

Exhibit B

Statement of Dr. Michio Kaku
Concerning the Disposal of TMI Waste

I am a full professor of nuclear physics at the Graduate Center of the City University of New York. I graduated from Harvard University in 1968, Phi Beta Kappa, Summa Cum Laude (with highest honors), and number one in my physics class. I received my Ph.D. in nuclear physics at the Lawrence Radiation Laboratory at the University of California at Berkeley in 1972. I subsequently taught on the faculty at Princeton University, and have been a professor with the City University of New York for the past 14 years. I have published over 45 articles in various professional journals and contributed to over 6 books. I am the author of Nuclear Power: Both Sides, which has since become the standard reference on the nuclear debate. My credentials are enclosed at the back of this statement.

I have been asked to review the NRC's plans to dispose of TMI waste water, as presented in the supplement to the Environmental Impact Statement Supplement (NUREG-0683). I find several things disturbing about the presentation from a strictly professional point of view. Previous EIS concerning the disposal of radioactive wastes have totalled more than a thousand pages, with scores of charts, diagrams, graphs, and tables. In comparison, I find the present NUREG-0683 deficient. It does not reflect careful scientific scholarship, and seems to have been slapped together at the last minute. Many key areas of scientific information seem to have been carelessly left out, making it difficult to make an accurate scientific analysis of its credibility. The report

verges on sloppiness and I hope it does not reflect a deeper attitude toward the clean-up operation. I will list some of the areas that I feel are lacking in scientific rigor and reveal a certain amount of hastiness.

1. The list of radionuclides on page 2.3, Table 2.2, is a very poor indication of the actual radiation inventory of the water. For example, compare it with pages 7-5,7-6,7-7 of the original EIS, published 6 years ago, and we find that the current list omits many important radionuclides originally tabulated by the NRC. Some of the radionuclides that are left out by the NRC in the current volume are important, including: Nb-95, Zr-95, Sb-125, Te-125m, Te-127m, Te-129m, Co-58, Te-I-129m, Ru-103. Thus, it is difficult to evaluate the present EIS supplement because it is deficient in this important analysis. This is a significant point, because there were literally hundreds of radioactive chemicals dissolved in the RB and sump water, making it a virtual soup of radioactive elements. The ion exchange mechanism of the SDS and EPICOR II does not filter all elements identically (and in fact does not filter some elements like tritium at all), so we must have a careful reading of precisely what is presently in the water, compared to what it contained back in 1981 when the first EIS was compiled.

2. Even the original EIS of March, 1981, failed to make a complete radiation inventory, e.g. neglecting to compute the transuranics contained in the water. In a normally functioning 1,000 megawatt reactor, for example, the accumulated high waste within 100 tons of uranium di-oxide is about 30 tons, of which 500 pounds consists of plutonium. Most of the plutonium is reactor grade plutonium-240. Most of these transuranics are not very water soluble, compared to iodine or

strontium. However, they certainly exist in the water. I mention them because the transuranics are some of the most toxic chemicals known to science. Their low levels of concentration in the water are compensated by the fact that they are quite toxic. Yet no mention is made to them either in NUREG-0683 of 6 years ago, or the present EIS.

3. No mention is made of how the radioactive levels in the water were obtained. Given the fact that the original radiation inventory exceeded half a million curies, this is not a trivial question. Thus, it is impossible to give a detailed assessment of the accuracy of the radiation levels because no indication is made of how these measurements were taken and how reliable they are. Statements of the willingness of utility officials to drink this water are not scientifically relevant and in fact are misleading.

4. The tritium count in the water raises some concern. Originally, there was 2,500 curies of H-3 in the RB Sump Water. The EPICOR II and the SDS, of course, cannot extract out the H-3. The filters work on the principle of ion exchange, as in a water softener, so that H-3 cannot be removed. However, the present EIS only lists 1,020 curies of H-3 on Table 2.2. Where did the other 2/3 of the tritium suddenly disappear to? Normal radioactive decay cannot account for this, because H-3 has a half life of 12.3 years. No mention of this discrepancy appears in the EIS.

