UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD

In the Matter of CONSOLIDATED EDISON COMPANY OF NEW YORK (INDIAN POINT UNIT 2) POWER AUTHORITY OF THE STATE OF NEW YORK (INDIAN POINT UNIT 3)	Docket Numbers 50-247-SP 50-286-SP April 19, 1983

REORGANIZED TESTIMONY OF
JOHN R. THORNBOROUGH
AND TESTIMONY OF
DARYL BOHNING

Parents Concerned About Indian Point hereby submits the reorganized testimony of John R. Thornborough and the testimony of Daryl Bohning. Parents respectfully requests that these two witnesses be presented together as a panel at 3:30 Friday, April 22.

Respectfully submitted

Pat Posner (pds)

Pat Posner
Parents Concerned About Indian Point
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My name is John R. Thornborough. I live at 2623 Stoney Street, Box 637, Shrub Oak, New York.

I hold a B.A and a M.A. Degree in Biological Sciences and a Ph.D. in Human Physiology. My educational background also includes training at Cornell University in radiation and its biological effects. This training program included the use of radioisotopes in biological and medical research. Currently I am a Professor of Physiology at the Sophie Davis School of Biomedical Education of the City College of New York where I am also Associate Dean for Academic Affairs. In addition, I am an Adjunct Professor of Physiology at New York Medical College. The duties of my jobs include administrative functions, teaching of medical students, and laboratory work as a research scientist. In the latter role I regularly use radioisotopes.

My activities relating to environmental matters include: Chairman of the Yorktown Conservation Board;

radiation and the Indian Point nuclear generating plants. These statements of fact are followed by four logical conclusions.

STATEMENTS OF FACT

1. RADIATION IS DAMAGING TO HUMANS.

2. There is a certain amount of naturally occuring BACKGROUND RADIATION to which all humans are exposed.

3. There is no THRESHOLD. The damaging effects of radiation exist at all levels of exposure and any increase in background radiation will lead to an increase in the extent of damage.

4. CHILDREN ARE MORE SUSCEPTIBLE to the damaging effects of radiation than are adults.

5. The NORMAL OPERATION of the Indian Point nuclear generating plants increases the exposure of Westchester's children to radiation.

6. An ACCIDENT, with an associated release of radiation or radioactive material, is possible at Indian Point and would further expose Westchester's children to hazard.

DISCUSSION

It seems clear from a review of the scientific literature that exposure to radiation and/or radioactive materials may DAMAGE HUMAN individuals and represents a threat to the health of the human species. It is well documented that radiation exposure, in very high levels, will lead to radiation sickness and death. Lower levels of exposure to radiation appear to greatly increase the risk of various forms of cancer, induce developmental abnormalities (teratogenesis) and produce genetic mutations

In all cases, it would seem that the disease state induced by exposure to radiation is a result of cellular damage. If radiation entering a cell causes sufficient destruction of molecules, cellular death may insue. If enough cells die, the individual will die When irradiation of a cell damages only a few molecules and they happen to be appropriate ones the cell may become a cancer cell.

may be natural, the result of the radioactive decay of naturally occuring radionuclides in the planet and the radiation generated by our closest star, the sun or, not natural, from sources including fallout from nuclear testing, diagnostic medical and dental radiation and various commercial activities. Such background radiation also is capable of inducing disease and mutations and may be the cause of a certain number of cancers and mutations within the human population.

However, our species evolved within background radiation. Presumably, therefore, the species, as a whole, is able to withstand some level of radiation without threat to its existance. We can do nothing about the level of naturally occuring background radiation and the question before us is what are the effects on our species of adding to the background radiation by the use of medical and commercial radioactive sources including the nuclear generating plant at Indian Point.

considered absolutely safe... In the absence of evidence of a threshold below which it may be presumed that there is no risk it is prudent to assume that the risk of excess lung cancer increases with ionizing radiation from zero exposure."

The scientific literature abounds with studies that demonstrate that CHILDREN ARE MORE SUSCEPTIBLE to the damaging effects of radiation than are adults. This incresed susceptability ranges from the first trimester in utero through adolescence. Thus, Sternglass (1972) concludes, .. "the dose required to double the incidence of serious defects in the genetic control mechanism of the human cell...is of the order of 100 millirads in the first trimester, compared to 10 to 100 rads...in the reproductive cells of the mature adult."

In general, cells undergoing growth and cell division are much more susceptible to damage by radiation than cells that are not. This fact is, of course, the

reactor itself or by accidents during the handling of either the nuclear fuel or the nuclear waste. Therefore, one can conclude that the presence of a nuclear generating plant such as those at Indian Point, will produce an increase in the background radiation level, at very low doses, and also will generate some statistical probability for an accidental release of a higher dose of radiation.

In summary, it may be argued that the cellular damage induced by radiation is the result of some probabilistic event and whether or not there is, in fact, a radiation release by a nuclear generating plant is also described by probabilities. Thus, the hazard represented by a plant may be described by the product of these two probabilities Such a figure, whatever it may be, is not likely to vary significantly from one nuclear generating plant to another.

Finally, the effect of this statistical hazard on the human species can be determined by calculating

CONCLUSIONS

1. Nuclear generating plants, such as those at Indian Point, cannot be made completely without hazard.

2. Nuclear generating plants offer a special hazard with respect to children.

3. Nuclear generating plants, therefore, should be sited so as to minimize the chances of radiation exposure to humans (i.e. in areas of low population density).

4. The plants at Indian Point are sited in a highly populated area and, indeed, offer maximum chances for exposure to humans.

5. The plants at Indian Point should be shut down and decommissioned.

APPENDIX

SURVEY OF PERTINENT SCIENTIFIC LITERATURE

I. RADIATION IS DAMAGING TO HUMANS

1. Archer, V.E., "Occupational exposure to radiation as a cancer hazard", Cancer, 39: 1802-1896,1977.

"Whether or not neoplasms result from an exposure is apparently determined largely by probabilistic considerations, although there are differences in susceptibility of individuals."

