



## Before the Atomic Safety and Licensing Appeal Board

#### In the Matter of

CONSOLIDATED EDISON COMPANY OF NEW YORK AND POWER AUTHORITY OF THE STATE OF NEW YORK

(Indian Point Station, Units 1, 2 and 3)

Docket Nos.	50-3
	50-247
	50-286

CITIZENS' COMMITTEE FOR

PROTECTION OF THE ENVIRONMENT

PROPOSED FINDINGS OF FACT AND

CONCLUSIONS OF LAW RELATING TO ISSUE #4 -

THE MICROSEISMIC MONITORING NETWORK

Submitted by:

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April 15, 1977

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### I. FINDINGS OF FACT

A. <u>The Proposed Expanded Microseismic Monitoring Network</u> Will Provide Information Necessary To Assess Adequately The Seismic Hazard At Indian Point Station.

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The presently existing Consolidated Edison (Con. Ed.) 1. microseismic monitoring network consists of 13 stations around the northeastern extension of the Ramapo fault near Indian Point Station. It extends roughly 22 kilometers (northeastsouthwest) by 8 kilometers (northwest - southeast). Within its boundaries, the network provides reasonably precise hypocenter locations and focal plane solutions for earthquakes of magnitude (mg) equal to or greater than 1. Such small events would be detected to approximatly 20 kilometers outside the network; however, one could not obtain satisfactory hypocenter locations or focal plane solutions for such events. LISC. DIR. TEST. (PANEL), p.3; NYS. DIR. TEST., pp. 18-19; TR 6318. The proposed expanded Con. Ed. microseismic monitoring 2. network would consist of a significantly larger number of stations. It would cover an egg-shaped area 90 km in length and approximately 45 kilometers at its widest point. It would extend from above the Fahnestock Lake to below the Pompton Lakes. Within the monitored area, stations would be located with sufficient density to provide fault plane solutions for earthquakes of magnitude (mg) equal to or greater than 1.0.

The network would have the capability to determine locations for earthquakes of magnitude (mg) of greater than or equal to 0.0 occuring within the monitored area. In addition sufficient three component (two horizontal and one vertical) stations would be uniformily located throughout the network to clearly distinguish the onset of shear wave arrivals. LISC. DIR. TEST. (PANEL), p.3.

3. On the basis that the present Con. Ed. network is recording 1-2 earthquakes of magnitude 2 or greater per year, both the NRC Staff and Dr. Aggarwald agree that the expanded network may detect as many as 5-10 earthquakes of magnitude 2 or greater per year. This means that in the 2 year period, the network may detect as many as 10-20 earthquakes of magnitude 2 or greater. TR. 6264, 6536.

4. Both Staff experts and Dr. Aggarwald agree with the observation that earthquakes are distributed in magnitude approximately exponentially - that is, as the magnitude decreases the number of earthquakes increases approximately exponentially. TR 6254, 6323-33, 6536. At the laboratory sample level, this correlation has been observed to hold true to the level of rock mechanics. TR 6323-6327 (See also, TR 6536, where Dr. Aggarwald testified that data derived from seismic instruments at Blue Mountain Lake show the exponential correlation holding true to the level of magnitude minus 3.5).

a. Networks detect all earthquakes above the "level of homogenity;" below that level, many go undetected.
TR 6362-4. Most microseismic monitoring networks are homogenous only to the level of magnitude 3.5-4. TR 6325.
Even very dense networks located along the San Andreas

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are homogenous only to the level of magnitude 1.5-2. TR. 6326. This explains why data sets derived from most microseismic monitoring networks fail to show the exponential correlation. TR 6362-4.

b. The Licensees introduced no evidence to refute this observation.

5. Thus on the basis that the expanded network may detect 5-10. earthquakes of magnitude 2 or greater per year, and assuming homogenity to the level of magnitude 0, theoretically, one might expect to detect 500-1000/year earthquakes of magnitude 0 or greater. Since the level of homogenity is likely to be well above magnitude 1, numerous events will go unrecorded. Nevertheless, both the Staff and Dr. Aggarwald agree on the basis of the record derived from the presently existing network, and assuming the exponential correlation to hold true generally, that there is good reason to believe that the expanded network will provide a reasonably large and well recorded data base. STAFF DIR. TEST, p. 5; NYS, DIR. SUPP. TEST., p.1; TR 6437. The recorded data will aid in the following assessments: 6.