5. The present EIS gives a misleading interpretation of the properties of tritium on pages 2.5 and 2.6. At best, it is self-serving. At worst, deceptive. The EIS only takes selected quotes from the NCRP, the National Council on Radiation Protection and Measurement, and omits others which may show the hazards of tritium. For example, the EIS

quotes that HTO has a 10 day biological half-life in the body, but neglects to say that HTO can also be incorporated directly into cell membranes, where it becomes a rather permanent part of the body's chemistry. Thus, the radioactive HTO can irradiate body tissues over the life-span of the individual, causing possible radiation damage. Thus, the figure on the biological half-life in the body is not indicative of the actual body burden of radioactive materials one may incorporate into human tissue. Yet no mention was made of this. Some rather feeble attempts are made to calculate radiation exposures to the tritium at a distance, but no attempt is made to calculate tritium that is incorporated into the body itself and hence irradiates the body at close range.

6. Because water is everywhere in our environment, and since HTO is chemically identical to water, the pathways for ingestion or inhalation of this water are non-negligible. Because the utility is making preparations for possible boil-off of this water into the air, it becomes a significant question how much of this water will eventually become ingested into the human population. Boil-off, evaporation, or river dumping all have the same net effect of releasing radioactive HTO into the environment where it can be picked up by living organisms. I find the analysis of how much radiation can be ingested into humans from an evaporation or boil-off whole deficient in the report. It appears as if the authors of the report simply dashed off the sections on environmental and health hazards as an after-thought.

7. The EIS does not mention that the radiation standards for beta radiation may soon be changing. The T-65 dosimetry, which was originally used to calibrate the radiation from the Hiroshima bomb, is

now known to have been miscalibrated. Recent work done at the Livermore National Laboratory, which designs hydrogen warheads, has shown that neutron levels probably cause less biological damage than previously thought, but that electrons and gamma rays do more damage. This is significant because the Hiroshima data is perhaps the largest of all epidemiological studies of radiation health effects, outweighing all the others. A recalibration of the Hiroshima data with the correct numbers for beta radiation may show that chemicals like HTO are more dangerous than previously thought, forcing a revision of the NCRP data. Yet no mention is made of this in the EIS.

8. The NRC makes no mention of the reliability of the vendors and companies which may eventually carry out the release of this water into the air or river. Normally, it is not that essential that the EIS address this question. However, given the rather unsavory documented history of past deception, some of it conscious and some of it bordering on the criminal, it is not too much to ask the NRC to thoroughly evaluate the reliability of these companies and the role of the utility.

9. Not enough attention is paid to the negative effects of river dumping, both commercial and environmental.

As a small example, consider the fact that 90% of the value of landed value from Chesapeake fishery comes from shellfish, a luxury item for many restaurants, and hence highly subject to people's perceptions of how safe it is to eat shellfish. The well-publicized dumping of the insecticide kepone and other pollutants in the 1970s into the Chesapeake caused enough negative impressions for the consumer to have a sizeable economic effect on the Chesapeake economy. The adverse effect on the sale of oysters and bluefish is well-documented, causing an economic loss

to the area. Dumping of TMI waste water into the river could very well have a negative effect on the economy of the area, given the fact that much of the economy rests on luxury items that are highly susceptible to changes in people's tastes.

10. In summary, I find that the present supplement to the EIS is not very valuable from a scientific point of view. The NRC has not done its homework. It is hard to make a reasonable scientific conclusion given the paucity of scientific information contained in the report.

At best, it shows a certain insensitivity and lackadaisical attitude toward radiation safety. At worst, it shows an inclination to disregard the health and safety of the people of Harrisburg.

BIOGRAPHY OF DR. MICHIO KAKU

Dr. Kaku holds the title of Full Professor of Theoretical Physics and has a joint appointment at the Graduate Center of the City University of New York (CUNY) and the City College of New York. He has been a professor at the Graduate Center for over ten years. He is an expert in weapons and reactor physics.

Dr. Kaku graduated from Harvard University in 1968, Phi Beta Kappa, Summa Cum Laude (with highest honors), and ranked number one in his physics class.

Dr. Kaku graduated with a Ph.D. in nuclear physics from the University of California at Berkeley (Lawrence Radiation Laboratory) in 1972 after publishing nine journal articles.

He joined the faculty of Princeton University as a Lecturer in 1972.

In 1973, he was asked to join the faculty at the Graduate Center of the City University of New York, where he has been a professor for the past decade.

He was elected a Fellow of the American Physical Society in 1980, an honor held by only 10% of all American physicists.

He is the author of three popular books: Nuclear Power: Both Sides (with Jennifer Trainer: W.W.Norton pub.), To Win a Nuclear War: The Pentagon's Secret War Plans (South End Press), and Beyond Einstein: The Cosmic Quest for the Theory of the Universe (Bantam Press).

In 1979, he was the first nuclear physicist not connected with the industry to be allowed to tour the damaged reactor at Three Mile Island.