2. Hempelmann, L., Lisco, H. and Hoffman, J.G. "The acute radiation syndrome: A study of nine cases and a review of the Problem", Annals of Internal Medicine, 36: 279, 1952.

Found increased skin cancer (basal cell and squamous call Ca) in early experimenters and medical and dental practicioners. These subjects were exposed to X-rays at high dose rates.

3. Matanoski, G.M., Seltser, R., Sartwell, P.E., Diamond, E.L. and Elliott, E.A., "The current mortality rates of radiologists and other physician specialists: deaths from all causes and from cancer", American Jour. of Epidemiology, 101(3): 188-198, 1975.

"The cohort mortality experience of radiologists and other specialists over a 50-year period was examined on the assumption that these groups would differ relative to a presumed decrease in radiation exposure. Radiologists had an excess in all-cause mortality rates compared to the other specialists for all cohorts who entered the Radiological Society of North America before 1940; the excess remained even when the cancer deaths were removed from the rates. These data are consistent with the concept of accelerated aging due to radiation. The cancer mortality rates for radiologists were higher than those of other specialists for an additional decade through 1949. The 1950-1959 cohort had not aged sufficiently to demonstrate the expected peak cancer mortality on the 60-64 year age group.

Several hypotheses are presented to suggest reasons for differences in the trends of age-specific cancer mortality by cohorts of entry."

4. Matanoski, G.M. et al., "The current mortality rates of radiologists and other physician specialists: specific causes of death", American Jour. of Epidemiology, 101 (3): 199-210, 1975.

"The cohort mortality experience of radiologists over a 50-year period has been compared to that of other specialists with low levels of radiation exposure. The 1920-1929 conort of radiologists who joined the Radiological Society of North America had the highest mortality for several chronic diseases. After this early period, radiologists ranked highest only for cancer mortality. The excess risk of leukemia which was observed in the 1920-1929 and 1930-1939 cohorts has subsequently decreased. During the same period, lymphoma mortality, especially multiple myeloma, has been increasing with a significant excess of deaths appearing in radiologists who entered the specialty society between 1930-1939 and 1940-1949."

5. Seltser, R. and Sartwell, P.E., "The influence of occupational exposure to radiation in the mortality of American radiologists and other medical specialists", American Jour. of Epidemiology, 81: 2, 1965.

These authors found that American radiologists had a higher age-specific death rate than non-radiological medical specialists who had not received occupational radiation exposure.

The mean age at death for the radiologists was five years less than for non-radiologists. This difference has been lessening in recent years with the use of improved machinery and more caution.

6. United Nations Report of the Scientific Committee on the Effects of Atomic Radiation, General Assembly Official Records: 24th Session supp. No. 13, (A/7613), New York, 1969.

This report presents evidence for increased leukemias with X-ray exposure in radiologists, increased lung cancer with Radon daughter exposure and increased thyroid carcinomas in radiotherapy patients.

7. Najarian, T. and Colton, T., "Mortality from leukemia and cancer in shipyard nuclear workers", Lancet, p. 1018-1020, May 13, 1978.

In this study, the next of kin of 592 Portsmouth nuclear shipyard workers were contacted and 146 of these were found to have been exposed to radiation at work of about 0.2 rem annually. Eighteen deaths were reported where eight were expected. Of the deaths, six were from leukemia where one might be expected in the general population.

> "The increased numbers of cancer and leukemia deaths among Naval nuclear shipyard workers seem out of proportion to predictions based on prior knowledge of the effects of ionizing radiation in man. Previous data suggest that 50-100 rem doubles leukemia mortality and 300-400 rem doubles the number of total cancer deaths. Radiation records from the shipyard were not available to us, but radiation doses seem to have been well within national occupational safety standards. Information provided by 50 past and present P.N.S. nuclear workers suggested total radiation doses of

less than 10 rem lifetime. Within the Naval Nuclear Propulsion Program the mean radiation exposure for the industrial workers at risk (which includes the shipyard workers) was 0.211 rem annually. The nuclear workers at the P.N.S. had six times the proportional mortality of leukemia and twice the proportional mortality for all cancers expected for U.S. White males of the same age-groups. These increased figures were found with radiation doses that probably averaged less than 10 rem total lifetime exposure as measured by workers' film badges."

8. Archer, V., "Geomagnetic force associations with cancer distribution and weather conditions.", Proceedings 10th Midyear Topical Symposium of the Health Physics Society, Saratoga Springs, Oct. 11-13, 1976.

9. Betell, R., "Measurable health effects of diagnositic X-ray exposure", Testimony before the Subcommittee on Health and the Environment, U.S. House of Representatives, July 11, 1978.

10. Bross, I.D.J., Proceedings of a Congressional Seminar on Low-level Ionizing Radiation; a report submitted by the Subcommittee on Energy and the Environment of the Committee on Interior and Insular Affairs, U.S. House of Rep./ 94th Congress, 2nd Session, 79-767-0, Nov. 1976.

11. Bross, I.D.J., "Major Strategic mistakes in the management of the Conquest of Cancer Program by the NCI", Testimony to the 95th Congress of the United States, House of Representatives, Intergovernmental Relations and Human Resources Subcommittess of the Committee on Government Operations, June 14, 1977.

12. Bross, I.D.J., "An action program to protect the public against the mindless use of diagnostic radiation and other technology", Testimony to the United States Senate Commerce Commitee, Oversight Committee for Radiation Health and Safety, June 17, 1977.

13. Brues, A.N., "Radiation as carcinogenic agent", Radiation Research, 3:272-286, 1955.

14. Burrows, H. and Clarkson, J.R., "The role of inflammation in the induction of cancer by X-rays", British Jour. of Radiology, 16:381, 1943.

15. Furth, J. and Tullis, J.L, "Carcinogenesis by radioactive substances", Cancer Research, 16: 5-21, 1956.

16. Furth, J. and Lorenz, E., "Carcinogenesis by ionizing radiation", Radiation Biology, Hollender, A. ed., New York, McGraw Hill, Vol. 1, part 11, p 1145-1201, 1954.