-whether the events are occuring randomly or tend to display a spatial alignment.

- assuming a spatial alignment, whether it is near the surface expression of a fault.

- assuming alignment near the surface expression of a fault, whether the fccal mechanisms show movement consistent with the geometry of the fault.

-assuming an alignment near the surface expression of

a fault or an alignment suggesting subsurface faulting, what is the vertical extent of faulting, and the

variation in the orientations of the principle directions

of the stress. STAFF DIR. TEST. p.7-8; TR 5653, 5675, 5798, 5934,5945, 6228-9, 6533-4.

7. The foregoing assessments will confirm conclusions regarding the capability of the Ramapo fault or the existence of "unusual circumstances" suggesting a potential for that fault to support significantly damaging events.

a. There is general agreement that the expanded microseismic monitoring network will not provide a statistical basis which would enable one to predict with confidence the probability of occurence of larger earthquakes. LISC. DIR. TEST. (WILLIS); TR 6228, 6360-2.

b. However, analysis of the location of events and the focal plane solution permits knowledgable seismologists to make a general quantitative judgment regarding the seismic potential of the fault. TR 6228-9; 6235-6; 6244-7.
c. Scientists are utilizing microseismic data to make such judgments with increasing success. TR 5694; 5945-8; 6242-4; 6331-2.

B. Absent The Proposed Expanded Microseismic Monitoring Network The Requisite Information Will Not be Obtained.

The data required to confirm conclusions regarding the 1. capability of the Ramapo fault or the existence of "unusual circumstances" suggesting a potential for the fault or another structure to support significantly damaging events is recordings or earthquakes in sufficient number and of sufficient quality to permit derivation of precise hypocenter locations and fault plane solutions. STAFF DIR. TEST., pp.7-8; NYS. DIR. TEST., pp. 18-19; NYS. DIR. SUPP. TEST., pp.1-2; TR 6437. The present coverage - which includes stations of the Con. 2. Ed. network, the New York State network, the Connecticut network, and stations operated by universities and individual operators - will not provide the needed data. STAFF DIR. TEST., p.9; NYS. DIR. TEST., pp.18-20; NYS. DIR. SUPP. TEST., p.1;

a. The area of interest is substantially larger than that limited area in the vicinity of the site that falls within the boundary of the present Con. Ed. network.
An adequate assessment of seismic hazard at Indian
Point Station requires the analysis of earthquake activity along portions of the Ramapo fault that lie without the boundary of the present Con. Ed. network and analysis of seismic activity presumably occuring along adjacent faults. In the first place, activity along those other sections of the Ramapo fault may reveal that the fault is capable or reveal a pattern of activity suggesting a significant earthquake potential (i.e. may reveal "unusual circumstances" under 10 CFR §100 (Appendix A (iv)(7)). Likewise, monitoring activity in the region adjacent to the fault is necessary to assess whether the seismic energy is being released preferentially along the Ramapo fault ("unusual circumstance")

STAFF, DIR. TEST., pp.18-20; TR 6228, 6280, 6294. b. The present coverage provides reasonably precise hypocentral locations and focal plane solutions for earthquakes of approximately magnitude 1 or greater <u>only</u> in a very limited area in the vicinity of the site. c. The inadequacy of the present coverage is demonstrated by the fact that although more than 18 earthquakes have been detected and recorded in the area of interest since April 1974, the data permitted focal plane solutions to be derived for only eight of the events. NYS. DIR. SUPP. TEST., p.1 (See also, TR 6529-6532, where Dr. Aggarwald testified that should an event occur on the southwest extention of the Ramapo fault in the vicinity of Pompton Lakes, there would be little, if any, usable data from stations south of the event, for events less than magnitude 4. Except in the most unusual circumstances - TR 6554 - absence of such data severely limits the confidence in the hypocentral locations and focal plane solutions.)

3. Assuming a finding that the present coverage is adequate that finding is premised on continued operation of the 13 station Con. Ed. network. Since the incremental cost of expanding that network is small, and the addition to the data base would be substantial, it is cost effective to expand the existing Con. Ed. network.

