UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
CONSOLIDATED EDISON	)	Docket Nos. 50-247-SP
OF NEW YORK (Indian Point, Unit 2)	)	50-286-SP
	)	
POWER AUTHORITY OF THE STATE	)	
OF NEW YORK (Indian Point, Unit 3)	)	

DIRECT TESTIMONY OF FRANK H. ROWSOME TO CONTENTION 1.1 and BOARD QUESTION 1.1

Q.1 State your name and position with the NRC.

A.1 My name is Frank H. Rowsome. I am Deputy Director of the Division of Risk Analysis in the Office of Nuclear Regulatory Research.

Q.2 What are your responsibilities in that position?

A.2 I assist the Director in planning and managing the research group in risk assessment, probabilistic safety analysis, operations research, reliability engineering, and related regulatory standards development.

Q.3 Have you prepared a statement of your professional qualifications?

A.3 Yes, the Statement of my professional qualifications is attached to this testimony.

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Q.4 What is the purpose of this testimony?

A.4 The purpose of this testimony is to respond to Contention 1.1, provide an outline of where the staff response to Board Question 1.1 can be found.

Q.5 How does Contention 1.1 read?

A.5 Contention 1.1 reads as follows:

> The probabilities and consequences of accidents at Indian Point Units 2 and 3 combine to produce high risks of health and property damage not only within the plume exposure EPZ but also beyond the plume exposure EPZ as far as the New York City metropolitan area.

Q.6 What is your summary response to Contention 1.1?

A.6 The Staff testimony in Section III above identifies that there are risks, but the adjective "high" is not warranted.

Q.7 What is the basis for that conclusion?

A.7 The risks would deserve to be called high risks, in my judgment, if they loomed large against the background of competing non-nuclear risks.

Q.8 How do the annual average risks compare with background risks?

A.8 The annual average early fatality risk for the site, evaluated "after fix", i.e. as the plants will be designed and operated in 1983, with the evac/reloc - late reloc model, amount to 0.019 early fatalities per year. Within 50 miles of the site there are roughly

15 million people (see Len Soffer's testimony in Section III). The average U.S. individual risk of accidental death from all causes averages 5×10^{-4} per person per year. (See NUREG-0880 p. 22). Thus, the background risk of accidental death in the region is roughly 7500 per year. Therefore the contribution to the risk of early accidental death posed by severe reactor accidents at the two Indian Point Units represents roughly 2.5 parts per million of the background risk averaged over a 50 mile radius of the plant.

The annual average risk of doses which would ultimately lead to cancer fatalities posed by severe reactor accidents at Indian Point amounts to 0.32 cancer fatalities per site year, total (i.e. from all distances from the plant and counting both units). Roughly 19 persons per 10,000 population die annually in the U.S. as a result of cancer. (See NUREG-0880 p. 23). Thus, we expect a background risk of roughly 28,500 cancer fatalities per year within 50 miles of the site. The severe reactor accident contribution to the cancer fatality risk thus amounts to roughly 11 parts per million of the background risk.

The annual average property damage risk for the two unit site amounts to $450,000 per year. We have not developed a realistic estimate of the background economic loss rate within 50 miles of the site, but it is clear that a wide variety of accidental hazards pose economic loss rates well in excess of this rate.

Thus I conclude that the annual average risks posed by severe reactor accidents at Indian Point Units 2 and 3 would not loom large against the background of competing risks, even if our reactor risk estimates were substantially underestimated.

Q.9 How do the risks posed by severe reactor accidents at Indian Point Unis 2 and 3 compare with the background of rare, high consequence risks?

A.9 Dr. Acharya's table IIIC5 shows the number of casualities to be expected if a severe reactor accident were to occur, in each of the several release categories. For some of the release categories, particularly release categories H and I, we expect no early fatalities at all, under any weather conditions. For the more severe but still comparatively probable release category C we expect no early fatalities if evacuation is feasible and early fatalities in the hundreds for earthquake - triggered ocurrences. Even for the especially rare, high consequence release categories A and B we expect early fatalities in the thousands, not tens of thousands. These particularly severe releases have occurrence intervals estimated to be less than once in a million reactor years.

The background or non-nuclear risk of events producing accidental deaths in the hundreds or thousands was calculated for the Reactor Safety Study. See Figures 6-1 and 6-2 in the Main Report (pp. 119-120). Nationally, the frequency of man-caused accidents that kill 100 or more people is roughly 0.7 per year.

The corresponding frequency of man-caused accidents that kill 1000 (10,000) or more is roughly 0.05 (.004) per year.