He has appeared on numerous occasions on national T.V., including the PBS Nova and Innovation series.

He has been quoted in the Los Angeles Times, U.S.A. Today, the Atlanta Constitution, the Washington Post, the San Francisco Chronicle, and has written articles for the Progressive magazine on space weapons, MIT's Technology Review on nuclear power, and OpEd pieces for the Boston Globe and Newsday.

Dr. Kaku also hosts his own radio program on WBAL-FM (99.5 fm) in New York every Wednesday evening. He also hosts a syndicated radio program called "Exploration" which is syndicated by 50 radio stations around the country.

Dr. Kaku has testified as a reactor physicist to the Nuclear Regulatory Commission in various reactor hearings around the country: Big Rock in Michigan, V.C. Summer in South Carolina, UCLA, Diablo Canyon in California, Bryon near Chicago, Shoreham in Long Island. He has also been admitted as expert witness in hearings on civil disobedience at cruise missile plants in Michigan and Trident missile plants in Long Island.

Professional Background:

His background in nuclear and theoretical physics includes:
Publications: Dr. Kaku has published about 35 articles in various physics journals and has contributed to five books in nuclear and theoretical physics.

He is the author of the forthcoming book: Introduction to Superstrings, to be published by Springer Press (Berlin).
Lectures Dr. Kaku has spoken at numerous international conferences on

theoretical and nuclear physics, including, for example, Moscow, as a guest of the Soviet Academy of Sciences, in Dec. 1978 and Cambridge, England, as a lecturer in the Supergravity conference, in the summer of 1980.

Dr. Kaku has spoken on a number of campuses, including:
Harvard University, Yale University, UCLA, Amhearst, New York University, Princeton University, Columbia, University of Rochester, Syracuse University, University of Michigan at Ann Arbor, Michigan State University at Lansing, University of Chicago, Univ. of Southern California, Mass. Institute of Technology, Rutgers University, George Washington University, Georgia Institute of Technology, Circle College (Chicago), Queens College, Brooklyn College, Hunter College, Univ. of Calif at San Diego, Univ. of Calif. at Irving, Cal State at Sacramento, Cal State Long Beach, University of Maryland, Univ. of Georgia at Athens, University of Cincinnati, Univ. of New Mexico, Univ. of Calif. at Berkeley, Calif. Inst. of Technology, Guilford College in North Carolina, Virginia Polytechnic Institute, University of New Mexico at Albuquerque, and many others.

Research Areas: Dr. Kaku has conducted research and published articles in several areas (a) unified field theories (supergravity, superconformal gravity, quantum gravity) (b) high energy physics (relativistic string models for hadronic physics, lattice gauge theory) (c) nuclear physics (neutron transport theory) (d) reactor and weapons physics (computer modeling of reactor and weapons accidents).

The articles he has published in the scientific literature include:

1. "Unitary Nonplanar Closed Loops." (with C.B.Thorn), Physical Review D1, 2860 (1970).
2. "Divergence of the Two-Loop Planar Graph in the Dual Resonance Model." (with J.Scherk), Physical Review D3, 430 (1971).
3. "The General Multi-loop Veneziano Amplitude." (with L.P. Yu). Physics Letters 33B, 166 (1970).
4. "Divergence of the N-loop Planar Graph in the Dual Resonance Model." (with J. Scherk), Physical Review D3, 2000 (1971).
5. "Unitarization of the Dual Resonance Amplitude I. Planar N-loop Amplitude." (with L.P. Yu), Physical Review D3, 2997 (1971).
6. "Unitarization of the Dual Resonance Amplitude II. The Non-planar N-Loop Amplitude." (with L.P.Yu), Physical Review D3, 3007 (1971).
7. "Unitarization of the Dual Resonance Amplitude III. General Rules for the Orientable and Non-orientable Multi-loop Amplitudes." (with L.P.Yu), Physical Review D3, 3020 (1971).
8. "Linear Dependences and the Multi-loop Veneziano Amplitude." Physical Review D3, 908 (1971).
9. "Functional Approach to Dual Models with Spin." (with M. Virasoro and M. Yoshimura), Nuclear Physics B33, 109 (1971).
10. "Dual Pion Model with Zero Intercept and Nine Dimensions." Physical Review D9, 2850 (1974).
11. "The Field Theory of Relativistic Strings." (with K. Kikkawa), Physical Review D10, 1110 (1974).
12. "The Field Theory of Spinning Strings." Physical Review D10, 3943 (1974).
13. "The Field Theory of Relativistic Strings II: Loops and Pomerons." (with K. Kikkawa), Physical Review D10, 1923 (1974).