17. Gibson, R., "Leukemia in children exposed to multiple risk factors", New England Jour. of Medicine, 279: 906-909, 1968.

18. Gibson, R., Grahan, S. Et al., "Irradiation in the epidemiology of leukemia among adults", Jour. of National Cancer Institute, 48 (2), 1972.

19. Gofman, J.W. and Tamplin, A.R., A series of 19 reports presented as Testimony before the Joint Comitteee on Atomic Energy, 91st Congress, 1-28-1970.

20. Gofman, J.W. and Tamplin A.R., "Epidemiologic studies of carcinogenesis by ionizing radiation", Proceedings of the Sixth Berkeley Symposium of Mathematical Statistics and Probability, Statistical Laboratory, Universtiy of California, U.C. Press, Berkeley, July 20, 1971.

21. Graham, S., Levin, M.L., et at, "Methodological problems and designs of the Tri-State Leukemia Survey", Annals of New York Academy of Science, 107: 557-569, 1963.

22. Hempelmann, L.H., "Epidemiologic studies of leukemia in persons exposed to ionizing radiation", Cancer Research, 20: 18, 1960.

23. Proceedings of the Congressional Seminar on Low-Level Ionizing Radiation. Available from the Environmental Policy Institute, 317 Pennsylvania Avenue S.E., Washington, D.C. 20003, U.S.A.

24. Pochin, E.E., "Carcinogenic effects of radiation in man: The importance of estimates for protection purposes", Proceedings of a Symposium on Radiation Induced Cancer, Athens, Greece, April 28 - May 2, 1969, Vienna, International Atomic Energy Agency, 1969.

25. Sagan, L.A., "Human radiation effect: An overview", Health Physics, 21: 827-833, 1971.

26. Scholte, Van der Wielen and Ruya, "Negligible and non-negligible risks in radio-diagnostic examination of patients", Radiologic Clinics, 45; 314-325, 1976.

27. Symposium on Biological and Environmental Effects of Low-level Radition, Volume I, Vienna, International Atomic Energy Agency, 1976.

28. Upton, A.C., Allen, R.C., et al., "Quantitative experimental study of low-level radiation carcinogenesis", Radiation Induced Cancer, International Atomic Energy Agency, Vienna, page 425-438, 1969.

29. Viadana, E. Bross, I.D.J., "Use of medical history to predict the future occurrence of leukemia in adults", Preventive Medicine, 3: 165-170, 1974.

30. White and Frey, "An estimation of somatic hazards to the United States population from dental radiography", Journal of Oral Surgery, January 1977.

II. BACKGROUND RADIATION

1. Klement, A.W., Miller, C.R., Minx, R.P. and Shleier, B., "Estimates of ionizing radiation doses in the United States, 1960-2000", U.S. Environmental Protection Agency, ORP/CSD 72-1, Rockville, Maryland, Aug. 1972.

Average whole body radiation doses in U.S.A. in 1970:

	millirems/yr.
ENVIRONMENTAL	
natural	130
global fallout	4
all other	< 0.01
MEDICAL	
diagnostic	72
dental radiography	0.3
radiopharmaceuticals	1.0
OCCUPATIONAL	< 1.0
MISCELLANEOUS	
T.V., air transport	< 3.0
TOTAL (approximately)	211

211 mrem/year is about 6.3 rems/30 yrs./person.

2. Spiers, G.W. "Background radiation and estimated risks from low-dose irradiation." Health Physics. 37 (6): 784-789, 1979.

III. QUESTION OF THRESHOLD

1. Archer, V.E., "Occupational exposure to radiation as a cancer hazard", Cancer, 39: 1802-1896,1977.

"It appears to be impossible to establish a threshold level for ionizing radiation in the production of neoplasms in experimental animals."

The linear hypothesis"....is a conservative approach for x-rays and other low-LET (Linear Energy Transfer) radiations but is probably not conservative when dealing with alpha particles or other radiations having high-LET."

2. Bair, W.J., and Thompson, R.C., "Plutonium: Biomedical Research", Science, 183: 715-722, 1974.

One hundred percent of dogs with small amounts of Plutonium-239 placed into the lung died of lung cancer.

3. Baum, J.W., "Population heterogeneity Hypothesis on radiation induced cancer", Health Physics, 25: 97, August 1973.

At lower doses of radiation the linear hypothesis underestimates the risk of cancer.

4. Brown, J.M., "Linearity vs. non-linearity for dose response for radiation carcinogenesis", Health Physics, 31: 231, September 1976.

At lower doses of radiation the linear hypothesis underestimates the risk of cancer.

5. Morgan, K.Z., Cancer and low level ionizing radiation", Bulletin of the Atomic Scientists, 300-41, September 1978.

[Morgan: Director of Health Physics Division of Oak Ridge National Laboratory (1943-1972)]

"There is no safe level of exposure and there is no dose of radiation so low that the risk of a malignancy is zero."

6. Morgan, K Z., "The linear hypothesis of radiation damage appears to be non-conservative in many cases", Proceedings of 4th International Congress of International Radiation Protection Association, Paris, France, paper #451, August 1976.

7. Morgan, K.Z., "Suggested reduction of permissible exposure to plutonium and other transuranium elements", American Industrial Hygiene Association Journal, August 1975.

"Dr. Morgan has suggested that existing radiation standards could underestimate the effects of exposure for many different reasons:

1. Extrapolations are made on data with observation periods of no longer than twenty years. Many conclusions are based on studies of animals with life spans of less than ten years. Because many health effects may not be apparent until twenty to thirty years after the initial exposures, or even longer, and because human beings live more than seventy years, on the average, known health effect rates can only increase as more human data are gathered.

2. The linear model assumes an average exposure. The elderly and the very young may be more susceptible to radiation effects than the middle-aged.

3. Adequate data on the effects of very low exposures have not been developed. Instead, the standards are based on extrapolations from high or intermediate doses down to zero. But at a higher dose a larger fraction of the exposed cells may be directly killed from radiation, instead of showing signs of genetic damage or cancer. At lower doses fewer cells may be killed and more could be likely to suffer latent radiation damage, such as cancer, as a consequence."