Although only a portion (of the order of one percent) of this background of man caused multi-fatality accident risk is applicable within fifty miles of the site, it is still far larger than the frequencies found in Dr. Acharya's testimony. See also, Figure IIIC1 which indicates that Indian Point Unit 2 can be expected to give rise to accidents characterized by 100 or more early fatailities with frequency of three per million years. Similarly the frequencies for accidents with 1000 or more (10,000 or more) early fatalites in Figure IIIC1 is 2×10^{-6} (5×10^{-7}) per year. The frequency of still more severe accidents declines quite rapidly above that consequence level. I am lead to conclude that among rare man-caused accidents having early fatalities in the hundreds or more, the contribution posed by severe reactor accidents at Indian Point is quite small. Dr. Acharya's Table IIIC5 shows expected cancer fatalities in the range tens to thousands for the several release categories. These cancer fatalities do not occur in one year but are the cumulative totals for roughly 40 years after the hypothetical accident. These can be compared with the uniform background of roughly 7500 cancer fatalities per year to be expected within 50 miles in any case. Thus, we can conclude that even if such an accident were to occur, the increment in the cancer rate each year would not loom large against the non-nuclear background cancer fatality rate.

Note that a large part of the severe accident risk posed by Indian Point Units 2 and 3 originate in accidents triggered by earthquakes and hurricanes. Earthquakes or hurricanes of the severity sufficient to cause a severe reactor accident at Indian Point would constitute regional disasters of far broader extent than the effects of the radioactive plume. The Staff has not developed a non-nuclear risk assessment for these events, but it seems plausible to us that the casualties and property damage associated with these trigger events would exceed those attributable to the nuclear component of the disaster.

In short, we do not see severe reactor accidents as potentially looming large against the background of competing risks.

Q.10 Is this piece of testimony meant to reflect the Staff position on acceptable risk?

A.10 No, it is merely meant to address Contention 1.1. We shall deal with the implications of the risk assessments for regulatory action in the testimony to be filed on Commission Question 5.

Q.11 What is the first basis for Contention 1.1 in the Board Order of November 15, 1982?

A.11 The first basis for Contention 1.1 reads:

> 1) The risk of injurious health effects to people in the plume exposure EPZ from excessive exposure to radiation, as a result of accidents, will be exacerbated by an impeded evacuation because:

a) Licensees have failed to demonstrate that proper emergency action levels (EALs) as required by 10 C.F.R. § 50.47(b)(4) have been established which will allow prompt recognition of the range of possible accidents at Indian Point Units 2 and 3 and prompt and correct diagnoses of such accidents for the recommendation of appropriate protective actions (UCS/NYPIRG 1B5); and

b) Licensees have failed to provide instrumentation in accordance with Reg. Guide 1.97, Rev. 2, thus compromising their ability to adequately monitor the course of accidents at Indian Point Units 2 and 3 (UCS/NYPIRG IB5);

Q.12 What is the Staff's view of this basis?

A.12 Our risk analysis suggests that evacuation of the plume exposure EPZ will be impeded, for the risk dominent accident scenarios, though not for the reasons cited in the basis. Rather, a large part of the risk originiates in accidents triggered by earthquakes or hurricanes. As noted in Staff testimony sections IIIC and IVB above, these trigger events constitute regional disasters that can impede evacuation. Therefore we believe the sub-basis a) and b) to be moot. For the reasons developed above, we do not feel that impeded evacuation leads to "high" risks.

Q.13 What is the second basis for Contention 1.1 in the Board Order of November 15, 1982?

A.13 The second basis reads:

2) A risk of health and property damage as a result of accidents extends beyond the plume exposure EPZ to the New York City metropolitan area because:

a) under certain meteorological conditions, life-threatening doses would occur in the New York City metropolitan area for a WASH-1400, PWR-2 type accident (UCS/NYPIRG IIID), and there are no areas which would adequately protect the public health and safety in such circumstances (UCS/NYPIRG IIID, FOE/Audubon I, basis 7); and

b) contamination of the Hudson River would affect beaches as far away as Coney Island and Rockaway Beach (See NUREG-0850, Vol. I, Preliminary Report, Appendix D) (UCS/NYPIRG IVA).

Q.14 Where, in the Staff testimony are the issues raised in sub-basis 2a treated?

A.14 The range of life-threatening doses can be found in the testimony of Dr. Acharya in section IIIC, see also IVB. See also the testimony of Roger Blond on Board Question 1.3 below.

Q.15 Where, in the Staff testimony, are the issues raised in sub-basis 2b treated?