14. "Ghost-Free Formulation of Quantum Gravity in the Light Cone Gauge." Nuclear Physics B91, 99 (1975).
15. "Calculation of the Functional Measure in Quantum Gravity." (with P. Senjanovic) Physical Review.
16. "Soliton Dictionary for Massive Quantum Electrodynamics." Physical Review. D12 2330 (1975).
17. "Time-Dependent Generalizations of 't Hooft-type Monopoles." Physical Review, 1975.
18. "SU(4) and a New Class of Exact, Time-dependent Classical Solutions to Gauge Theories." Physical Review D13, 2881 (1975).
19. "Gauge Theory of the Conformal and Superconformal Group." (with P.K. Townsend and P. van Nieuwenhuizen), Physics Letters 59B, 304 (1977).
20. "Superconformal Unified Field theory." (with P.K. Townsend and P. van Nieuwenhuizen), Physical Review Letters 39, 1109 (1977).
21. "Unified field theories with U(N) Internal Symmetries: Gauging the Superconformal Group." (with S. Ferrara, P.K. Townsend and P. van Nieuwenhuizen), Nuclear Physics B12, 125 (1977).
22. "Properties of Superconformal Gravity." (with P.K. Townsend and P. van Nieuwenhuizen), Physical Review D17, 3179 (1978).
23. "Poincare Supergravity as Broken Superconformal Gravity." (with P.K. Townsend), Physics Letters 76B, 54 (1978).
24. "Unified Approach to Matter Coupling in Weyl and Einstein Supergravity." (with A. Das and P.K. Townsend), Physical Review Letters 40, 1215 (1978).
25. "Supersymmetry at High Temperatures." (with A. Das), Physical Review D18, 4540 (1978).
26. "Observations on the Gribov Ambiguity in General Relativity in the Coulomb Gauge." (with A. Das). Nuovo Cimento 50B, 303 (1979).
27. "Lattice Formulation of General Relativity." (with A. Das and P.K. Townsend), Physics Letters 81B, 11 (1979).
28. "Conformal Gravity in Hamiltonian: Another Approach to the Renormalization of Gravity." Nuclear Physics B203, 285 (1982).
29. "Strong Coupling Approach to Conformal Gravity". Physical Review D27, 2819 (1983).
30. "Superconformal Gravity in Hamiltonian Form." Physical Review D27, 2809 (1983).
31. "Effective Potentials in Different Supergravities." Physics Letters 126B, 183 (1983).
32. "Gauge Theory on a Random Supersymmetric Lattice." Physical Review Letters. 1983
33. "Super Lattice and Gauge Theory." submitted to Physical Review, 1983.
34. "Generally Covariant Lattices, the Random Calculus, and the Strong Coupling Expansion to Quantum Gravity." submitted to Nuclear Physics, 1983.
35. "The Fissioning Universe: a Kaluza-Klein Solution to the Problem of Homogeneity and Isotropy." (with J. Lykken) in preparation.
36. "Dimensional Transmutation on the Lattice as the Origin of the Planck Length." in preparation.
37. "Gauge Covariant Theory of Strings," Nuclear Physics, vol. B267, 1985, p. 125.
38. "Geometric Derivation of String Field Theory from First Principles, I: The Tensor Calculus and Curvature Tensors," to be published in Nuclear Physics B.

39. "Review of String Field Theory," to be published in the International Journal of Modern Physics, 1987.
40. "Geometric Derivation of String Field Theory from First Principles II: Superstrings without Constraints," to be published in Nuclear Physics B.

Contributions to Scientific Books

- "Strings and Quantum Gravity," and "Quantum Gravity in the Light Cone Gauge." Proceedings of the 2nd Latin American Conference on General Relativity, Caracas, 1976.
- "Einstein's Unified field Theory and Supergravity." Einstein Centennial Lecturers, St. George Campus of the University of Staten Island.
- "Lattices and Supergravity." Superspace and Supergravity. S. Hawking and M. Rocek. Cambridge University Press. 1981.
- "Conformal Supergravity." Supergravity, P. van Nieuwenhuizen, 1980.
- "Gauge Covariant Theory of Superstrings," Proceedings of the Argonne Symposium in Topology, Geometry, and Anomalies, Chicago, March 1985, World Scientific Publishers.
- "Introduction to the Field Theory of Strings," Lewes Summer School on Superstrings, July 1985, World Scientific Publishers.