> a. The present Con. Ed. network has provided the information essential to obtaining reasonably precise hypocentral locations and focal plane solutions for TR 6539-6544; many events occuring in the region of interest. 6547-9. In particular those stations provided the data essential to deriving focal plane solutions for the earthquakes of June 7, 1974 (Wappinger Falls, N.Y.); July 19, 1975 (Mahopac, N.Y.); August 22, 1975 (Lake De Forest, N.Y.); March 6, 1976 (Ossining, N.Y.); March 11, 12, 1976 (Pompton Lakes, N.J.); April 13, 1976 (Ridgefield, N.J.); August 20, 1976 (Mount Pleasant, N.Y.); September 22, 1976 (Indian Point, N.Y.); November 22, 1976 (Scarsdale, N.Y.), NYS. DIR. TEST., TABLE 7; TR 6540-4. But for the Con. Ed. network, it is unlikely that satifactory focal plane solutions could be derived for these events.

# TR 6525-6528; 6552.

c. Since the number of earthquakes greater than magnitude 3.5-4 likely to occur in the area of interest within a two year time frame is small, the coverage without the present Con. Ed. network, will provide little, if any, usable data.

d. The licensees estimate the cost of installing and operating the expanded network for a two year period to be \$1,071,000. However, as much as \$536,500 may be spent to operate the existing network. Thus the additional cost of operating the expanded network is only \$534,500, and this figure does not include any credit for the salvage value of the equipment.

 Licensees divide the cost of expanding and operating the present network into four phases

Phase	I:	Relocation and operation for a 6 month transition period\$104,500
Phase	II:	Design and site selection for expanded network\$ 47,000
Phase	III:	Purchase and installation of additional equipment\$358,500
Phase	IV:	Operation and maintenance of expanded network for 24 months\$561,000
2) Licensees admitted that they well may incur the		
\$104,500 expense in operating the present network		
because operation may be removed from the site to		
Clifton, New Jersey. TR 6088. In addition, Licensees		

admitted that operation of the present existing network at Clifton may cost as much as \$18,000 a month. TR 6091. Thus, if the Licensees continue to operate the present network it may well cost (\$104,000) + ( $$18,000 \times 24 = $432,000$ ) = \$536,500.

3) The Licensees failed to give any credit for the salvage value of the equipment. Mr. Gonnella, the Licensees witness, testified that the equipment would not be marketable, and in any event, after two years use, would not be salvagable. TR 6099. However, Mr. Gonnella's testimony is of dubious value. First, Mr. Gonnella is not experienced in operating seismographs. His conclusions regarding the useful life of the machines are purely speculative. TR 6100-02. Second, Mr. Gonnella made no effort to determine the resale value of microseismic monitoring equipment. TR 6100-02.

#### II. CONCLUSIONS OF LAW

A. <u>The Enlarged Microseismic Monitoring Network Is Required</u> <u>To Reasonably Assure That The Indian Point Facilities May Continue</u> To Operate Without Undue Risk To The Public Health and Safety.

10 CFR §100 (Appendix A), "describes the procedures for determining the quantitative vibratory ground motion design basis at a site due to earthquakes..." These procedures result in designation of the Safe Shutdown Earthquake - that earthquake which produces the maxiumum vibratory ground motion for which certain structures, systems and components critical to safety are designed to remain functional. The Safe Shutdown Earthquake is defined by response spectra pursuant to quidelines set out in Appendix A.

Central to this process is identifying faults which may be of significance in determining the Safe Shutdown Earthquake. Appendix A requires "[F]or faults, any part of which is within 200 miles of the site and which may be of significance in establishing the Safe Shutdown Earthquake, determination of whether these faults are to considered as capable faults."

For capable faults, Appendix A requires ascribing an earthquake potential to the fault and postulating occurence 5/ of the "maximum event" at the point on the structure closest

 $\overline{2}$ / 10 CFR §100(Appendix A III(c))

 $\overline{3}$ / 10 CFR §100 (Appendix A VI(a)(1))

 $\overline{4}$ / 10 CFR §100 (Appendix A, IV(a)(7), footnotes omitted) 5/ Selection of that event is based on seismic and geologic considerations, including the maximum historic event that can be

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<sup>1/ 10</sup> CFR \$100 (Appendix A, II)

to the site, in order to assess the fault's significance in determining the SSE. In addition, Appendix A requires that non-capable faults be given such consideration where "unusual circumstances" indicate it would be appropriate. Such "unusual circumstances" would exist for example, where the analysis of the instrumental recordings of earthquake activity suggested a significant earthquake potential related to a known or inferred structure.