(This summary taken from Nader et al, Menace of Atomic Energy.)

8. Muller, J., and Wheeler, W.C., "Causes of death in Ontario uranium mines (second report)", May 1974.

"There is now no longer any real question of recommending a level of exposure to ionizing radiation that in the light of present knowledge can be considered absolutely safe."

"In the absence of evidence of a threshold below which it may be presumed that there is no risk, it is prudent to assume that the risk of excess lung cancer increases with ioninizing radiation from zero exposure."

IV. CHILDREN ARE MORE SUSCEPTIBLE

1. Bithell and Stewart, "Prenatal irradiation and childhhod malignancy: A review of British data from the Oxford Survey", British Journal of Cancer, pages 31-71, 1975.

2. Bross, I.D.J., and Natarjan, N., "Leukemia from low-level radiation", New England Journal of Medicine, 287: 107-110, 1972.

These authors report that children with hives or asthma are 8 times more susceptible to leukemia from the same radiation exposure than other children.

3. Bross, I.D.J., and Natarajan, N., "Risk of Leukemia in susceptible children exposed to preconception, in utero, and postnatal radiation", Preventive Medicine, 3: 361-369, 1974.

4. Court-Brown, W.M. and Doll, R., "Leukemia in childhood and young adult life", British Medical Journal, 1: 981, 1961.

These authors demonstrate an increased cancer rate with in utero, low-dose x-rays.

5. Court-Brown, W.M. and Doll, R., "Mortality from cancer and other causes after radiotherapy for ankylosing spondylitis", British Medical Journal, 1327-1332, 1965.

> "Exposure to moderate amounts of radiation in childhood has produced cancer of the thyroid, and it seems probable that exposure to small amounts of the order of 1-10 rads in utero produces all the principal types of childhood cancer. Mortality rates from all cancers other than leukemia were raised in American radiologists compared with those in specialist physicians and ophthalmologists and otorhinolaryngologists (Selster and Sartwell, 1965)...".

6. Ford, D.D., Patterson, J.C.S., and Treuting, W.L. "Fetal exposure to diagnostic x-rays and leukemia and other malignant diseases in childhood", Journal of the National Cancer Institute, 22: 1093-1104, 1959.

This is a retrospective study of 152 cases and 306 controls dead from other causes. They found a relative risk of 1.7 after intrauterine x-ray exposure.

7. Graham, S., "Preconception, intrauterine, and postnatal irradiation as related to leukemia", National Cancer Institute Monograph, 19: 347-371, 1966.

8. Hempelmann, L.H., "Neoplasms in youthful populations following x-ray treatment in infancy", Environmental Research, 1: 338, 1967.

Conclude that radiation induced thyroid carcinoma presents a higher risk in children than in adult populations. Furthermore, risk increases linearly as the dose increases.

9. Holford, R.M., "The relation between juvenile cancer and obstetric radiography", Health Physics, 28: 153, February 1975.

10. Keith, Brown and Ames, "Possible obstetric factors affecting leukemia in twins", Comparative Leukemia Research, (1975), Bibl. Haemat, No. 43, pages 221-223.

11. Landau, E., "Health effects of low-dose radiation: Problems of assessment", International Journal of Environmental Studies, 6: 51, 1974.

12. McMahon, B., "Prenatal x-ray exposure and childhood cancer", Journal of National Cancer Institute, 28: 1173, 1962.

13. MacMahon, B., "X-ray exposure and malignancy", Journal of the American Medical Association, 183: 721, 1963.

This paper reports that children have a higher risk of dying of radiation induced leukemia than do middle-aged persons.

14. McMahon, B. and Hutchinson, G.B., "Prenatal x-ray and childhood cancer: A review", Acta Unio Int. Contra Cancrum, 20: 1172, 1964.

> "A study of the association between prenatal x-ray and childhood cancer is described. Review of all published studies of this question reveals both positive and negative results. However, many studies are based on small numbers and the results have large sampling errors. All published studies, taken either individually or as a group, are compatible with the cancer risk in children x-rayed in utero being 40 per cent higher than in children not x-rayed in utero. Several individual studies and all studies taken as a group are, on the other hand, incompatible with the hypothesis of no difference in cancer risk between the two groups."

15. MacMahon, B., and Newill, V.A., "Birth characteristics of children dying of malignant neoplasms", Journal of the National Cancer Institute, 28: 231-244, 1962.

This is a retrospective cohort study in which 556 cancer deaths were referred to a cohort of 734,243 with number exposed based on a 1% sample (intrauterine x-ray: 770 exposed, 6,472 unexposed) and a relative risk of 1.44 was found.

16. Modan, B., et al, "Radiation induced head and neck tumors", Lancet, 277-279, February 23, 1974.

Radiation for ringworm of the scalp resulted in an increasing risk of brain, parotid and thyroid tumor. The dose causing thyroid carcinoma, 6.5 rads, is the lowest reported.

17. Mole, R.H., "Ante-natal irradiation and childhood cancer: Causation or coincidence?," British Journal of Cancer, 30: 199, 1974.

18. Natarajan, N. and Bross, I.D.J., "Preconception radiation and leukemia", Journal of Medicine, 4: 2765-281, 1973.

19. Pochin, E.E., "Malignancies following low radiation exposures in man", British Journal or Radiology, 49: 577, July 1976.

20. Refetoff, S., Harrison J., et al, "Continuing occurrence of thyroid carcinoma after irradiation to the neck in infancy and childhood", New England Journal of Medicine, 292: 171-175, 1975.

A study from the University of Chicago of 100 persons who received childhood irradiation showing a 7% increase of carcinoma. As 71,000 persons in the Chicago area received childhood irradiation, the public health implications are overwhelming.

21. Silvernman, C., and Hoffman, D.A., "Thyroid tumor risk from radiation during childhood", Preventive Medicine, 4: 100, 1975.

Review of 7 epidemiological studies and of radiation doses from diagnostic x-rays, scans and uptakes. The low dose, 6 rads, associated with thyroid cancer in 2 studies, raises questions about the long-term effect of diagnostic procedures in childhood.

