comparable magnitude in California and Japan. Hence, dry casks, critical piping and spent fuel assemblies, are likely to be more sensitive to shaking at higher frequencies at sites east of the Rocky Mountains. This information needs to be re-evaluated for Indian Point since the design spectrum used in the 1970s is likely to be too low and hence not as safe at high frequencies as previously supposed. A key question is why has this not been done already? New data, for example are now available for the 2002 Au Sable Forks, Adirondacks NY shock, which was of similar magnitude to the 1884 New York City earthquake.

A colleague and I were surprised to find out at the presentations on April 27 that the dry casts proposed for Indian Point would not be bolted to their foundation. Ms. McMullin's letter of April 30 states, "Indeed, analyses of similar casks, in areas of



higher seismic risk than Indian Point have shown that in a nearby earthquake, they will not tip over or release radioactive contents.” On April 27 an Entergy briefer stated that dry casks are to be bolted to their foundation at the Diablo Canyon reactors in California. While Diablo Canyon is located in an area of higher seismic hazard, shaking at high frequencies may not be as great a problem as at Indian Point. Also, at no point have I read or heard from officials at Entergy or NRC that extra precautions should be ~~taken for Indian Point since it is located close to many more people than Diablo~~ Canyon. **Bolting dry casts to their foundation is a small matter, would cost little and would yield increased safety.**

#### What Causes our Earthquakes?

We now have a better understanding of the stresses or pressures in the earth that generate earthquakes along the two belts I described. It involves high horizontal compressive forces oriented in an ENE direction much like those found in a broad area of the eastern and central US and in adjacent parts of Canada.

Knowledge of which faults in our region are seismically active is very incomplete. Activity in the second belt I described broadly parallels the Ramapo Fault and many small earthquakes have occurred on or close to it. Opinions differ about the orientation of faults that were active in those events--do they splay off from the Ramapo Fault or do some involve motion on the master fault itself (see [http://www.ideo.columbia.edu/news/2004/04\\_30\\_04.htm](http://www.ideo.columbia.edu/news/2004/04_30_04.htm)). The ENE direction of maximum compressive stress in our region is such that either faults of either orientation could rupture in significant earthquakes.

It does not take a long feature like the Ramapo Fault to generate a damaging earthquake. The 1737 and 1884 shocks of M 5.2 probably had rupture lengths of only about 5 miles. An



event of that size has occurred historically along the two belts I described about once every 150 years. If spent fuel is stored at Indian Point for the next 40 years (assuming operating licenses for the reactors are extended an additional 20 years), the chance of an earthquake occurring along either of those two belts is about  $40/150 = 27\%$ . **Our relatively poor knowledge of earthquakes and active faults in this area should result in conservative judgments about risks to critical structures like nuclear power facilities.**

---

### Earthquake Monitoring

In the 1970s and early 1980s NRC supported a number of university and state efforts to monitor and study earthquakes in regions east of the Rocky Mountains, the sites of most of the power reactors in the US. When license applications for new reactors ceased 25 years ago, NRC halted that support. The requirements set by NRC for earthquake monitoring near Indian Point appear to have been dropped several decades ago. The letter from Ms. McMullin indicating that "we continuously monitor seismic activity at Indian Point ... the monitors have yet to go off" indicates that an instrument sensitive to only very strong shaking is being operated. Several factors argue for greater monitoring and study:

1. 19 reactor licenses in the US have been extended for an additional 20 years; more applications are likely, including those for Indian Point 2 and 3.
2. Earthquake risks to spent fuel pools were not considered in the 1975-1976 Indian Point hearings. It was assumed that spent fuel would be shipped offsite either for reprocessing or disposal.
3. NRC has permitted operators to increase the density of used nuclear fuel assemblies in spent fuel pools by about a factor of 4, leading to greater risks from earthquake shaking (and terrorism).



4. With delays in the opening of the Yucca Mountain facility for high-level radioactive waste, spent fuel assemblies are likely to remain on site at Indian Point either in pools or in dry casks for at least another 15 years and longer if licenses are extended for an additional 20 years beyond 2013 and 2015.
5. Existing reactors are aging.
6. New reactors and sites are again being considered.

---

**Thank you. See my article "Indian Point: Critical Decisions Ahead" which is available on the web site for Riverkeeper.**

**From:** Kyle Rabin <krabin@riverkeeper.org>  
**To:** <sjc@nrc.gov>, <beh@nrc.gov>  
**Date:** 8/12/04 12:59PM  
**Subject:** 08-12-04 Riverkeeper Letter to the NRC regarding Seismic Hazard Threat to Indian Point

Mr. Collins and Mr. Holian:

Good afternoon.

I have attached a copy of a letter Riverkeeper mailed out today to the NRC on the matter of the seismic hazard threat to Indian Point.

Before going into more detail on the seismic hazard threat issue, the letter formally requests that:

- 1) the Nuclear Regulatory Commission take immediate action to ensure that a competent and independent authority on seismic research conduct an updated seismic hazard analysis for the Indian Point nuclear power plant, particularly in relation to the high-density spent fuel pools and the proposed dry cask storage facility. Such an analysis should be subjected to peer review and public scrutiny.
- 2) the NRC subject Indian Point, both now and during the license renewal process, to the same stringent criteria applied to companies seeking to build new reactors on existing or new sites.

Attached to the letter is a statement submitted by Dr. Lynn Sykes from Lamont-Doherty Earth Observatory at the July 15, 2004 NRC meeting on the dry cask storage proposal for Indian Point.

Thank you for taking the time to consider this matter. We look forward to hearing back from you.

\*\*\*\*\*

Kyle Rabin  
Senior Policy Analyst

& Campaign Director  
Riverkeeper, Inc.  
25 Wing & Wing

Garrison, NY 10524-0130  
Phone: (845) 424-4149 ext. 239  
Fax: (845) 424-4150  
krabin@riverkeeper.org  
<http://www.riverkeeper.org>

\*\*\*\*\*

**CC:** "Brian McDermott" <BJM@nrc.gov>