Acknowledged experts have raised serious questions regarding the significance of the earthquake activity in assessing the seismic hazard to Indian Point Station. In this proceeding, Dr. Lynn Sykes, chairman, Department of Seismology, Lamont-Doherty Geological Observatory has testified that the Ramapo fault has demonstrated the characteristics of a capable fault. Scientists testifying on behalf of New York State take the position that the data does not permit a conclusive finding on way or the other. In addition, Dr. Sykes testified that "capable" or not, analysis of the instrumental recordings of earthquake activity indicates a significant earthquake potential related to the Ramapo fault. New York State experts join in Dr. Syke's concern.

associated with the fault, the length of the fault, the relationship of the fault ot regional tectonic structures, the nature, amount and geologic history of displacement along the fault. 10 CFR §100 (Appendix A IV(a)(8) & V (a)(1)(ii)); see also TR 6251-6; 6351-7.  $\frac{6}{10}$  CFR §100 (Appendix A V(a)(1)(ii).  $\overline{7}/$  10 CFR §100 (Appendix A IV(a)(7).  $\overline{8}/$  CCPE PF (Issue #4) A.6. & A.7.; TR 6228-9; 6235-6; 6244-7. 9/ TR 6505

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The main trace of the Ramapo fault runs within one-quarter mile of the site. Were the Ramapo fault considered capable, or were the requisite "unusual circumstances" established, Appendix A would require postulating occurence of the "maximum event" at the point on the structure closest to the site in order to assess the fault's significance in determining the Safe Shutdown Earthquakes. That wasn't done for the Indian Point Station  $\frac{11}{}$  because it had been concluded that the Ramapo fault was not "capable" or "unusual".

As noted above, those prior conclusions - critical to the designation of the Safe Shutdown Earthquake for the facilities at Indian Point Station - have been challenged by acknowledged experts. Other acknowledged experts, notably Dr. Charles Richter and the Staff scientists, believe the  $\frac{12}{}$ 

All parties are relying on basically the same data. The data base is small and leaves room for different interpretations. That two such imminent scientists as Dr. Lynn Sykes and Dr. Charles Richter can come to opposite conclusions is the strongest testimony to the fact. This proposed expanded micro-

10/ The Licensees assert that such an exercise is meaningless, arguing that the SSE for the facility assumes that a Modified Mercalli intensity VII occurs at the site, and, in any case, the largest event that can be reasonably associated with the Ramapo fault is no greater than Modified Mercalli intensity VII. However, this position is based on a misreading of Appendix A. TR 5797, 5856, 5878. The Licensees err by equating two different approaches set out in Appendix A. In the first approach the SSE is derived by assuming the highest intensity of the historic earthquake in the tectonic province occurs at the site (Section V(a)(1)(ii)). The second approach is applicable only when a causative fault is near the site. In that case, "The effect of

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seismic monitoring would provide information confirming one  $\frac{13}{}$  view or the other.

Appendix A expressly recognizes the need for such confirmatory programs by calling for "[A]dditional investigations and/or more conservative determinations than those included in the criteria...for sites located in areas having complex geology as in areas of high seismicity." The record in this proceeding establishes that the Ramapo fault is an area of  $\frac{15}{}$  complex geology.

proximity of an earthquake on the spectral characteristics of the Safe Shutdown Earthquake shall be taken into account" (Section V (a)(l)(iv)). As the Staff points out, where there is reason to believe that a source will localize earthquakes near the site, special consideration must be given to the near field effects, i.e. the high frequency amplitudes occuring in the near field. Where such local sources exist, Appendix A requires a determination that the components necessary to the safety of the facility are designed to withstand these high frequency peak amplitudes. See, TR 6214-18. 117 More precisely, there is no evidence in the record that the Licensee had conducted such an analysis. See, TR 5877 12/ The Staff, however, believes the prior conclusions to be provisionally valid only and in need of confirmations. 13/ CCPE PF (ISSUE #4) A.6. & A.7. 14/ 10 CFR §100 (Appendix A II) 15/ TR. 6335