22. Sternglass, E.J. "Radiation Risks", Bulletin of the Atomic Scientists, page 4-5, June 1972.

"...It is the dose to the early developing embryo and fetus during the first few months of pregnancy that produces the greatest impact, both for a given family and for society as a whole."

"....The dose required to double the incidence of serious defects in the genetic control mechanism of the human cell...is of the order of 100 millirads in the first trimester, compared to 10.0 to 100. 0 rads...in the reproductive cells of the mature adult."

"A typical chest x-ray....results in an average dose of about 50 millirads to the upper part of the body. However, the dose to the gonads from scattered radiation is only about 2 millirads."

23. Stewart, A., "Low dose radiation cancers in man", Advances in Cancer Research, 14: 359, 1971.

Found increase of other cancers than leukemia in irradiated in utero children.

24. Stewart, A., and Kneale, G.W., "Radiation dose effects in relation to obstetric x-rays and childhood cancers", Lancet, June 6: 1185-1187, 1970.

Epidemiological data from the Oxford Survey of Childhood Cancers was analyzed in respect to in utero exposure to x-rays during obstetrical investigations. The risk of cancer was greatest when exposure occurred during the first trimester and excess cancer was directly related to fetal dose.

25. Stewart, A., Webb, J., and Hewitt, D., "A survey of childhood malignancies", British Medical Journal, 1: 1495-1508, 1958.

This is a retrospecitve study that matched 1,638 cancer cases with 1,638 live controls and found a relative risk of 1.92 after intrauterine x-ray exposure.

26. Wick, G.L., "Is there a safe radiation limit", New Scientist, page 276-278, August 6, 1979.

> "If the claims of some radiologists, that no 'safe' limit exists, are true, the setting of radiation standards should be a public issue."
>
> "Damage caused by it (radiation) has been studied much more extensively than that of any form of pollution."

V. NORMAL OPERATION

1. Ichikawa, and Nagata, "Nuclear power plants suspected to increase mutations", from the Laboratory of Genetics, Faculty of Agriculture, Kyoto University, Kyoto, Japan 606.

An interesting article based on the use of bioassay with susceptible plants (the spider-wort) to determine possible health effects of very low-level radiation around a nuclear power plant.

2. Neyman, J., "Public health hazards from electricity producing plants", Science, 195 (4280): 754-758, 25 February 1977.

Author concludes that one cannot extrapolate well from A-bomb studies and mice studies, but must take into account multipollutant and multilocality considerations.

In addition to the above, there is a considerable amount of evidence presented at the current hearing and at others that the normal operation of nuclear generating plants leads to an increase in the radiation exposure suffered by the neighboring population.

VI. ACCIDENT

Especially since the accident at Three Mile Island, the literature abounds with evidence of radiation beyond from both real and postulated reactor accidents. Further citations are not needed here.

Sources of Radioactive Release From Reactors & Reactor Waste

1. "routine radioactive releases."
2. "accidental" releases at the reactor.
3. accidental releases during transport of radioactive materials to and from reactors.
4. environmental contamination from storage or disposal of high-level wastes.
5. accidental releases through sabotage.

TESTIMONY OF DARYL BOHNING, PhD.

I. Professional Qualifications

Born and raised on a farm in Iowa, I received my doctorate in elementary particle physics from Iowas State University in 1966. This was followed by a postdoctoral fellowship in physics at Rutgers University doing work in elementary particle physics. Then I took an NIH traineeship in Biophysics at Harvard University and Massachusetts General Hospital working under Gordon Brownell on advanced nuclear medicine techniques and doing pulmonary physiology. Dr. Brownell is co-author of a classic text on dosimetry and he pioneered positron imaging.

After a year at Miami University in Oxford, Ohio, teaching undergraduate and graduate physics and helping to design a biophysics course, I took a position as staff scientist in the NYU Institute of Environmental Medicine with Dr. Roy Albert helping manage animal and clinical research programs investigating the inhalation and biological clearance of airborne particulates with radiotracer techniques. I also worked on mathematical/computer models of competing-risk cancer induction and the deposition of inhaled particles and their, subsequent, clearance.

After four years at NYU, I joined the pulmonary division of the Department of Medicine at the State University at Stony Brook and helped Dr. Edward Bergofsky set up clinical particle deposition and clearance research programs at Stony Brook and the Northport V.A. Hospital. Using nuclear medicine techniques, we investigated the relationship between particle inhalation and clearance and chronic obstructive lung disease, again emphasizing my interests in mathematical/computer modeling and data analysis. One year, I also taught pulmonary physiology in the Physiology and Biophysics Department at Stony Brook.

I then transferred to nearby Brookhaven National Laboratory as staff scientist, where, with the support of Dr. Stanton Cohn and his uniquely sensitive Whole Body Counting Facility, and Dr. Harold Atkins, then president of the Society of Nuclear Medicine, set up a unique study to measure the long-term retention of inhaled particulates in man,

normal and diseased. While there I was also co-editor of the proceedings of a conference on the health effects of photovoltaics, and did a mathematical/computer modeling project for Dr. Victor Bond, director of the Brookhaven Laboratory Medical Division, in which we attempted to predict the relative radiation-induced mutation frequency for different radiation by convoluting radiobiological damage data from pink mutations of the radiosensitive Tradescantia plant with energy transfer spectra for the different radiation measured in a test ionization cell.

Presently, I am the head of a group of 10 systems-analysts and analyst programmers setting up a comprehensive data processing system for the Lederle Laboratories (Pearl River, NY) Toxicology Facility as well as process control systems for American Cyanamid's Fermentation Pilot Plants at Lederle Laboratories and in Gosport, England.

I am the author of 25 publications,,including a chapter of an environmental and occupationsl medicine textbook, "Particle Deposition and Pulmonary Defense Mechanisms," published a few months ago, and another chapter, entitled, "Radiation and Public Health: A Perspective," to be published later this spring.