A.15 See the testimony of Richard Codell on Section IIID of the Staff testimony.

Q.16 Does this conclude your testimony on Contention 1.1?

A.16 Yes, though my testimony on Board Questions 1.1 and 1.2 follow.

Q.17 How does Board Question 1.1 read?

A.17 Board Question 1.1 reads:

> What are the consequences of serious accidents at Indian Point and what is the probability of occurrence of such accidents? In answering this question the parties shall address at least the following documents: (a) the Indian Point Probabilistic Safety Study (IPPSS) prepared by the Licensees; (b) the Sandia Laboratory "Letter Report on Review and Evaluation of the Indian Point Probabilistic Safety Study" (Letter Report), dated August 25, 1982; and (c) any other reviews or studies of the IPPSS prepared by or for the Licensees, the NRC Staff, or the Intervenors, or any other document which addresses the accuracy of the IPPSS.

Q.18 Where, in the Staff testimony, are these issues addressed?

A.18 See testimony section III. The whole of the section is material to the Staff assessment of accident likelihood, severity and/or consequences. In addition, the IPPSS, the current (final) version of the Sandia Letter Report, NUREG/CR-2934, and Staff critques thereof are dealt with in testimony section III. Note that testimony section IVC also includes a critique of certain aspects of the IPPSS uncertainty analysis.

Q.19 Does this conclude your testimony on Board Question 1.1?

A.19 Yes.

PROFESSIONAL QUALIFICATIONS
FRANK H. ROWSOME, 3rd
U.S. NUCLEAR REGULATORY COMMISSION

I am Frank H. Rowsome, 3rd, Deputy Director of the Division of Risk Analysis in the Office of Nuclear Regulatory Research. I have served in that capacity since joining the NRC in July 1979. The work entails planning, budgeting, managing and staffing the Division. Much of the work of the Division is devoted to research in reactor accident risk assessment. The remainder entails risk assessment applied to non-reactor aspects of the nuclear fuel cycle and to standards development related to system reliability or risk.

I received a bachelor's degree in physics from Harvard in 1962. I studied theoretical physics at Cornell, completing all requirements for a Ph.D except for the dissertation in 1965. From 1965 to 1973, I taught and engaged in research in theoretical physics at several colleges and universities.

In 1973 I joined the Bechtel Power Corporation as a nuclear engineer. My initial assignment was to perform accident analyses for nuclear plant license applications. After six months in that job, I was transferred to a newly formed group of systems engineers charged with developing for Bechtel a capability to perform risk assessments and system reliability analyses of the kind the NRC was then developing for the Reactor Safety Study. In that capacity I performed reliability analyses of nuclear plant safety systems, developed computer programs for system reliability analyses, performed analyses of component reliability data, human reliability analyses, and event tree analyses of accident sequences. I progressed from nuclear engineer, to senior engineer, to group leader, to Reliability Group Supervisor before leaving Bechtel to join the NRC in 1979. In this last position at Bechtel, I supervised the application of engineering economics, reliability

engineering, and analysis techniques to power plant availability optimization as well as nuclear safety analysis.

While serving as Deputy Director of the Division of Risk Analysis (and its anticedent, the Probabilistic Analysis Staff), I also served as Acting Director (7 months), acting chief of the Reactor Risk Branch (9 months) and acting chief of the Risk Methodology and Data Branch (4 months).

This experience has given me the practitioner's view as well as the manager's view of those facits of reactor risk assessment entailing the classification of reactor accident sequences, system reliability analysis, human reliability analysis, and the estimation of the likelihood of severe reactor accidents. I have the manager's perspective but not the practitioner's experience with those facits entailing containment challenge analysis, consequence analysis, and risk assessment applied to other parts of the nuclear fuel cycle.

My role in the development of testimony for this hearing has been as coordinator of the preparation of testimony on risk and one of the coordinators of the technical critique of the licensee's "Indian Point Probabilistic Safety Study." I am not an expert on the design or operation of the Indian Point plants.

List of Publications

1. "The Role of System Reliability Prediction in Power Plant Design," F.H. Rowsome, III, Power Engineering, February 1977.

2. "How Finely Should Faults be Resolved in Fault Tree Analysis?" by F.H. Rowsome, III, presented at the American Nuclear Society/Canadian Nuclear Association Joint Meeting in Toronto, Canada, June 18, 1976.

3. "The Role of IREP in NRC Programs" F.H. Rowsome, III, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

4. "Fault Tree Analysis of an Auxiliary Feedwater System," F.H. Rowsome, III, Bechtel Power Corp., Gaithersburg Power Division, F 77 805-5.