Moreover, the need for conservativism in assessing the seismic hazard to nuclear power plant sites, is stressed in Well aware of the enormous uncertainties in Appendix A. seismic risk evaluation, the Commission has stressed that the provisions of Appendix A "are minimum requirments, and they have consistently been interpreted as such in licensing decisions. From the scope of the required investigations it is apparent that the Commission intended the task to be approached with That directive is particularly applicable here the utmost caution. where imminent scientists have testified that there is accumulating evidence that the seismic hazard at the site has been underestimated. Further, it must be taken into account that Indian Point Station is approximately 30 miles from New York City a population center of 8,000,000 people. Under these circumstances, nullifying the operating license condition short circuits the conservative approach mandated in Appendix A.

<u>16/ See e.g.</u>, Section V(a)(1)(i) which states that "[T]he magnitude or intensity of earthquakes based on geologic evidence 'may be larger than that of the maximum earthquake historically recorded.'" Also Section V(a)(1)(vi) states that the "procedures in paragraph (a)(1)(i) through (iii) of this section [section V] shall be applied in a conservative manner."

17/ Amendment of Appendix A, Section V, "Seismic and Geologic Design Bases".

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Appendix A does not expressly require obtaining microseismic measurements; however, that is not a bar here. As Dr. Stepp stated, the drafters of Appendix A were aware that in many regions of the country there was no data to be obtained for lack of instruments in place. Under normal circumstances, installation of microseismic monitoring networks did not make sense from a cost/benefit standpoint. Additionally, Appendix A was drafted 5-6 years ago when seismologists were just beginning to interpret microseismic data. Thus the  $\frac{19}{19}$ 

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Here, the circumstances are far from normal. Installation of the expanded network is precisely the kind of "additional investigation" comtemplated in Appendix A. Furthermore, while there is still much to be learned about the significance of microseismic data, it is being used successfully and frequently by scientists in assessing seismic hazard.

18/ See e.g. In the Matter of Virgina Electric Power Company (North Anna Power Station, Units 1, 2, 3, and 4), ALAB 256, NRCI 75/1, 16 (January 27, 1975), where the Board recognizes the problem associated with making determinations under Section III(g)(2) of Appendix A where there are no instruments in place to record earthquakes. 19/ TR 6278

20/ TR 5694; 5945-48; 6242-4; 6331-2.

Finally, no new ground is broken here. Licenses have in the past been saddled with a condition requiring implementation of programs to confirm the validity of conclusions regarding the safety of the plant. Indeed in several instances, licenses have been conditioned to require the establishment of microseismic monitoring networks to confirm conclusions regarding the selection of the Safe Shutdown Earthquake.

In conclusion, to find "reasonable assurance" the Board must find compliance with Appendix A. Appendix A requires that if there is a capable fault near the site, or if unusual circumstances suggest a significant earthquake potential for such a fault, then special precautions must be taken to assure that the plant is designed to withstand the chance of an earthquake occuring on the fault. No fault near the Indian Point Station was judged to be "capable" or "unusual." Accordingly, the facilities at the Indian Point Station were built without taking the special precautions.

21/ TR 6291

22/ Vermont Yankee Nuclear Power Corporation (Vermont Yankee Nuclear Power Station), ALAB-138, RAI-73-7, 528-530 (July 25, 1973)

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Now emminent scientists hold the view that the Ramapo fault has exhibited the characteristics of a capable fault, or even if determined to be non-capable, that the fault exhibits significant earthquake potential. Other acknowledged experts contest this view.

In short, the validity of the old finding of compliance with Appendix A is uncertain. Implementation of a microseismic monitoring network will assist in resolving that uncertainty. Such additional investigations are clearly warranted to provde the necessary assurance that the facilities at Indian Point Station may continue to operate without undue risk to the public health and safety.

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B. The Licensees Have the Burden of Proof.

10 CFR §2732 provides that the proponent of an order has the burden of proof. Here the Licensees seek an order nullifying a condition in the operating license on the basis that it is not warranted to provide reasonable assurance to the health and safety. Accordingly, the burden of proof is theirs.

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Respectfully submitted,

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DATED: 15 April 1977