II. Statement on Contention 6.2

> "A benefit would accrue from the shutdown of Indian Point Units 2 and 3 because the environment of children would be improved by a decrease in the release of radioactive material."

The obvious and incontestable fact is thatthe environment of the children in the vicinity would DEFINITELY be improved if the Indian Point nuclear power plants were shut down becasue then the inevitable radioactive releases, however small, would be totally eliminated. In addition, they would not have to live under the constant fear of a major release, no matter how small the probability - a psychological reality, the effects of which we are only beginning to appreciate.

As documented by the licensees and the U.S. Nuclear Regulatory Commission, a variety of arrborne and liquid effluents containing substantial amounts of radiation are routinely released from the Indian Point power plants. In my professional opinion as

a physicist with over ten years of environmental and medical research experience with radiation, it is total speciousness to try to justify a technology that jeopardizes our children's economic, physical and psychological future, with the capability and possibility, no matter how remote, of poisoning our own, our children's, their children's, and their children's children's futures for thousands of years, by saying that it is no worse then other inappropriate and outdated technological influences we should be trying to replace!

For a typical 1000 megawatt reactor, we are taking a few hundred Curies of natural radioactivity in the uranium fuel, and turning it into approximately 15 billion Curies of radioactive materials. Radioactivity, which by its very nature as the expression of the binding energies of the atomic nucleus, energies orders of magnitudes greater than the energies that bind the chemical structures of which all living craatures are composed, is disruptive of life. 15 billion Curies of radioactive materials which, again by its very nature, can never be totally contained by the chemically bonded materials with which we build power plants.

The Indian Point complex probably contains from 50 to 100 billion Curies of radioactivity, generates thousands of tons of liquid and solid wastes containing thousands of Curies of radioactivity each year, and when it is shut down will leave behind a mass of radioactive waste containing hundreds of thousands of Curies for a period of time longer than the history of our civilization. No matter how far we ship it, no matter how deep we try to bury it, somehow, someday substantial amounts of that artificially induced radioactive material will find its way back into our environment.

For those who would argue that the hazards of low levels of radiation are not very great, I would remind you that the primary source of data on the low-level effects of radiation is the atoiic bomb data from Hiroshima and Nagasaki. In 1981, some 36 years after the fact, it was found that the estimates of the radiation released by those bombs was incorrectly computed, significantly increasing our estimates of the health effects from exposure to x-rays and gamma rays, and nullifying key data for estimating the biological effectiveness

of neutrons relative to gamma rays.

There is no low-level threshold below which there are no harmful effects of radiation. A gamma ray or any other type of radiation is a discrete quantum with a unique emergy. Though the probability may be very small, a single photon or ionizing particle energetic enough to disrupt the DNA molecule is cabable of causing a cancer or inducing a mutation. Even at very low mrem doses, the body is still being penetrated by tens of thousands of photons.

No matter how much effort and money is put into trying to contain the hundreds of billions of Curies in the Indian Point and other power plants, we are constantly reminded of its presence and its dangers, by daily routine emissions and by accidental leaks and unmonitored pathways. Lest we put too much faith in the people who insist, despite the frequent reports of economic and technological miscalculations and blunders, that nuclear power plant releases can be kept to "safe" levels, think about how many things go wrong with the technology around you in every facet of your life, and how many times we have totally misjudged the consequences of our actions. The people in the power industry are only human, and things get fouled up just asmmuch in their industry as it does in any other. In my opinion we would be wise to devote our talents and resources to developing ways of operating our society that don't depend on trying to bottle up 50-100 billion Curies of radioactivity twenty five miles from one of the great population centers of the world.

Intervenor-Observer

Richard E. Gendron

Observation Point

Decontamination Center
Fire Training Center
Hawthorn, New York

1:00 p.m. The decontamination center in Hawthorn, New York is located in a small lobby and foyer of the Fire Training Center. The floor in the center is divided down the middle by a strip of white tape; the area on the right side of the line serves as the contaminated area, the area to the left is uncontaminated. Decontamination team members are stationed at the entrance to each of the two bathrooms and the bathrooms are also divided by strips of tape.

There are seven team members and two alternates, all of whom are either doctors or nurses and work for the Board of Health. Dr. Gallutso is the leader of this particular team. (This particular training does not necessarily require a medical background.)

The first victim arrives at the door and is met by a team member. The person is then scanned with a geiger counter, declared safe, and proceeds on to the registration table and out the door. There are also two state troopers stationed in the room. This decontamination center is not meant for the general public, it is for emergency workers.

It is explained that, in accordance with the accident scenario, these particular people (victims) are arriving from the Buchannan area.

I ask Dr. Gallutso a number of questions:

1. Would the team members be wearing hoods in an actual emergency? The team are dressed in what looks like cotton overalls that are taped at the wrist and ankles. It seems that the hoods are part of Civil Defense Preparedness and are back ordered.

2. How many people are processed per hour? Approximately 4-8.

3. What happens if a person is found to be contaminated? The person is first

taken down the right side of the tape, into the lavatory, his clothing is shaken off, and another reading is taken. If the reading is positive, the victim's clothing is taken off and placed into two plastic bags. The victim is then taken down the right side of the tape line to the showers where he washes with plenty of soap and water. Another reading is taken. He is then issued a new pair of disposable coveralls and sent on to a safe zone where the Red Cross will provide him with food and shelter. I was told that coveralls were also back ordered.

4. What is the limit of safety as far as the contamination is concerned? 1.0 millirems to 3.0 millirems.

1:55 Another victim arrives and enters through the southern door (which is the only door which is being used for an entrance), is given a scan with the geiger counter, found to be clean, and passes on to the registration table. After the person's particulars are registered, she passes down the hall on the left of the taped line and exits.

The next victim is a federal observer. It is determined that he has a contaminated sleeve and is told to go to the lavatory with one of the team members, stand on a brown piece of paper, and to shake. For the sake of the simulation, he is found to still be contaminated. He is taken along the right side of the taped line to the showers. After showering the victim is checked again, found to still be at an unsafe radiation level, and taken to a holding area. Dr. Gallutso calls Dr. Williams, the supervisor at the EOC, to arrange to have the victim removed. I ask where such victims will be taken and am told by Dr. Gallutso that he is unsure and to ask Dr. Williams.

A state trooper enters the control room area again. (Is this decontamination area too close to the control room?)

A call for fifteen ambulances to evacuate the V.A. Hospital comes in over the radio.

I ask how many teams comprise the emergency arm of the Civil Defense Preparedness. It is explained that there are 7 teams, each with 7 members and two alternates, in Westchester County.

Conclusion

In the final analysis, I feel that emergency workers, people who are puttting their own lives on the lines to protect the safety of others, must be given the proper equipment to successfully carry out their responsibilities. In all disaster situations, some people will react with fear while others take up the banner. We cannot expect emergency workers to sacrifice their own health and safety because of a lack of training or equipment.

As a jet mechanic, I have had some basic training concerning radioactive environments. One of the first precautions is to prevent breathing in the contaminants. Certainly if we are going to be in contact with suspected carriers of radioactive dust, we should be breathing through respirators in order to avoid becoming contaminated as well. Will we be satisfied with a strip of tape on the floor to protect the uncontaminated from the contaminated?

The United States Air Force uses operating room procedures when dealing with radioactive materials. Isolation is the key. Should the decontamination center be located in the same building as the communication center for the whole county? When we contaminate the control room who will take over? The equipment in this room is very modern and technical and will require a trained person to operate it. How are we going to transport the people that are contaminated without contaminating the drivers as well as others people working in the decontamination center?

I must also question whether or not the decontamination centers are

adequately staffed and if we can be certain that such workers would even fulfill their responsibilities in the event of a nuclear accident.

It is my view that, if the exercise had been an actual emergency, the members of the decontamination team, as well as the workers in the control room, would have been sacrificed regardless of the efforts of Dr. Gallutso or any of his team members.

I would also like to state that at this time we must begin a high priority program which aims to clean up the radioactive materials that are building up throughout our land. We must employ the finest minds that our great country can deliver and give them the freedom that they need to deal with this dilemma. We must put away the greed and the ego and bring forward the blessings that come with following conscience. We must trade the fear and uncertainty right now for a united effort to solve this problem. WE MUST DO THIS NOW FOR IT MAY ALREADY BE TOO LATE.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
CONSOLIDATED EDISON COMPANY OF NEW YORK (Indian Point Unit 2)	)	Docket Nos. 50-247 SP 50-286 SP
	)	
POWER AUTHORITY OF THE STATE OF NEW YORK (Indian Point Unit 3)	)	April 26, 1983

UCS/NYPIRG MOTION REQUESTING THE ASLB AND THE NRC TO COMMISSION STUDIES ON HUMAN RESPONSE TO RADIOLOGICAL EMERGENCIES AT INDIAN POINT

In its January 1981 Order (CL) defining the issues of concern to be addressed by the investigatory proceeding on Indian Point, the Nuclear Regulatory Commission stated:

> The Commission is concerned with the total risk to persons and property posed by the Indian Point plants and the risk to individuals living in the vicinity of the Indian Point site, including that resulting from the difficulty of evacuation in an emergency. (Emphasis supplied.)
> Order, at page 8.

The ASLB, in formulating contentions directed to the end of receiving evidence on the areas of concern to the Commission correctly admitted intervenors' proposed contention on human response to a radiological emergency. Contention 3.2, as revised by the ASLB, reads:

> The emergency plans for Indian Point Units 2 and 3 do not conform with NRC/FEMA guidelines because the assumptions made therein with respect to human response factors during a radiological emergency are erroneous. Hence the estimates of evacuation times and of the feasibility of timely evacuation for certain areas are incorrect.

The Board's reasoning for its decision to reformulate and reinstate contention 3.2 in its February 7, 1983 order (Gleason, J., dissenting), is instructive. At page 6, the Board ruled:

> We believe that the Intervenors have successfully argued their point with respect to the relevance of Contention 3.2 to determining the degree of conformance of the emergency plans with NRC/ FEMA guidelines and with respect to the unique importance of human factors assumptions in the Indian Point emergency plans. Moreover, the testimony that we have already heard on human facotrs from the counties and from FEMA, and that which has been offered by the Licensees, convince us that we should proceed to thoroughly ventilate this subject.

Human response factors are uniquely important to Indian Point because the high population density in the vicinity of the plants would exacerbate consequences resulting from the failure of human factors assumptions to hold in a radiological emergency. This dense population, coupled with the geographical, meteorological and roadway features of the area will adversely affect human responses in a radiological emergency.

The recognition of the importance of this issue to a consideration of the adequacy of emergency planning at Indian Point did not solve the problem of presenting the best available evidence on the subject to the Atomic Safety and Licensing Board. Intervenors attempted three approaches: testimony of the residents and emergency workers themselves about their anticipated responses to an accident at Indian Point; testimony of social science professionals about their opinions on the nature of radiological emergencies as opposed to natural disasters and the consequences of the unique characteristics of a radiological emergency on human response; and testimony about surveys commissioned in Suffolk County, New York, designed to predict the probable response

of residents and emergency workers to a radiological emergency at the Shoreham facility.

The Licensees' evidence consisted of the testimony of a sociologist and a psychiatrist directed to prove that the response of residents and emergency workers at Indian Point would parallel that of persons involved in natural disasters occurring over the past fifty years and that the concededly unique characteristics of a radiological emergency would not affect those responses.

The Board admitted into evidence the testimony of the Licensees' witnesses and of some of the Intervenors' witnesses; admitted the Suffolk County survey for a limited purpose, and rejected the evidence of residents and emergency workers at Indian Point about their anticipated response to an emergency there.

None of the evidence accepted by the Board adequately answers the question posed by Contention 3.2 and by the Commission: what can planners expect from the residents and emergency workers at Indian Point in time of crisis?

Judge Shon noted the inadequancy of the testimony presented by the Licensees on the subject when he addressed the Licensees' witness Dr. Lecker about his experience with employees at the TMI plants:

> Dr. Lecker, I hate to prolong this, but it occurs to me that there is another, perhaps more subtle, dichotomy among people and that is this:
>
> There are people who accept radiation and nuclear radiation, I mean, not necessarily solar radiation, but nuclear radiation, who accept it as simply another hazard which one can deal with with the proper equipment.
>
> There are, on the other hand, apparently a large number of people, I don't know what

> fraction of the population they constitute, who view this hazard as something so horrifyingly and subtly different from anything else, that they can't conceive of anyone getting near such stuff.
>
> Generally speaking it is the first group of people who work in nuclear emergency plants, because if you belong to the second group you wouldn't be there.
>
> But most of the questions I have heard the intervenors ask, and most of the suggestions they make, are postulated on the idea that the second group, the group that believes that radiation is, as I think William O. Douglas said, the most awesome force ever released upon mankind, if that group of people is, as the intervenors think, a substantial majority among the population, you don't find them working in nuclear power plants, so your example is not relevant.
>
> But there is a scene that operates to say most of those people are outside the fence. Here they are confronted by this thing that they most fear. Is it possible that there is a substantial body of thought?
>
> T. 11997-98.

Because the record is not complete on this important contention, the Union of Concerned Scientists and the New York Public Interest Research Group, Inc. request the Board to remedy the situation by undertaking the following:

a). Commission a study or studies designed, with the greatest possible expertise, the particulars for which are set forth in the affidavits of Drs. Kai T. Ericson and Albert Solnit, annexed hereto as Exhibit A;

b). Request the Nuclear Regulatory Commission to extend the time for filing of the Board's final recommendations on Contention 3.2

pending the receipt of the study results.

The utility of conducting such a study or studies, as outlined in the affidavit of Dr. Robert R. Holt, annexed as Exhibit B, includes the gathering of information on the state of public awareness of emergency procedures such as tuning into an EBS station upon the sounding of the sirens, an area of deficiency noted by FEMA in its post-exercise assessment of April 1983, the identification of problems of parents with the newly proposed and inadequately researched plan for early dismissal of school children, and the scientific prediction of the responses of emergency workers and residents to an accident at Indian Point requiring evacuation or sheltering. A survey of the residents and emergency workers around the Indina Point site will eliminate the speculation, and guesswork, which now comprise the record in this proceeding on this issue.

The Board has the authority, and the duty, to take measures to ensure a complete and responsive record on all important issues of concern to the Nuclear Regulatory Commission. In this special investigative proceeding, where no party carries the burden of going forward or of persuasion, the need for remedial action by the Board to fill the gaps left by the parties, is even more compelling.

The NRC has the responsibility to represent the public interest in this matter as in all matters of safeguarding public health and safety from nuclear hazards. Power Reactor Development Co. v. International Union of Electrical, Radio and Machine Workers, 367 U.S. 396, 404, 81 S. Ct. 1529, 1533, 6 L.Ed.2d 924 (1961). As the U.S.

Court of Appeals for the Second Circuit said of the Federal Power Commission under similar circumstances:

> This role does not permit it to act as an umpire blandly calling balls and strikes for adversaries appearing before it; the right of the public must receive active and affirmative protection at the hands of the Commission.

Scenic Hudson Preservation Conference v. Federal Power Commission, 354 F. 2d 608, 620 (2d Cir. 1965).

In this case, NYPIRG/UCS has raised and strongly pressed the issue of the likelihood of breaches of duty by key persons responsible for portions of the emergency response plan. NYPIRG/UCS has also presented evidence from a survey supporting the likelihood of such breaches at another nuclear plant in New York State, the Shoreham plant. The Licensees argue that the evidence from Shoreham is not valid at Indian Point. To our minds, it does not seem likely that human nature is appreciably different in Westchester and Rockland Counties than it is on Long Island. However, the truth will not be known unless a similar survey is conducted in the Indian Point area to determine if the same situation applies. UCS/NYPIRG, however, is not in a financial position to underwrite such a survey at Indian Point. Because of the obvious importance of this question to the ultimate issue in this proceeding, we believe the Board should exercise its sua sponte authority to order that such a survey be conducted at the Commission's expense. As the court said in Scenic Hudson, supra, "The Commission must see to it that the record is complete. The Commission has an affirmative duty to inquire into and consider all relevant facts." Id.

In another FPC case, relied on by the Scenic Hudson court, the U.S. Court of Appeals for the District of Columbia Circuit criticized the FPC for refusing to consider an alternative and for failing to take the

initiative in seeking information, Michigan Consolidated Gas Co. v. Federal Power Commission, 283 F. 2d 204 (D.C. Cir. 1960). The court observed that "the proposal appears prima facie to have merit enough to have required the Commission at some stage of the proceeding to consider it on its own initiative as an alternative..." Id. at 224. On rehearing the court added: "In viewing the public interest, the Commission's vision is not to be limited to the horizons of the private parties to the proceeding." Id. at 226.

In the instant situation, this Board's vision should not be limited to the horizons dictated by UCS/NYPIRG's financial constraints. The relevance of the possibility that officials will not perform their duties as expected during a nuclear emergency is too obvious to require explanation. If the Board does not take the initiative in seeking information on this topic, it will perforce reach its conclusions in this case without all the relevant facts. In order to make the record complete in this case, the Board should order that a survey be conducted of the relevant officials in the Indian Point area to determine how they say they would act in a nuclear emergency. Without this knowledge, the Board can have no confidence in the efficacy of the emergency response plans in question here.

WHEREFORE, UCS/NYPIRG request the Board to:

a) Commission a study or studies on human response to a radiological accident at Indian Point, designed with the greatest possible expertise, the particulars for which are set forth in the affidavits of Drs. Kai T. Ericson and Solnit, annexed hereto as Exhibit A;

b) Request the Nuclear Regulatory Commission to extend the time for filing of the Board's final recommendations on Contention 3.2 pending receipt of the study results.

Dated: New York, New York
April 26, 1983

AMANDA POTTERFIELD, ESQ.
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For UCS and NYPIRG

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